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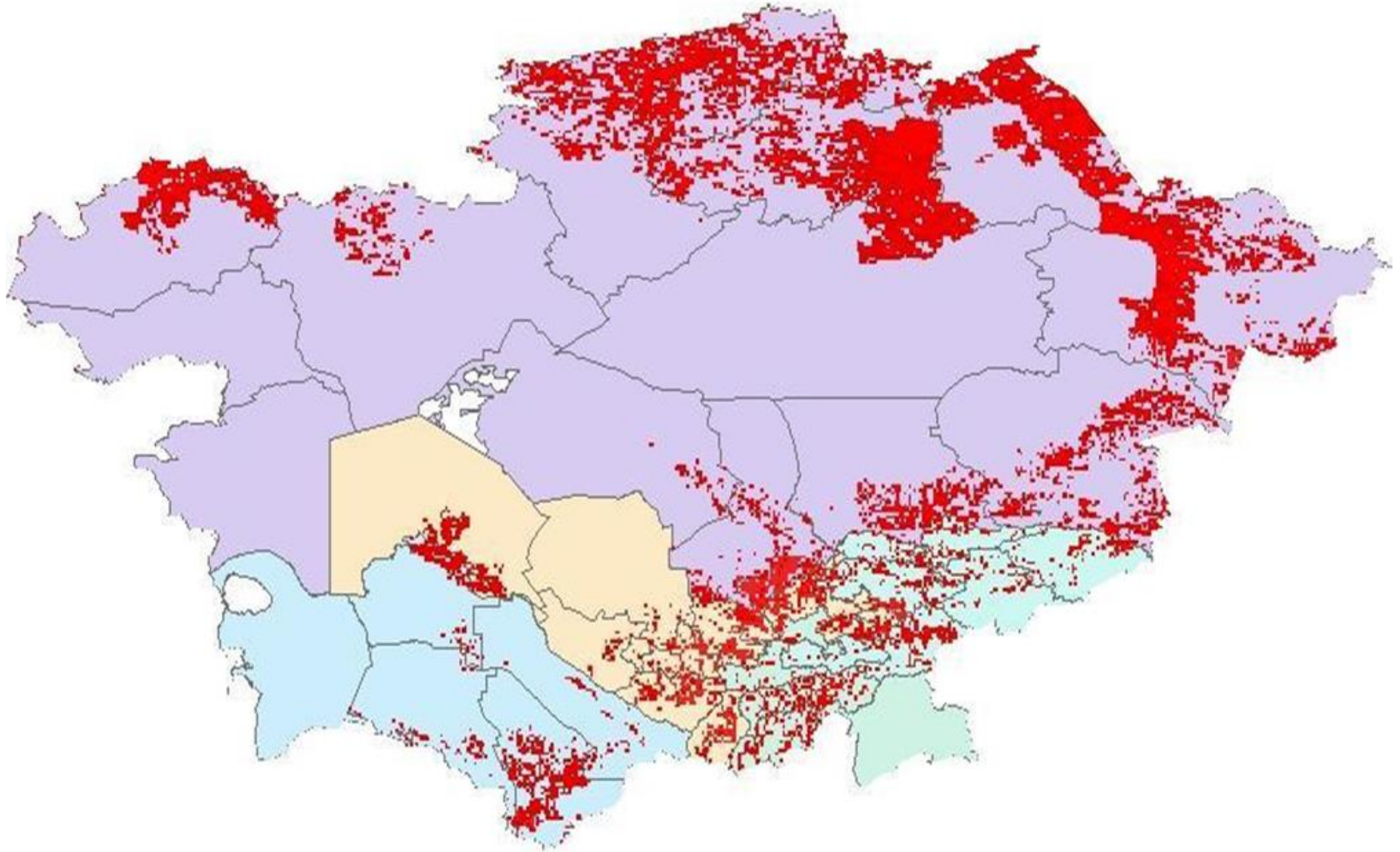


Economics of Land Degradation in Central Asia

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Problem Definition

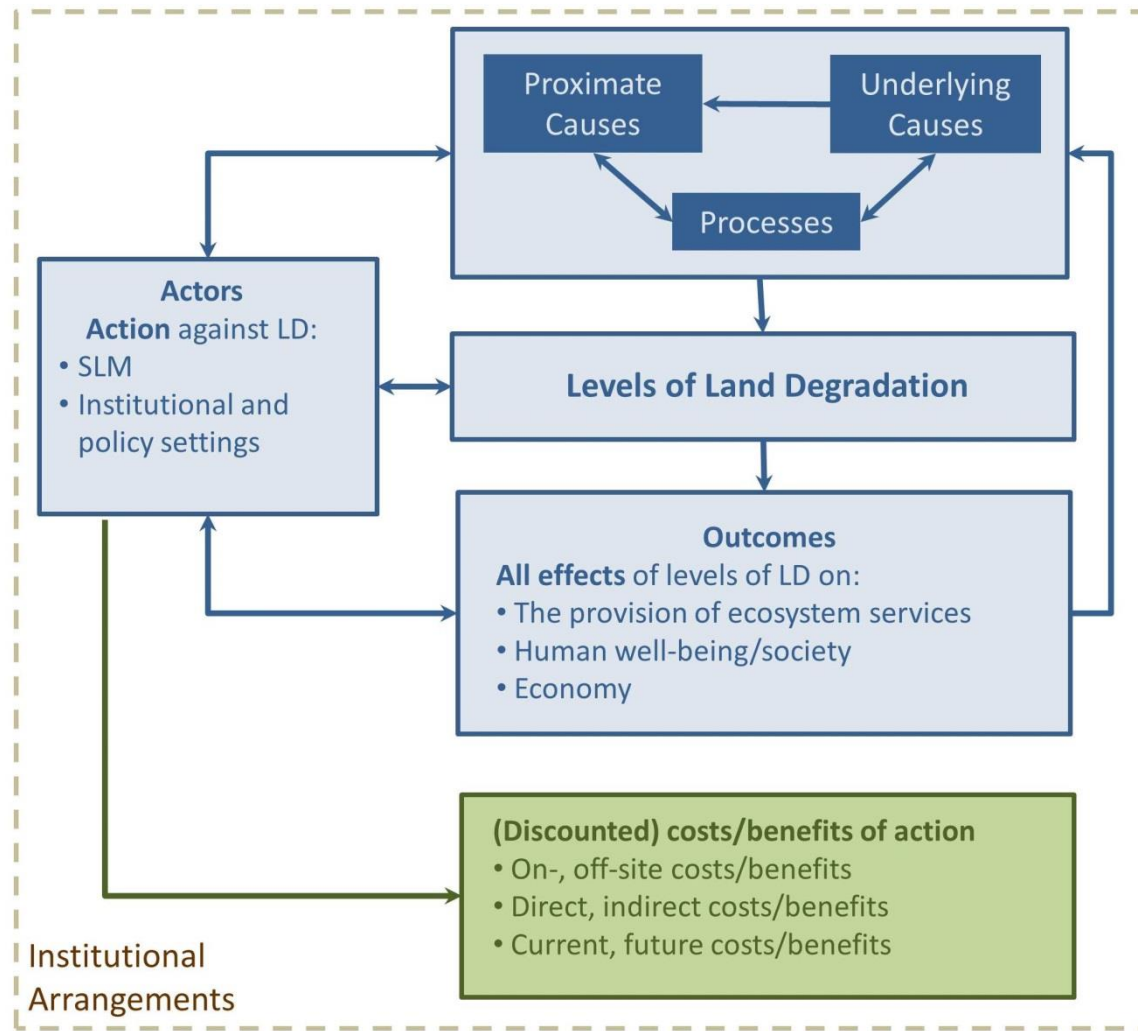


Source: Le et al. (2014). Red dots represent land degradation hotspots.

Research questions

- What is the total economic cost of land degradation in Central Asia?
- What are the major underlying drivers of land degradation in the region?
- What are the potential impacts of sustainable land management on rural livelihoods?

The Conceptual Framework



Total Economic Value (TEV) framework, including the value of ecosystem services

The costs of land degradation

1. Land degradation due to land use/cover change (LUCC)
2. Land degradation costs on a static land use/cover (especially the croplands)

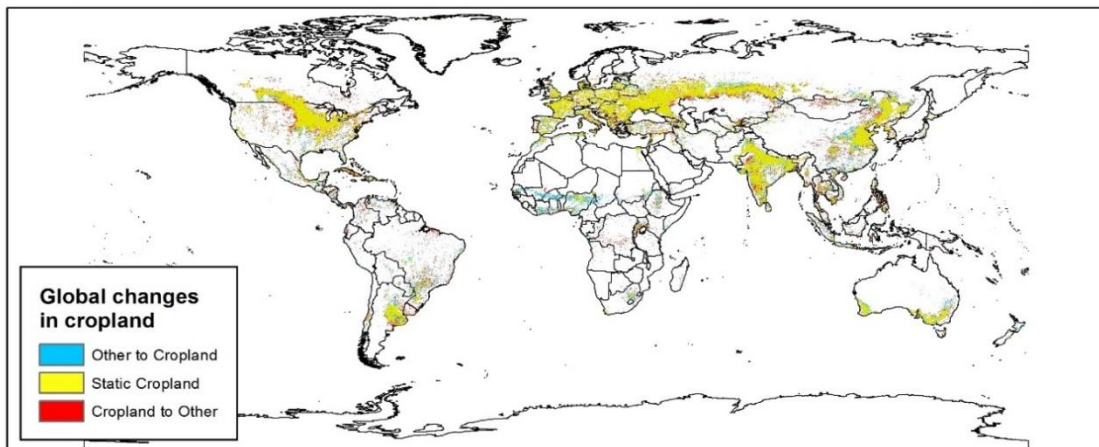
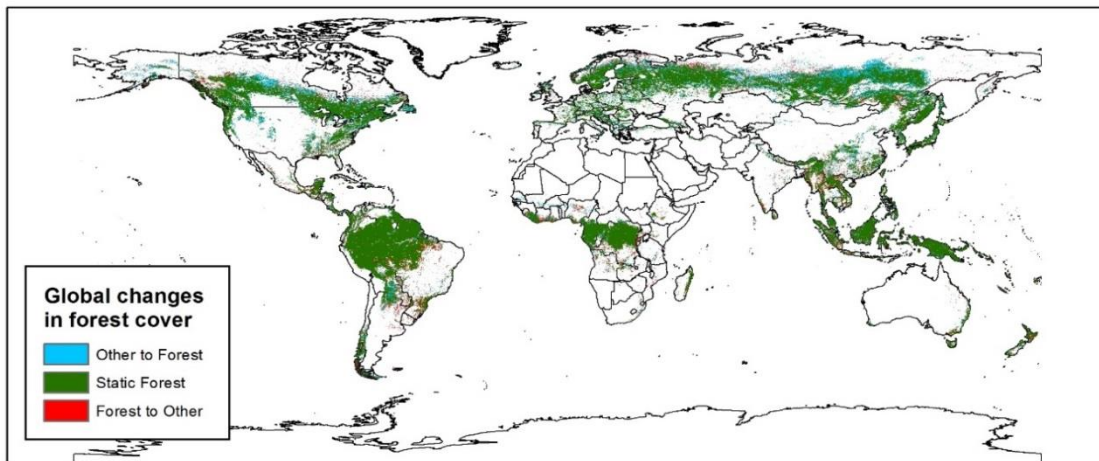
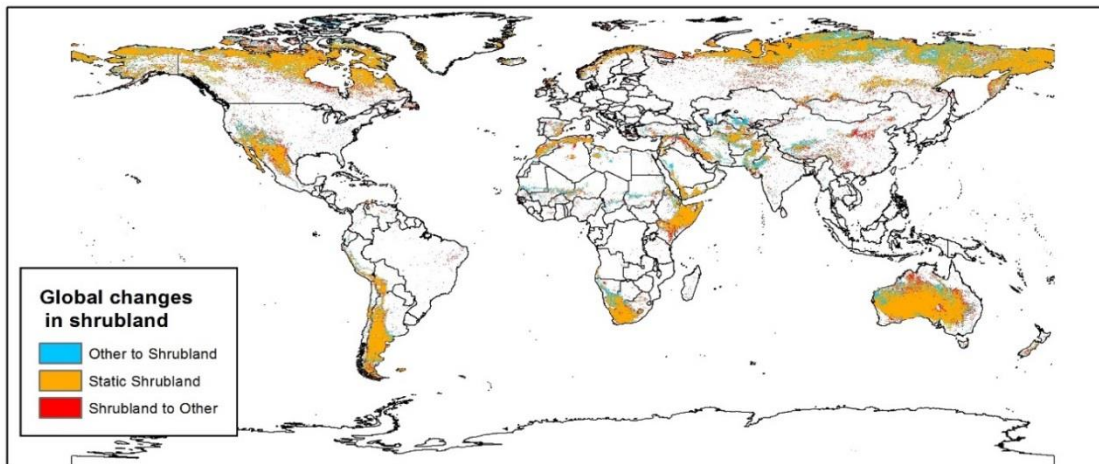
Land use/cover change in Central Asia in 2009 relative to 2001

Land Classification	Cropland	Forest	Grassland	Shrublands	Urban	Water	Barren
Kazakhstan	-10.0	1.5	19.0	1.4	0	-0.4	-12.3
Kyrgyzstan	-0.8	0.4	1.7	-0.9	0	0.0	-0.4
Tajikistan	-0.4	0.2	-0.5	0.2	0	0.0	0.5
Turkmenistan	0.6	0.0	-1.1	2.7	0	0.0	-2.3
Uzbekistan	0.4	0.1	0.4	4.3	0	-0.4	-5.1
Total	-10.3	2.2	20.0	7.6	0.0	-0.8	-19.6

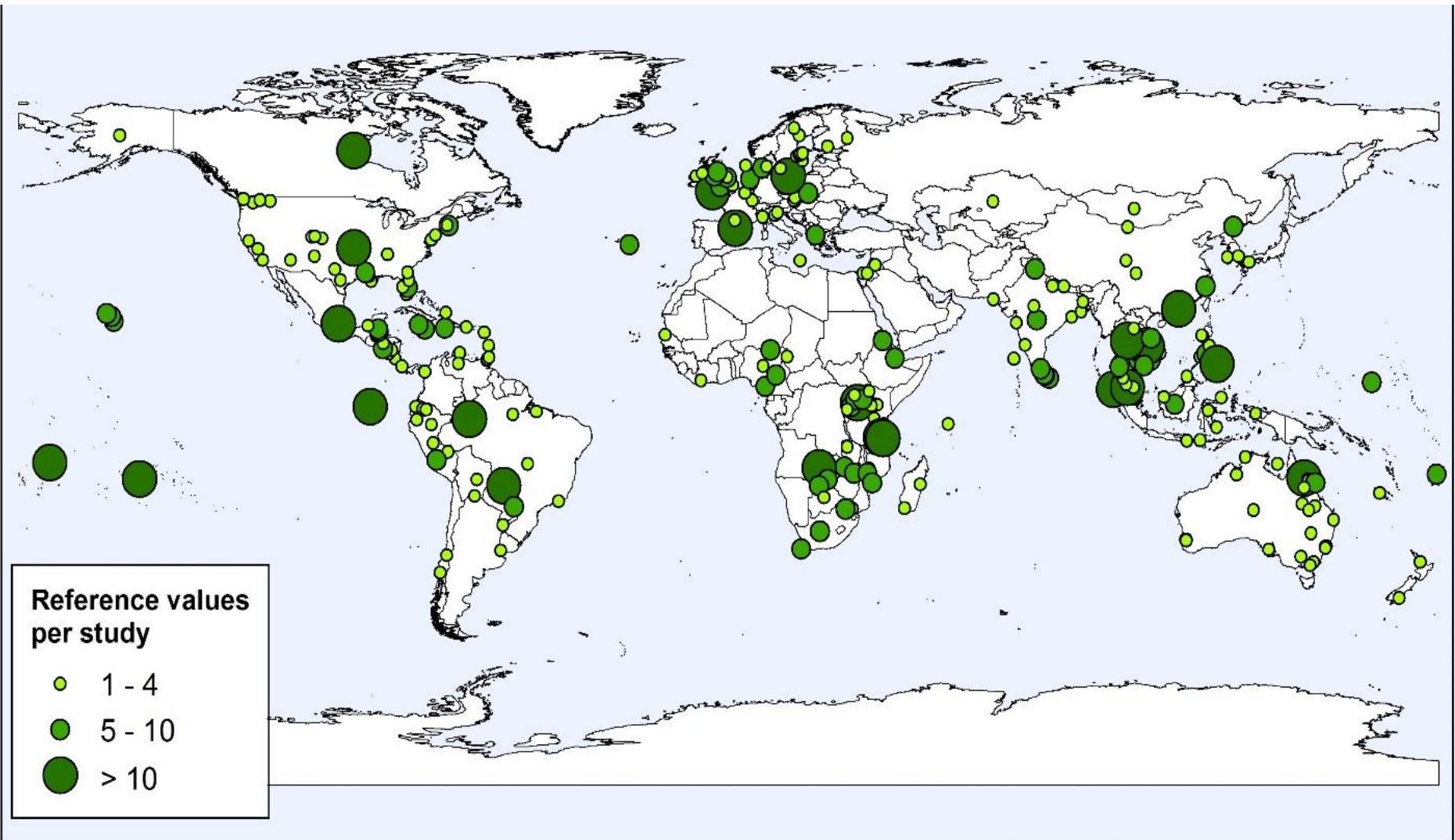
Note: in milion hectares.

Source: calculated using MODIS satellite LUCC data.

Based on
MODIS
LUCC
Data
Baseline: 2001
Endline: 2009



TEEB studies on ecosystem valuation



which provide with the TEV values of LUCC

The Costs of Land Degradation due to LUCC

Country	Annual cost of land degradation, in bln USD	Annual cost of land degradation per capita, in USD	GDP in 2009, current bln USD	Land degradation costs as a share of GDP (%), annually
Kazakhstan	3.1	1 782	115	3%
Kyrgyzstan	0.6	822	5	12%
Tajikistan	0.5	609	5	10%
Turkmenistan	0.9	1 083	20	5%
Uzbekistan	0.8	237	33	2%
Total	5.9	769	178	3%

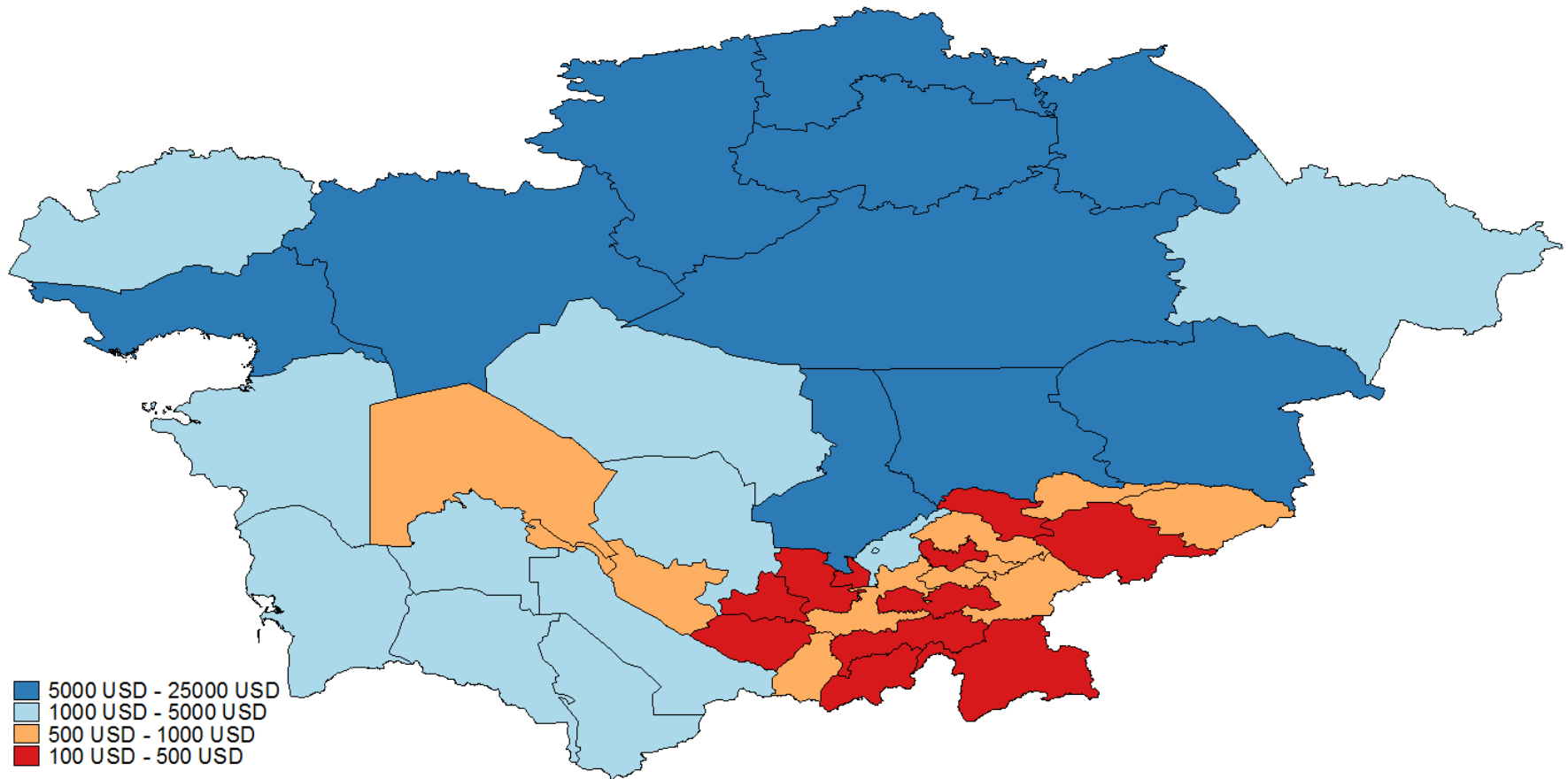
Based on LUCC between 2001 and 2009

Source: Mirzabaev et al. (2014, under review)

Costs of Land Degradation due to LUCC

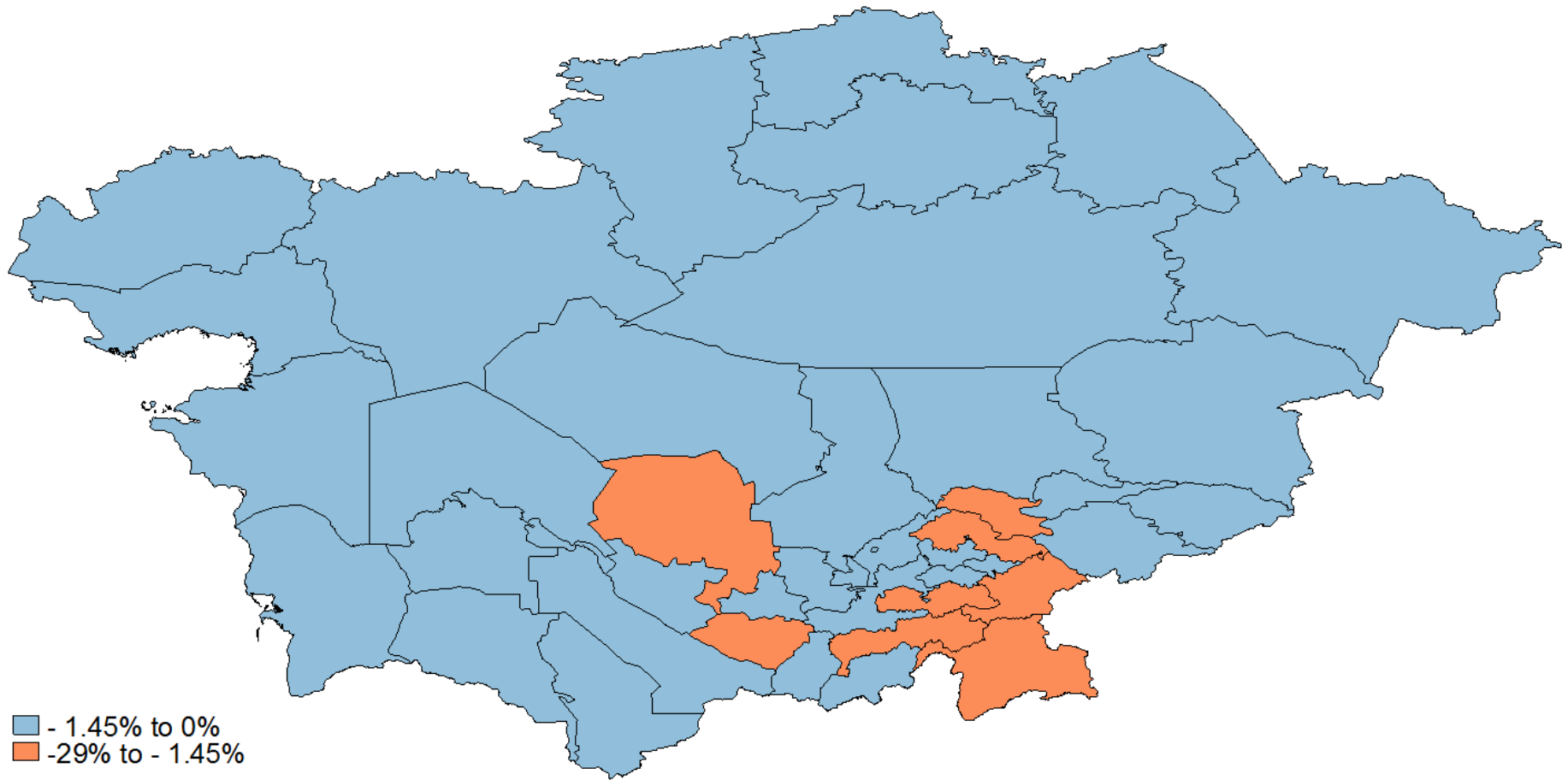
- The estimates show that the annual cost of land degradation in the region due to land use/cover change is about 6 bln USD, most which due to rangeland degradation (4.6 bln USD), followed by desertification (0.8 bln USD), deforestation (0.3 bln USD) and abandonment of croplands (0.1 bln USD).

Distribution of GDP per capita in Central Asia



Source: calculated based on province level GDP and population figures for 2007

Impact of Land Degradation on the Poor

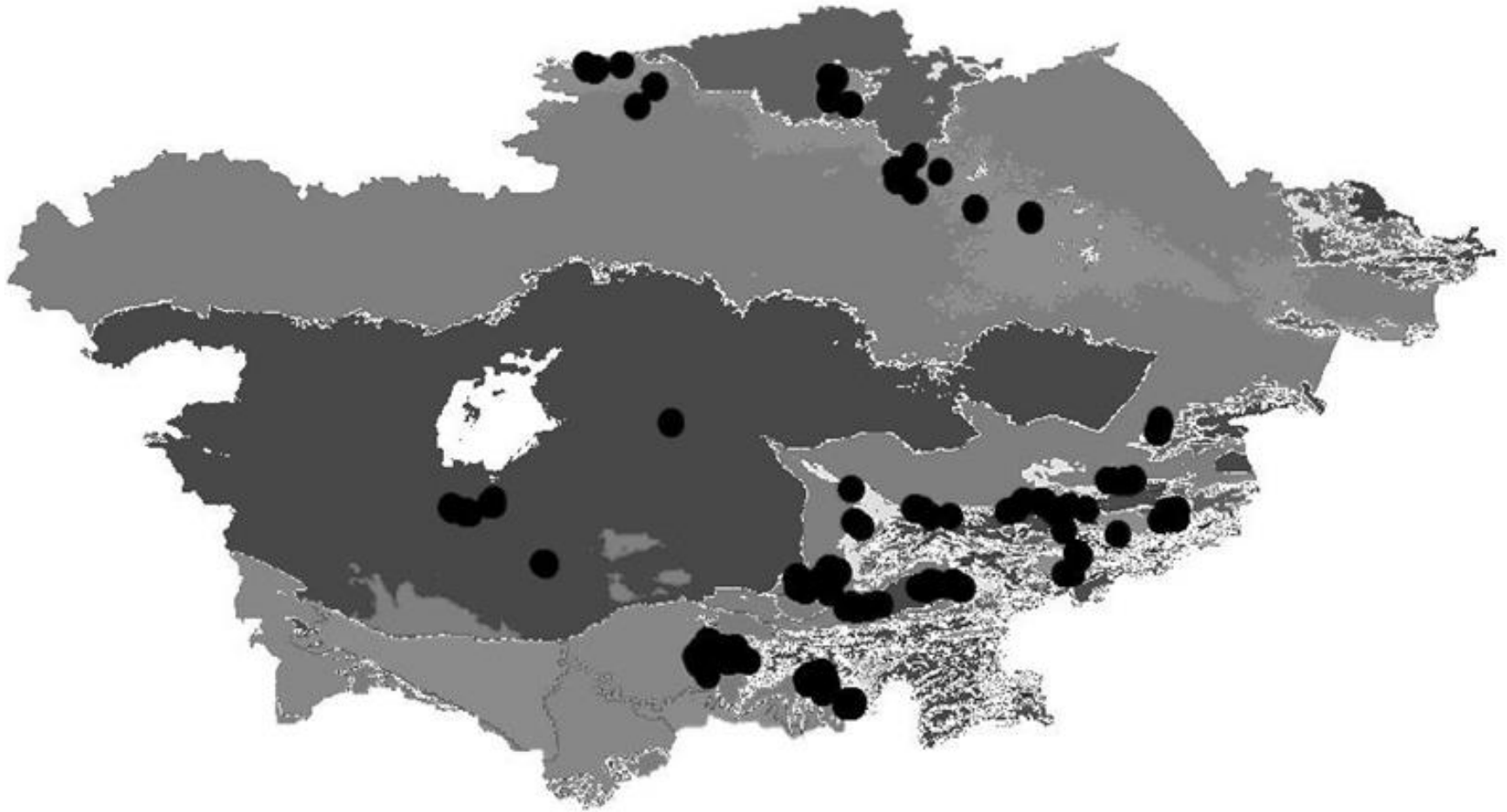


Source: Mirzabaev et al. (2014, under review)

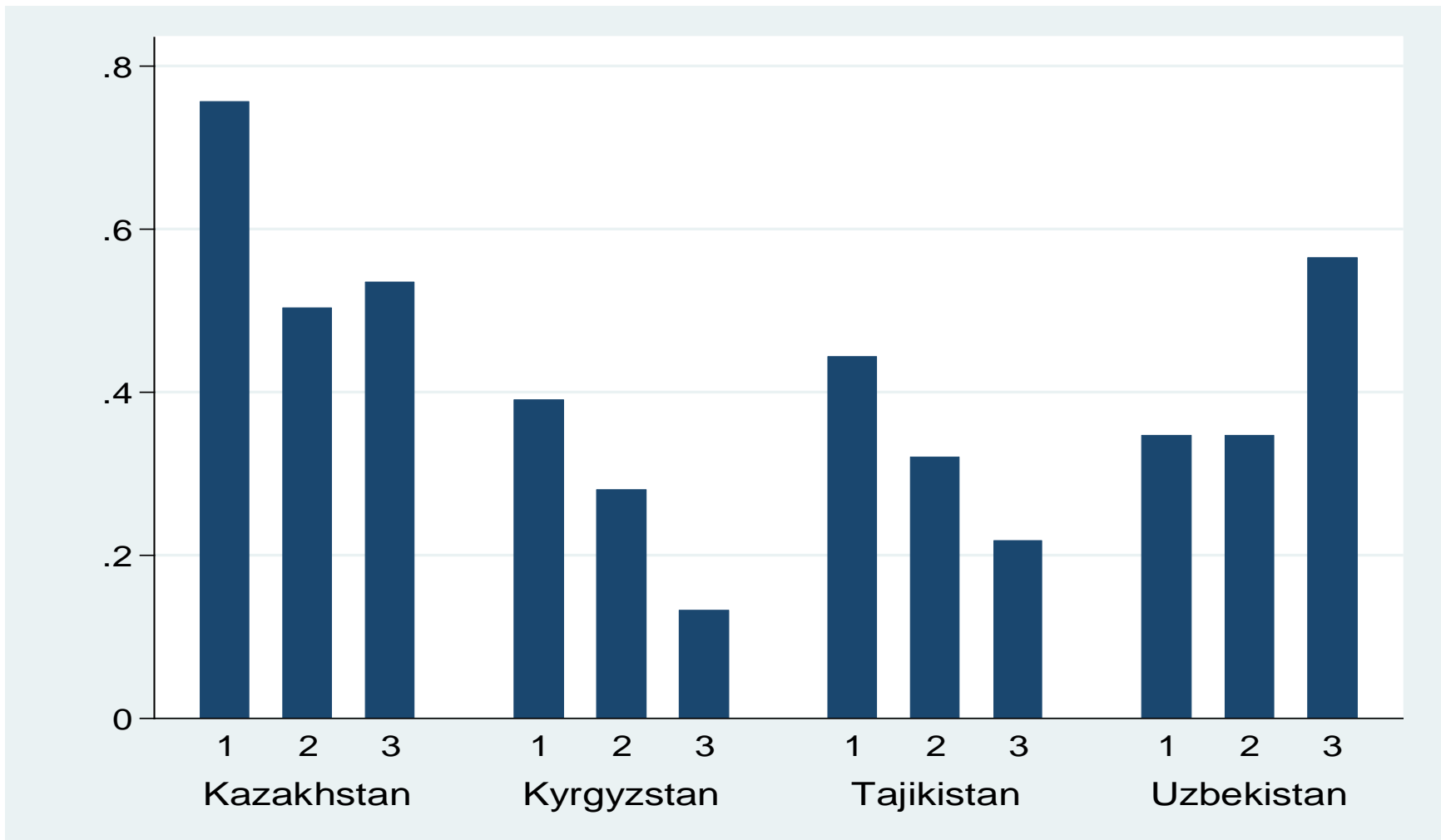
Land Degradation on Static Cropland

- DSSAT-CENTURY (Decision Support System for Agrotechnology Transfer) crop simulation model
- Three crops: wheat, maize, rice
- Two management options: baseline and integrated soil fertility management (ISFM)
- 40 years of crop yield simulations
- 330 million USD cost per annum, most due to loss of soil carbon (not due to yields decline)

Land Degradation Drivers and Impacts at Household Level

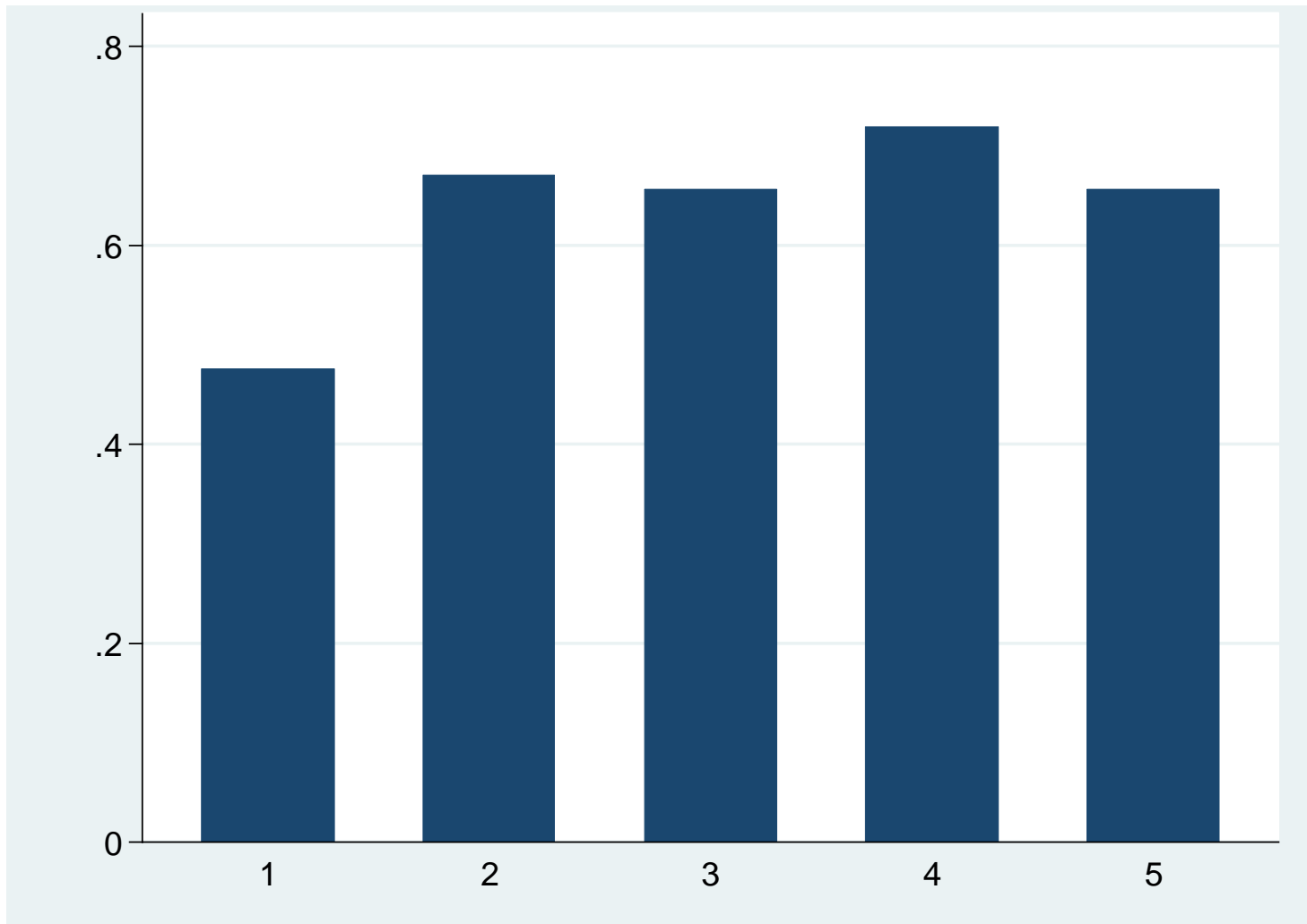


Land Degradation and the Poor



Categories: 1-poor, 2-middle, 3 –rich. Source: the survey dataset

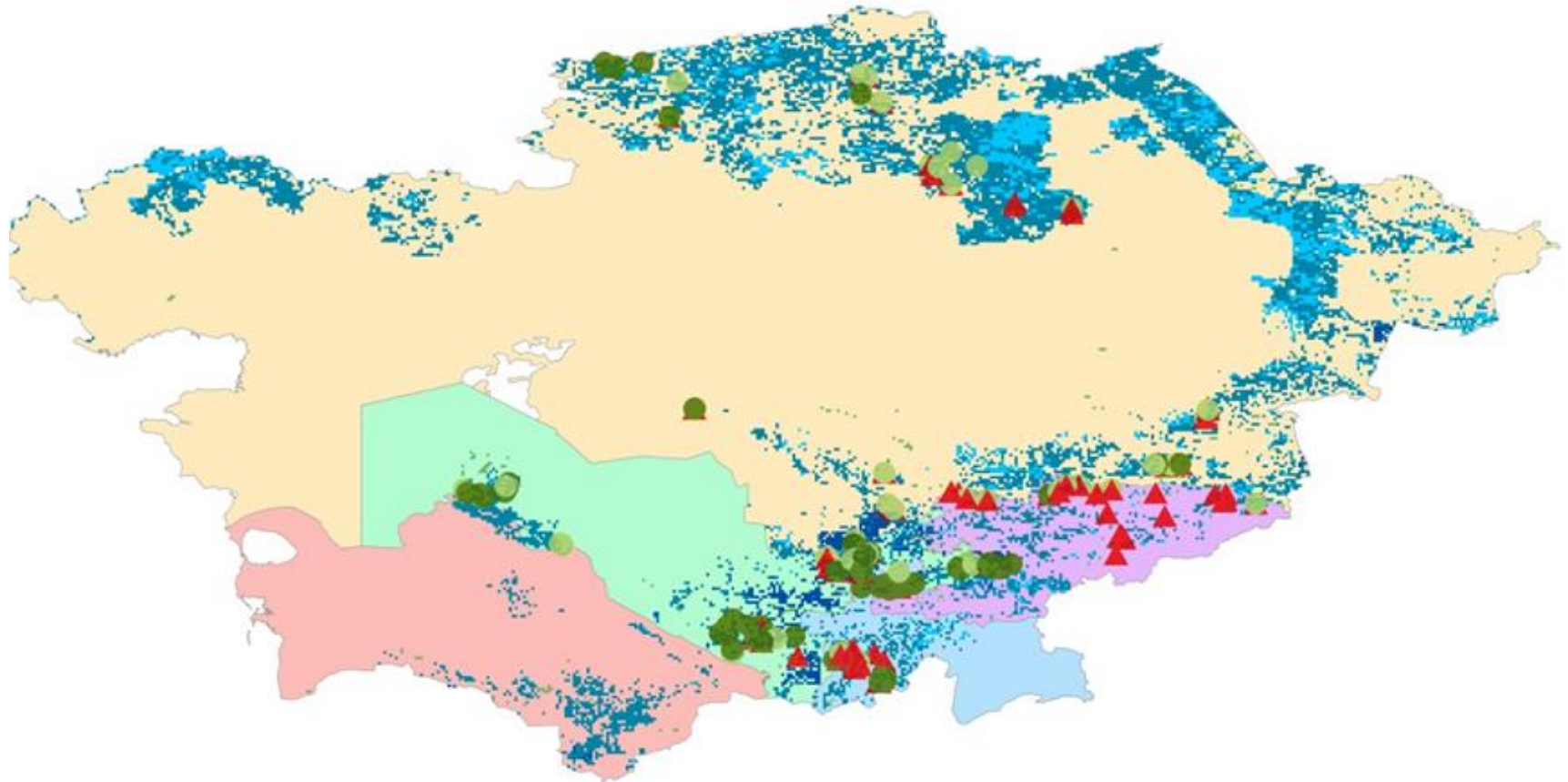
The Poor and SLM Use



Pearson $\chi^2(4) = 56.8061$ Pr = 0.000

Categories: 1-poorest, ... 5-richest. Source: the survey dataset

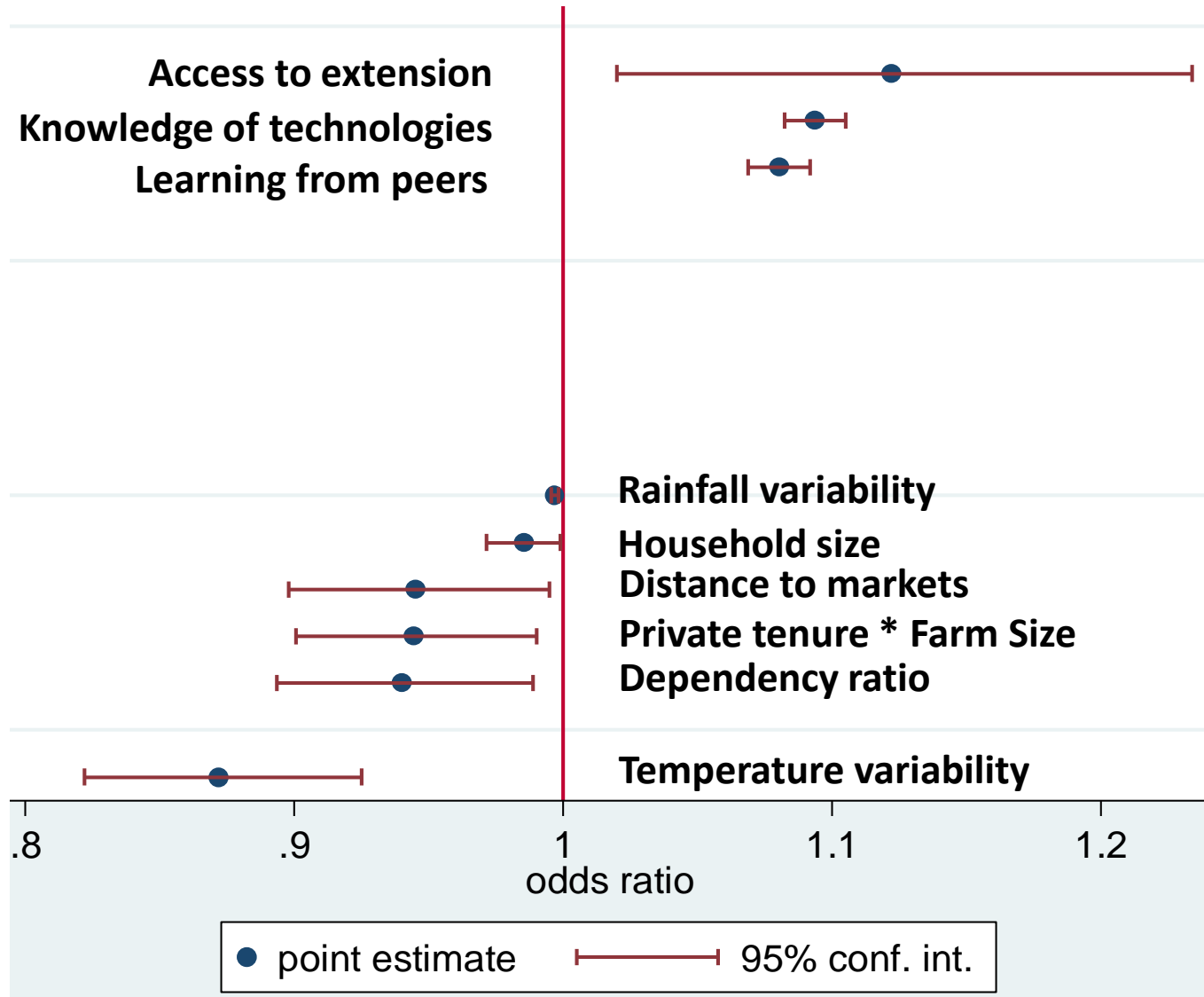
Land Degradation and SLM adoption



Number of SLM technologies adopted

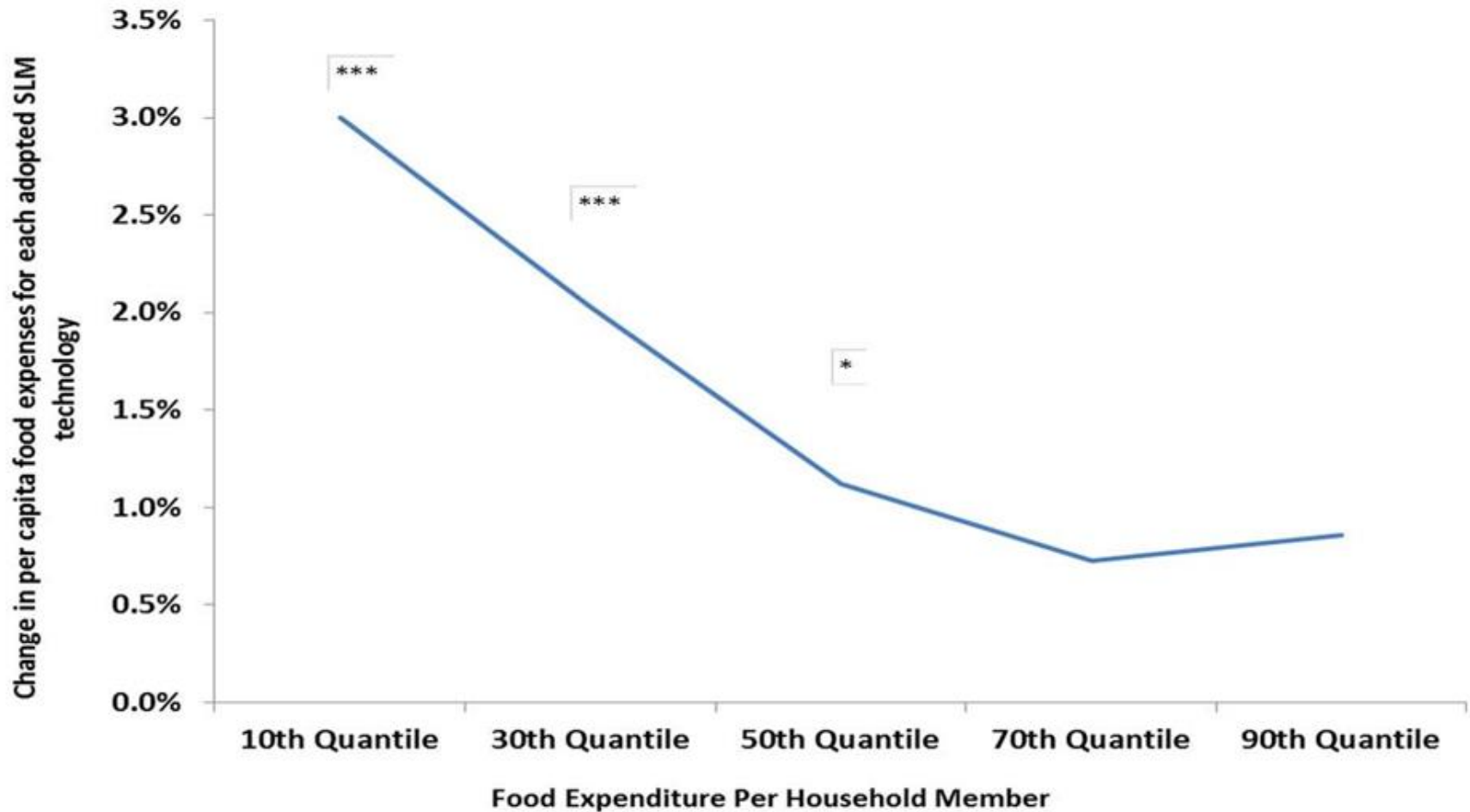
- ▲ 0
- 1 - 3
- more than 3

Drivers of SLM



Dependent variable: number of SLM technologies used (negative binomial regression)

SLM Use and Food Consumption



Quantile regression on per capita food expenses, controlling for a wide range of factors.

Conclusions

- The estimates show that the annual cost of land degradation in the region due to land use change is about 6 bln USD, most which due to rangeland degradation (4.6 bln USD), followed by desertification (0.8 bln USD), deforestation (0.3 bln USD) and abandonment of croplands (0.1 bln USD).

Conclusions

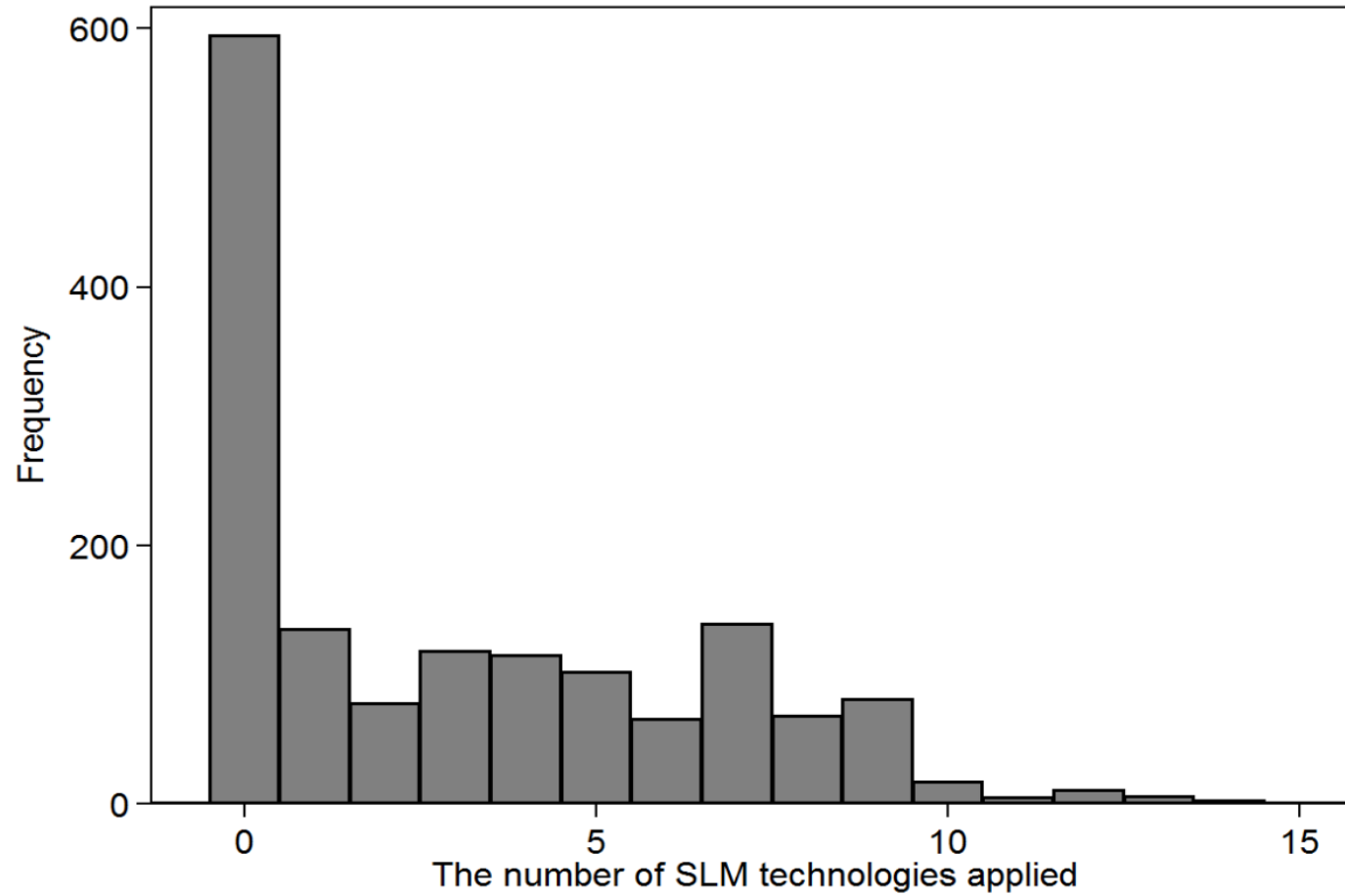
- In spite of this, the adoption of SLM technologies is inadequate, especially among the poor.
- Key drivers of SLM adoptions are better market access, access to extension, peer effects through learning about SLM from other farmers, private land tenure among smallholder farmers, and livestock ownership among crop producers
- SLM adoption is likely to improve the welfare of the poorest households.

Annex

Country	TEV 2001	TEV 2009	GDP in 2009	Value of ecosystems per capita, in USD	GDP/TEV
Kazakhstan	577	639	115	55 169	18%
Kyrgyzstan	40	45	5	14 620	11%
Tajikistan	20	19	5	6 261	27%
Turkmenistan	40	42	20	13 795	48%
Uzbekistan	44	53	33	3 481	63%
Total	720	797	178	22 935	20%

Country	Annual TEV cost of Land Degradation in 2009, in bln USD	Annual provisional cost of Land Degradation in 2009, in bln USD	Cost of Action (6 years), in bln USD	Cost of Action (30 years), in bln USD	of which, the opportunity cost of action, in bln USD	Cost of Inaction (6 years), in bln USD	Cost of Inaction (30 years), in bln USD	Ratio of cost of inaction/action
Kazakhstan	24	11	22	22	21	102	138	6
Kyrgyzstan	4	2	6	6	6	22	29	5
Tajikistan	4	2	4	4	4	17	24	6
Turkmenistan	7	3	10	10	9	35	48	5
Uzbekistan	7	3	11	11	11	36	49	5
Central Asia	47	20	53	53	51	213	288	6

Constant 2007 USD. Net present value for scenario calculations.



Variables	Coefficient	[95% Confidence Interval]	
Distance to markets (log)	-0.0565**	-0.11	-0.01
Household size	-0.0149**	-0.03	0.00
Dependency ratio	-0.0619**	-0.11	-0.01
Education (base - Primary education only)			
Middle school	0.0452	-0.15	0.24
High school	-0.00909	-0.21	0.20
College	0.0421	-0.16	0.24
University degree	0.0691	-0.13	0.27
Ph.D.	0.598*	-0.08	1.28
Country			
Kyrgyzstan	-2.642***	-2.94	-2.34
Tajikistan	-0.0634	-0.34	0.22
Uzbekistan	0.102	-0.10	0.30
Gender (base - Female)	-0.0737	-0.18	0.03
Age	0.00281	0.00	0.01
Agroecological zone (base - Arid)			
Semiarid	-0.770***	-0.97	-0.57
Sub-humid	-1.060***	-1.35	-0.77
Humid	-1.269***	-1.92	-0.62
Length of the growing period	0.00900***	0.00	0.01
Number of crops grown	0.00198	-0.03	0.03
Annual precipitation	0.000404	0.00	0.00
Mean annual temperature	0.0106	-0.01	0.03
Variance of temperature	-0.137***	-0.20	-0.08
Variance of precipitation	-0.00308***	0.00	0.00
Frequency of weather shocks	0.0217***	0.01	0.03

Farm size (log)	0.0110	-0.03	0.05
Private land ownership	-0.0624	-0.20	0.08
Interaction of private land ownership and farm size	-0.0573**	-0.10	-0.01
Access to extension	0.115**	0.02	0.21
Knowledge of SLM technologies	0.0895***	0.08	0.10
Source of SLM knowledge: other farmers	0.0771***	0.07	0.09
Source of SLM knowledge: farmers' association	-0.0796***	-0.09	-0.07
Source of SLM knowledge: media	0.0650***	0.03	0.10
Value of livestock	-1.54e-05**	0.00	0.00
Interaction of crop producer and value of livestock	2.21e-05***	0.00	0.00
Value of total assets	-2.10e-07	0.00	0.00
Constant	0.590**	0.04	1.14
Observations	1,519		

Variables	10th Quantile	30th Quantile	50th Quantile	70th Quantile	90th Quantile
Number of SLM technologies used	0.0307***	0.0203***	0.0112*	0.00727	0.00860
Household size	-0.102***	-0.108***	-0.0933***	-0.0915***	-0.0947***
Distance to markets (log)	-0.0430**	-0.0512**	-0.0359**	-0.0124	-0.0264
Dependency ratio	0.00502	0.00811	-0.0133	-0.0242	-0.00580
Education (base - Primary education only)					
Middle school	0.0667	-0.0125	-0.0623	-0.0804	-0.126
High school	0.0168	0.00182	-0.0663	-0.137	-0.0424
College	0.0757	-0.000312	-0.0534	-0.105	-0.170
University degree	0.0689	0.0372	-0.00705	-0.0487	-0.0717
Ph.D.	0.451**	0.215	0.329*	0.107	-0.195
Country					
Kyrgyzstan	-0.974***	-0.842***	-0.696***	-0.528***	-0.448***
Tajikistan	-0.559***	-0.673***	-0.725***	-0.629***	-0.519***
Uzbekistan	-0.590***	-0.697***	-0.703***	-0.581***	-0.676***
Gender (base - Female)	0.00855	-0.0390	-0.00970	-0.0358	-0.0216
Age	0.00250	0.00136	0.000153	0.00106	-0.000306
Number of crops grown	0.0144	0.0111	0.0135	0.0196	0.0170
Frequency of weather shocks	-0.000813	-0.00367	-0.00266	-0.00448	-0.00396
Farm size (log)	0.0115	0.0209	0.0212	0.0350	0.0549
Private land ownership	0.0771	0.0672	0.0534	0.110**	0.159*
Interaction of private land ownership and farm size	0.0155	-0.0128	-0.0296	-0.0293	-0.0316
Access to extension	0.0498	0.0387	0.0308	-0.0254	0.0863
Knowledge of SLM technologies	-0.00810	-0.00497*	-0.00334	-0.00596	-0.0131**

Variables	10th Quantile	30th Quantile	50th Quantile	70th Quantile	90th Quantile
Value of livestock	6.70e-06*	2.27e-06	8.65e-07	-1.06e-06	-1.38e-06
Interaction of crop producer and value of livestock	-4.51e-06	-7.66e-07	-4.58e-07	3.27e-06	7.86e-06
Asset category (base-less than 10 000 USD)					
	-0.0333	0.0252	0.0371	0.0570	0.0713
Assets more than 30 000 USD	0.229*	0.151*	0.171*	0.180**	0.193***
Interaction of Assets between 10 000 and 30 000 USD of number of SLM technologies used	0.0253	0.0157	0.0155	0.0185	0.0108
Interaction of assets more than 30 000 USD and number of SLM technologies used	0.00349	0.0125	0.0259*	0.0184	0.00399
Constant	0.258	0.817***	0.986***	1.085***	1.546***
Observations	1,519	1,519	1,519	1,519	1,519
Pseudo R2	0.2815	0.2884	0.2847	0.2853	0.2887

Market Access

