Supplementary Information

National wheat intensification and rapid scaling of a registered dry-seed conditioning programme in Uzbekistan

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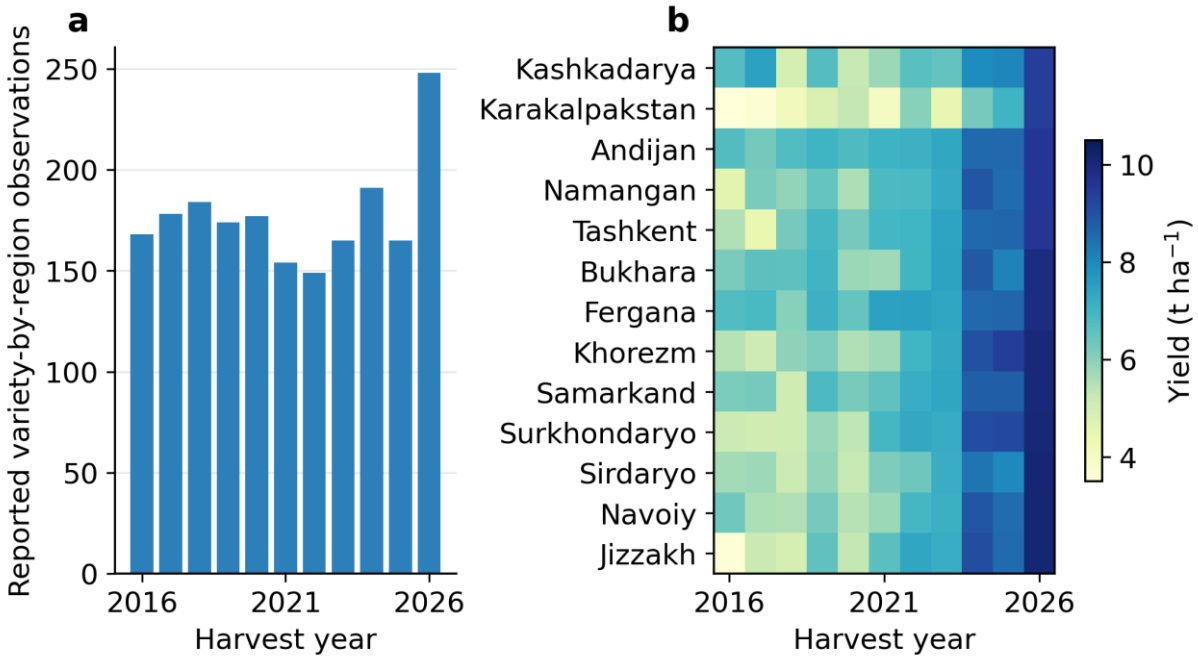
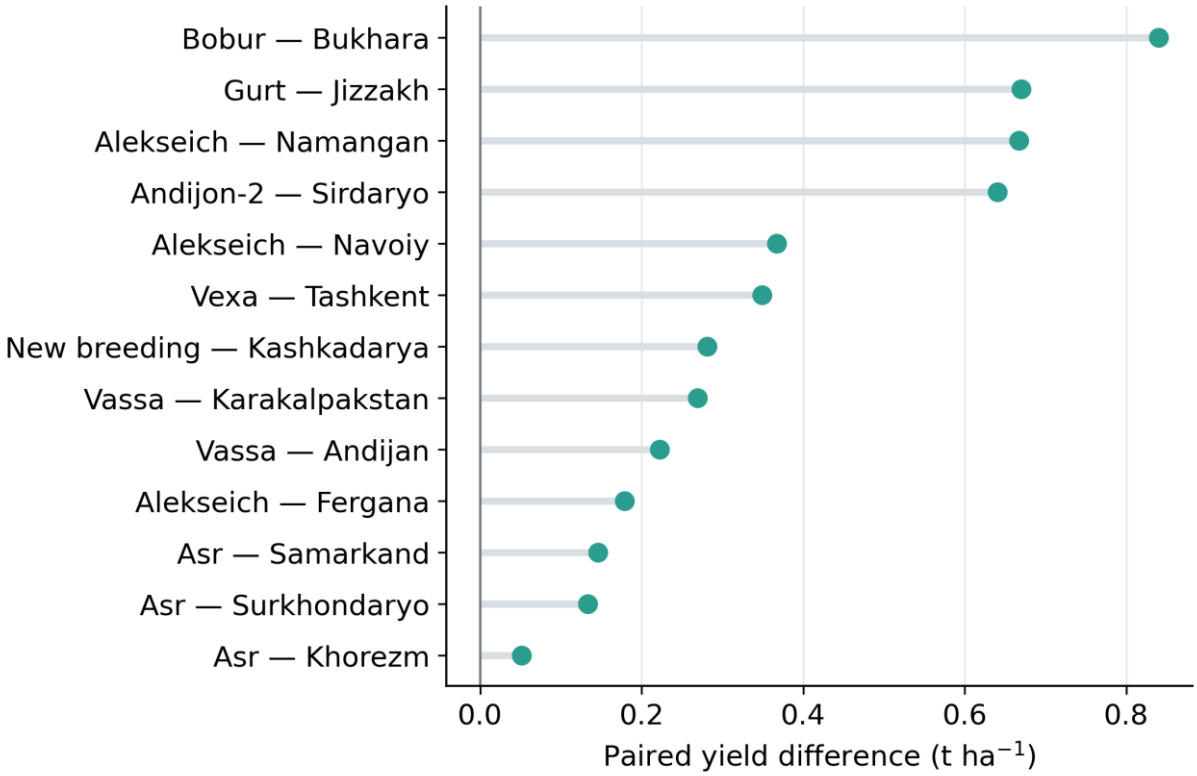
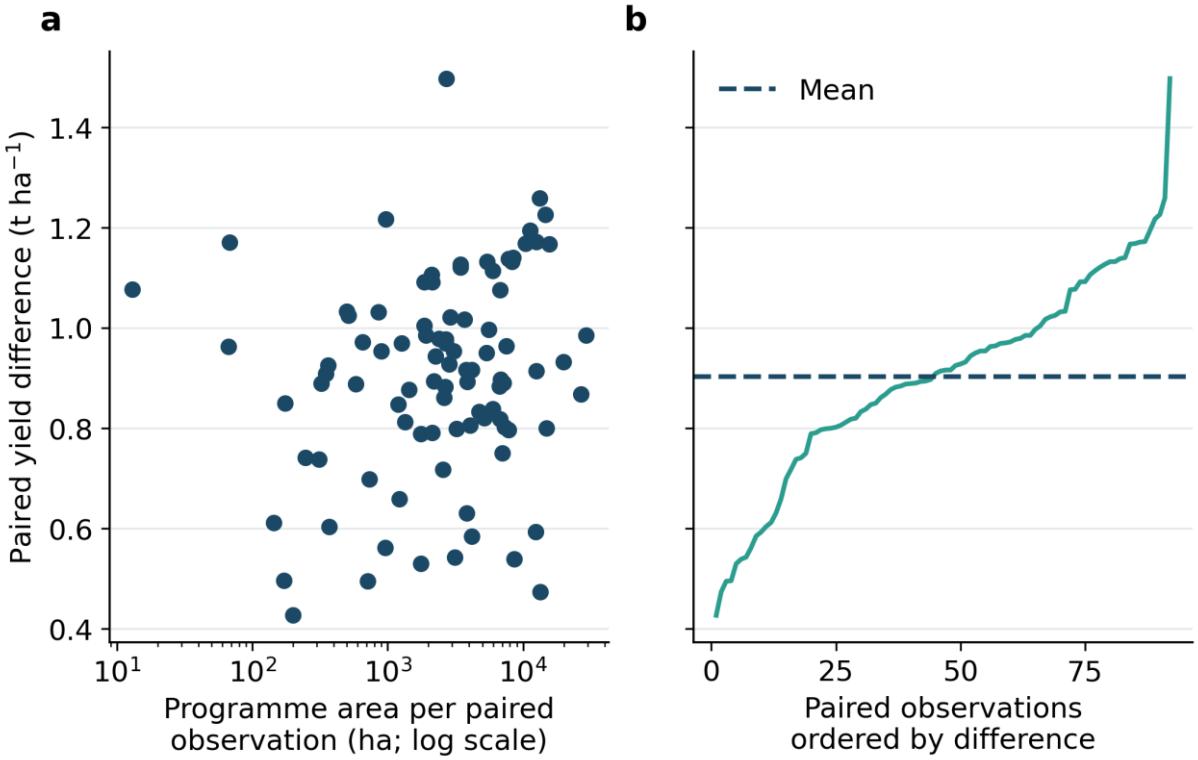
Supplementary Figures



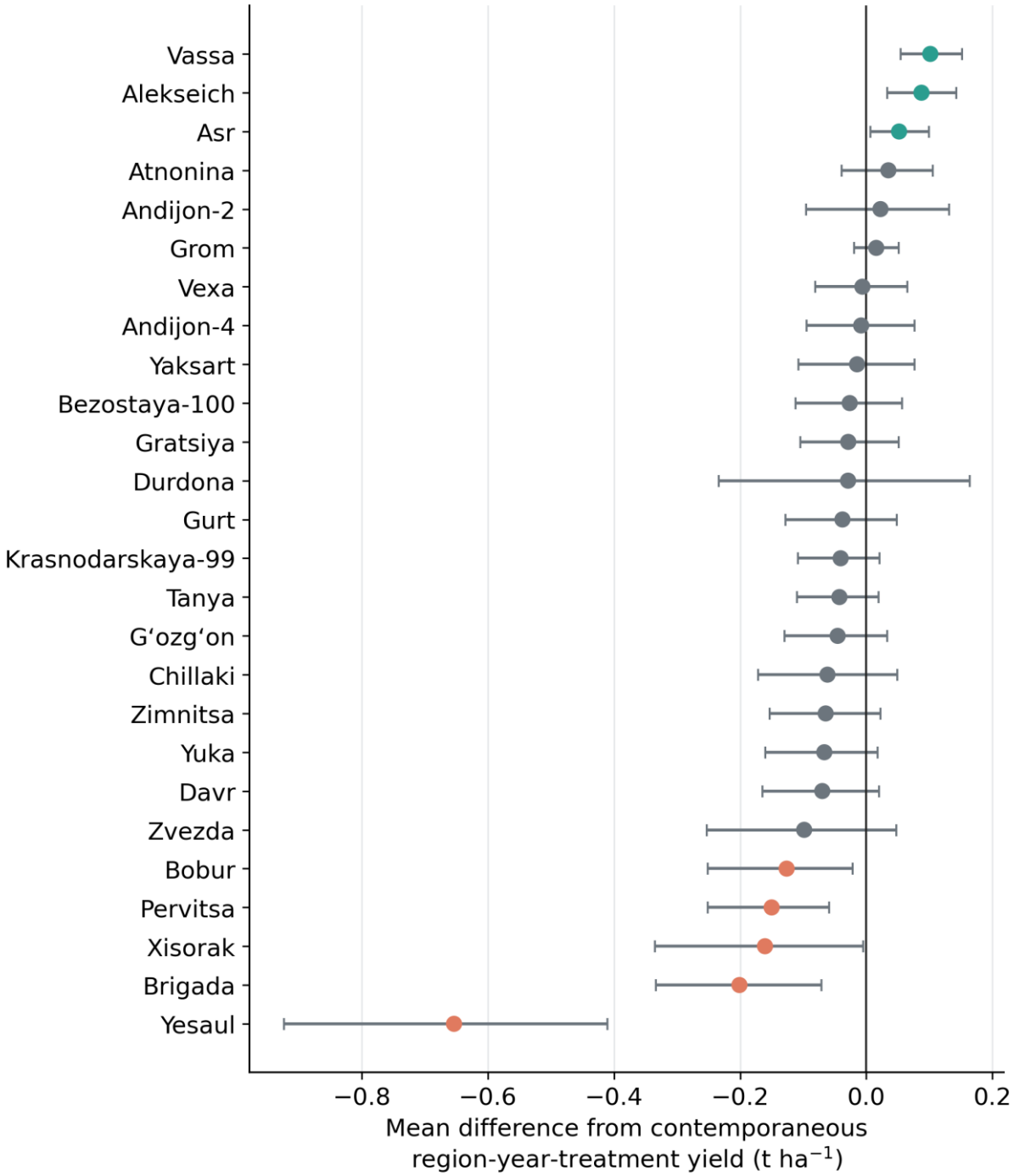
Supplementary Fig. S1 | Administrative data coverage. a, Number of reported variety-by-region observations by harvest year. b, Area-weighted yield by region and year.



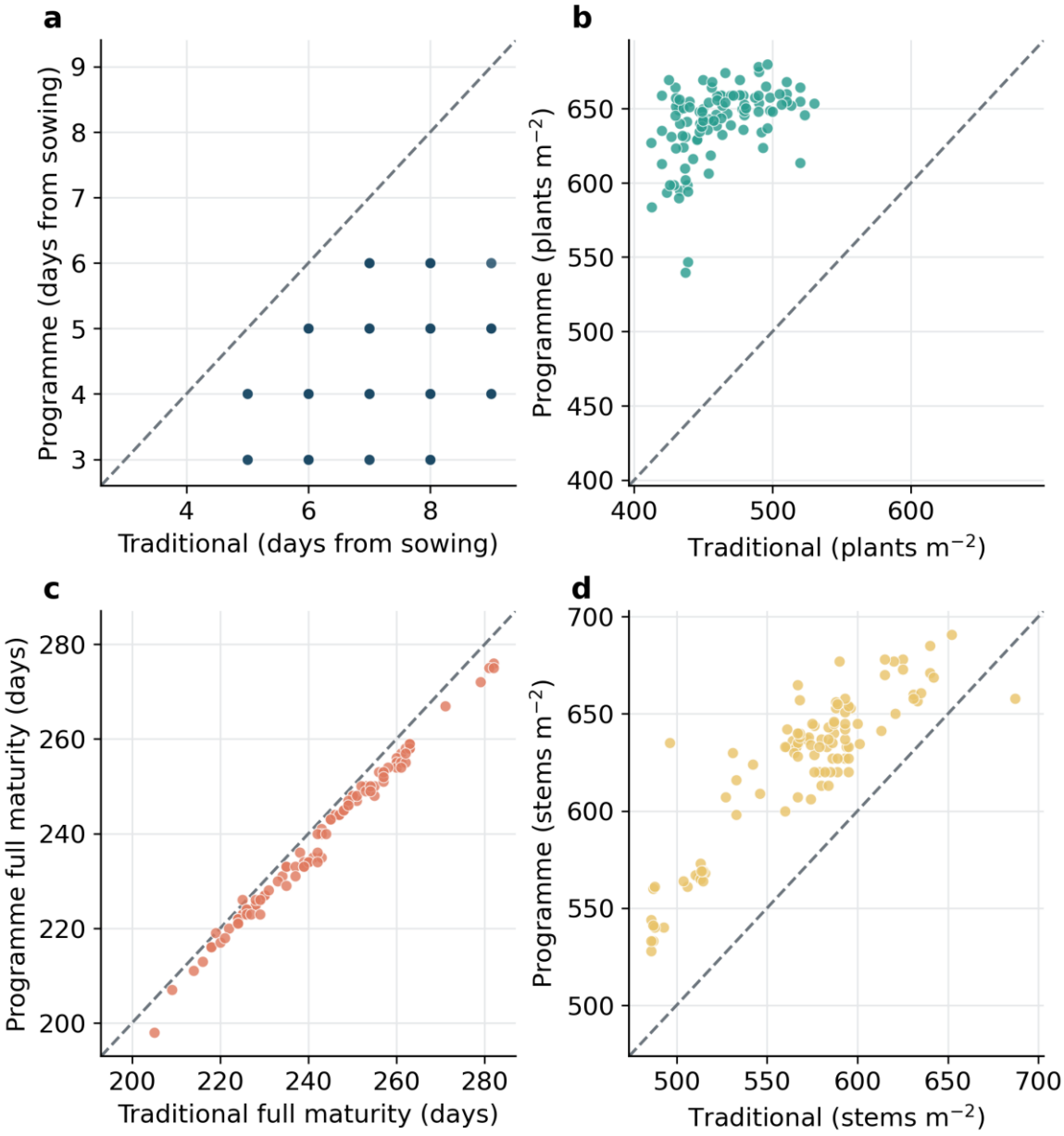
Supplementary Fig. S2 | Paired yield differences in the 2025 pilot. Programme minus traditional yield is shown for 13 variety-by-region observations.



Supplementary Fig. S3 | Sensitivity of the 2026 paired contrasts. a, Paired difference versus programme area. b, Ordered paired differences; the dashed line marks the unweighted mean.



Supplementary Fig. S4 | Environment-adjusted cultivar performance. Points are mean deviations from the contemporaneous region-year-treatment mean; bars are percentile 95% bootstrap intervals. Included varieties had at least 20 records, five years and five regions. Values summarise cultivar performance across recorded deployment environments.



Supplementary Fig. S5 | District field-monitoring contrasts in 2026. Paired programme and traditional district averages are shown for a, days from sowing to 75% emergence; b, plant density; c, days from sowing to full maturity; and d, productive stem density. Each point represents one district and the dashed diagonal denotes equality. The primary analyses used 106 paired districts across ten provinces.

Supplementary Tables

Supplementary Table S1 | Historical-trend predictions

a, Annual observations and pre-period predictions.

Year	Weighted yield, t ha−1	Pre-period linear prediction, t ha−1	95% PI lower	95% PI upper	Observed minus prediction, t ha−1
2016	5.641	5.288	3.831	6.744	0.353
2017	5.866	5.584	4.191	6.978	0.281
2018	5.531	5.881	4.535	7.228	-0.350
2019	6.530	6.178	4.860	7.496	0.352
2020	5.755	6.475	5.167	7.783	-0.720
2021	6.412	6.772	5.454	8.090	-0.360
2022	6.981	7.069	5.722	8.415	-0.088
2023	7.047	7.365	5.972	8.759	-0.318
2024	8.512	7.662	6.206	9.119	0.849
2025	8.436	7.959	6.425	9.493	0.477
2026	9.781	8.256	6.633	9.879	1.525

b, Residual serial-correlation diagnostics for the 2016–2024 fit.

Diagnostic	Lag	Statistic	d.f.	P value
Durbin–Watson	NA	1.900	NA	NA
Ljung–Box	1	0.356	1	0.551
Ljung–Box	2	0.514	2	0.773
Ljung–Box	3	0.530	3	0.912

Notes: Residual diagnostics did not indicate serial correlation in the 2016–2024 national trend fit. Ordinary least squares was fitted to 2016–2024 national area-weighted yields. PI denotes the prediction interval for a new annual observation; the nine-observation pre-period produces a broad expected range. Residual diagnostics are shown in panel b.

Supplementary Table S2 | Regional yield trajectories, 2016–2026

Region	2016 yield	2026 yield	Change	OLS slope	OLS P	Theil–Sen slope (95% CI)
Andijan	6.741	9.555	2.814	0.268	<0.001	0.252 (0.093–0.377)
Bukhara	6.200	9.873	3.673	0.301	0.005	0.329 (0.102–0.520)
Fergana	6.763	9.883	3.119	0.289	<0.001	0.269 (0.113–0.480)
Jizzakh	3.559	10.097	6.538	0.563	<0.001	0.567 (0.421–0.691)
Karakalpak-stan	3.440	9.406	5.966	0.452	<0.001	0.421 (0.248–0.655)
Kashkadarya	6.717	9.396	2.679	0.233	0.056	0.279 (-0.017–0.638)
Khorezm	5.444	10.000	4.557	0.482	<0.001	0.499 (0.266–0.747)
Namangan	4.608	9.570	4.962	0.418	<0.001	0.416 (0.238–0.587)
Navoiy	6.333	10.091	3.758	0.399	0.001	0.370 (0.114–0.673)
Samarkand	6.153	10.004	3.851	0.384	<0.001	0.385 (0.178–0.611)
Sirdaryo	5.673	10.082	4.409	0.404	<0.001	0.392 (0.128–0.618)
Surkhondaryo	5.133	10.042	4.910	0.526	<0.001	0.554 (0.362–0.651)
Tashkent	5.505	9.574	4.070	0.415	<0.001	0.413 (0.274–0.570)

Notes: Yields and changes are in t ha−1; slopes are in t ha−1 yr−1. Across regions, Friedman χ^2 = 110.60 (10 d.f., P = 4.04e-19); the exact Wilcoxon signed-rank P-value for the 2016–2026 change was 0.000244.

Supplementary Table S3 | Annual national summaries by seed-storage treatment

Year	Database treatment	Reported observations	Area (ha)	Yield (t ha−1)	Area share (%)
2016	traditional	168	1,132,630	5.641	100
2017	traditional	178	1,122,630	5.866	100
2018	traditional	184	1,107,130	5.531	100
2019	traditional	174	1,091,630	6.530	100
2020	traditional	177	1,077,569	5.755	100
2021	traditional	154	1,038,104	6.412	100
2022	traditional	149	1,030,464	6.981	100
2023	traditional	165	1,010,833	7.047	100
2024	traditional	191	1,012,776	8.512	100
2025	traditional	152	995,927	8.436	99.9
2025	vernalized	13	973	8.803	0.1
2026	traditional	104	262,045	9.218	27.7
2026	vernalized	144	685,065	9.997	72.3

Notes: Treatment-specific yields are descriptive marginal means weighted by cultivated area.

Supplementary Table S4 | Record-level restricted maximum-likelihood mixed model

a, Omnibus fixed-effect tests.

Fixed effect	Wald chi-square	Df	P-value
Harvest year	396.62	10	<0.001
Seed treatment	294.19	1	<0.001
Variety class	0.25	2	0.884

b, Fixed-effect coefficients.

Term	Estimate (t ha−1)	SE	z	P (two-sided)	95% CI low	95% CI high
Intercept	5.424	0.233	23.33	<0.001	4.968	5.879
2017	0.258	0.289	0.89	0.373	-0.309	0.824
2018	0.071	0.289	0.24	0.807	-0.495	0.637
2019	0.913	0.289	3.16	0.002	0.347	1.479
2020	0.245	0.289	0.85	0.397	-0.321	0.811
2021	0.731	0.289	2.53	0.011	0.164	1.298
2022	1.415	0.289	4.89	<0.001	0.848	1.982
2023	1.502	0.289	5.20	<0.001	0.935	2.068
2024	2.931	0.289	10.15	<0.001	2.365	3.497
2025	2.870	0.289	9.93	<0.001	2.303	3.436
2026	3.679	0.290	12.68	<0.001	3.111	4.248
Programme	0.762	0.044	17.15	<0.001	0.675	0.849
Russian vs New	0.047	0.115	0.41	0.681	-0.177	0.271
Uzbek vs New	0.033	0.115	0.28	0.776	-0.193	0.258

c, Variance components.

Component	Variance	Share of random plus residual variance (%)
Location × year environment	0.532	79.6
Named variety	0.011	1.7
Residual	0.125	18.7

d, Fixed-effect coefficients from the 2026-only sensitivity model.

Term	Estimate	SE	z	P value	95% CI
Intercept	9.177	0.160	57.42	<0.001	8.864–9.490
Programme	0.857	0.038	22.32	<0.001	0.782–0.933
Russian vs New	−0.026	0.142	−0.18	0.855	−0.305–0.253
Uzbek vs New	−0.114	0.145	−0.78	0.433	−0.399–0.171

Notes: Estimates are in t ha−1. The 2026-only model included crossed random intercepts for location and named variety.

e, Variance components from the 2026-only sensitivity model.

Component	Variance	Share (%)
Location	0.084	48.0
Named variety	0.015	8.7
Residual	0.076	43.3

Notes: Shares are relative to the sum of the two random-intercept variances and residual variance.

f, Fixed-effect coefficients from the 2026 area-precision sensitivity model.

Term	Estimate	SE	z	P value	95% CI
Intercept	9.132	0.135	67.67	<0.001	8.867–9.396
Programme	0.908	0.029	30.90	<0.001	0.850–0.965
Variety class[Russian]	-0.016	0.109	-0.15	0.881	-0.231–0.198
Variety class[Uzbek]	-0.083	0.112	-0.74	0.459	-0.303–0.137

g, Variance components from the 2026 area-precision sensitivity model.

Component	Variance	Share (%)
Location	0.092	68.6
Named variety	0.010	7.2
Residual	0.033	24.3

Notes: Yield (t ha−1) was the response. In panels a–c, fixed effects were harvest year, programme status and variety class; crossed random intercepts were region-by-year environment and named variety. Panels d–e show the equal-record 2026 sensitivity model; panels f–g show the area-precision sensitivity. Coefficients quantify adjusted associations; reference levels were 2016, traditional seed storage and the New variety class.

Notes: The area-precision sensitivity assumes residual precision proportional to cultivated area. It tests sensitivity to aggregated record scale and does not treat hectares as independent field replicates. The narrower interval reflects the assumed precision weighting and should not be interpreted as stronger evidence than the equal-record model.

Supplementary Table S5 | Paired treatment summaries

a, Principal matched summaries.

Year	n_p	n_r	Aprog	Mean Δ (95% CI)	Weighted Δ (95% CI)	n_+	Δ (%)	Eprod
2025	13	13	1	0.37 (0.24–0.50)	0.39 (0.25–0.52)	13	4.5	0.4
2026	92	10	447	0.90 (0.78–1.02)	0.94 (0.81–1.05)	92	9.8	419.7

b, Small-cluster t sensitivity for the 2026 matched estimates.

Estimand	Estimate	Cluster SE	d.f.	95% CI	P value	Wild P
Unweighted mean	0.903	0.062	9	0.762–1.044	<0.001	0.002
Programme-area-weighted mean	0.939	0.065	9	0.792–1.087	<0.001	0.002

Notes: For weights w_i and estimate $\bar{d}w = \Sigma_i w_i d_i / \Sigma_i w_i$, CR1 cluster-robust variance was calculated as $[G/(G-1)](\Sigma_i w_i)^{-2}\Sigma g[\Sigma i \in g w_i(d_i - \bar{d}w)]^2$, with region as the cluster and t inference using $G-1 = 9$ degrees of freedom.Exact wild-cluster bootstrap-t P values enumerate all 2^{10} Rademacher sign patterns for region-level score contributions; with ten clusters, 0.002 is the minimum attainable two-sided P value.

c, Regional structure of the 2026 matched differences.

Matches	Regions	Regional η^2	SD of region means	Pooled within-region SD
92	10	0.791	0.195	0.098

Notes: Standard deviations are in t ha−1. Regional η^2 is the fraction of the total squared dispersion in aggregate matched differences attributable to differences among regional means; it is descriptive.

Notes: Δ denotes programme minus traditionally stored yield in t ha−1; n_p is the number of matches, n_r the number of represented regions, Aprog is programme area (10^3 ha), n_+ the number of positive matches and Eprod the production-equivalent (10^3 t). Principal CIs are percentile 95% region-cluster bootstrap intervals. Panel b provides cluster-robust t intervals and exact wild-cluster bootstrap-t P values; panel c summarises regional clustering. Eprod expresses the matched difference at the represented-area scale and is not used for attribution.

d, Exact-matching flow.

Year	All records	Programme/traditional records	Matched combinations	Unmatched programme/traditional	Matched programme area, ha (%)	Regions
2025	165	13/152	13	0/139	973 (100.0)	13
2026	248	144/104	92	52/12	446,746 (65.2)	10

e, Descriptive consistency of matched differences across programme years.

Comparison	2025	2026	Regions in both years	Spearman ρ	P value
Unweighted mean difference, t ha−1	0.370	0.903	10	0.297	0.405

Notes: Panel d accounts for all records in each programme year. Unmatched records lacked the opposite treatment for the same year, named variety, variety class and region. Panel e compares unweighted regional mean differences; the 2025 pilot provides directional feasibility evidence and is not directly comparable in magnitude with the larger 2026 scale-up.

f, Yield-association estimates across analytical specifications.

Specification	Estimate (t ha−1)	Scope
All 2026 records, area-weighted marginal	0.779	248 records
2026 crossed-random-intercept REML	0.857	248 records
2026 area-precision REML sensitivity	0.908	248 records
Exact-matched unweighted mean	0.903	92 matched combinations
Exact-matched programme-area-weighted mean	0.939	92 matched combinations

g, Matched and unmatched 2026 record composition.

Subset	Treatment	Records	Area (ha)	Mean yield	Area-weighted yield
Matched	Traditional	92	251,343	9.217	9.219
Matched	Programme	92	446,746	10.120	10.058
Unmatched	Traditional	12	10,702	9.339	9.194
Unmatched	Programme	52	238,319	9.826	9.882

Notes: Panels f–g show how the estimated programme association changes as compositional control and record-scale sensitivity increase, and describe the matched and unmatched records. The specification range makes selection into the exact-matched subset explicit; it is not a sequence of causal estimates.

Supplementary Table S6 | Regional paired summaries for 2026

a, Regional matched summaries.

Region	n	Aprog	Mean Δ (95% CI)	Wt. Δ	Median Δ	Range
Jizzakh	1	5.44	1.13 (NA)	1.13	1.13	1.13–1.13
Fergana	7	79.50	1.20 (1.05–1.34)	1.13	1.14	0.99–1.50
Namangan	8	45.74	1.11 (1.01–1.21)	1.12	1.15	0.83–1.22
Tashkent	10	46.70	1.07 (1.01–1.13)	1.12	1.08	0.95–1.19
Samarkand	17	38.20	0.91 (0.85–0.98)	0.91	0.95	0.59–1.03
Kashkadarya	10	59.69	0.91 (0.85–0.98)	0.90	0.90	0.75–1.09
Sirdaryo	9	34.11	0.90 (0.86–0.95)	0.90	0.91	0.80–1.00
Surkhondaryo	10	61.64	0.85 (0.80–0.90)	0.84	0.88	0.72–0.96
Navoiy	8	30.03	0.78 (0.73–0.84)	0.81	0.80	0.66–0.86
Karakalpakstan	12	45.70	0.54 (0.50–0.58)	0.54	0.54	0.43–0.63

b, Regional ecological linear sensitivities for 2026 adoption.

Outcome	Slope	SE	95% CI	P value	R^2
2026 regional yield	0.241	0.371	−0.575–1.057	0.529	0.037
2016–2026 yield change	0.751	1.581	−2.728–4.230	0.644	0.020

Notes: Slopes are t ha−1 per 100-percentage-point increase in the programme-area share. All 13 regions were exposed, and adoption ranged from 45.6% to 100%, limiting contrast across the ecological gradient.

Notes: a, Δ is programme minus traditional yield (t ha−1); area is 10^3 ha, and estimates with few matches are descriptive. b, Ecological OLS models across 13 regions; adoption is scaled 0–100%.

Supplementary Table S7 | Environment-adjusted cultivar performance

Variety	n	yr	R	Area	Yield	Adjusted Δ (95% CI)	Δ > 0 (%)	CV (%)
Vassa	97	11	13	811.5	7.5	0.102 (0.055–0.152)	59.8	22.4
Alekseich	100	8	13	952.1	8.0	0.087 (0.034–0.143)	65.0	18.4
Asr	133	11	13	892.2	7.3	0.052 (0.006–0.099)	56.4	23.6
Atnonina	84	8	13	340.1	7.8	0.035 (-0.039–0.105)	57.1	19.3
Andijon-2	37	8	7	118.7	7.1	0.022 (-0.095–0.132)	51.4	26.5

Grom	130	11	13	1630.4	6.6	0.016 (-0.019–0.051)	53.8	23.1
Vexa	43	6	13	228.7	8.3	-0.006 (-0.081–0.065)	48.8	14.0
Andijon-4	50	11	10	196.1	6.6	-0.008 (-0.095–0.077)	54.0	22.3
Yaksart	58	11	11	307.9	6.4	-0.015 (-0.108–0.076)	53.4	21.7
Bezostaya-100	64	8	12	187.0	7.6	-0.026 (-0.113–0.057)	43.8	16.3
Gratsiya	39	7	9	142.6	5.7	-0.029 (-0.105–0.051)	43.6	15.7
Durdona	27	7	8	44.2	6.2	-0.029 (-0.234–0.164)	44.4	15.1
Gurt	47	8	12	120.6	7.9	-0.038 (-0.128–0.049)	44.7	16.6
Krasnodarskaya-99	88	11	13	759.0	5.9	-0.041 (-0.108–0.021)	55.7	20.4
Tanya	89	11	13	821.3	6.3	-0.043 (-0.110–0.019)	43.8	23.8
G‘ozg‘on	52	11	9	316.5	6.2	-0.045 (-0.130–0.033)	50.0	22.1
Chillaki	30	9	5	199.6	6.3	-0.062 (-0.171–0.050)	36.7	18.9
Zimnitsa	81	11	13	184.9	6.2	-0.064 (-0.154–0.022)	48.1	24.4
Yuka	69	11	12	299.6	5.9	-0.067 (-0.160–0.018)	49.3	24.5
Davr	60	8	10	345.0	7.4	-0.070 (-0.165–0.020)	36.7	20.3
Zvezda	40	10	9	77.5	6.0	-0.099 (-0.253–0.048)	37.5	23.0
Bobur	57	11	10	195.6	6.3	-0.126 (-0.251–-0.022)	42.1	21.2
Pervitsa	75	11	13	230.0	6.4	-0.150 (-0.252–-0.059)	40.0	21.0
Xisorak	30	10	8	115.7	7.8	-0.161 (-0.335–-0.005)	43.3	25.0
Brigada	34	5	11	128.8	5.8	-0.201 (-0.334–-0.071)	32.4	13.5
Yesaul	22	6	6	36.7	5.2	-0.654 (-0.923–-0.411)	13.6	17.4

Notes: Yield and adjusted differences (Δ) are in t ha−1; yr and R are the numbers of represented years and regions, and Area is deployed area in 10^3 ha. Adjustment centres each record on its contemporaneous region-year-treatment area-weighted mean. CIs use 20,000 percentile bootstrap samples. Values summarise performance across recorded deployment environments.

Supplementary Table S8 | Paired-analysis sensitivity

a, Leave-one-region-out estimates for 2026.

Excluded region	Pairs	Mean difference (t ha−1)	Weighted difference (t ha−1)
Fergana	85	0.879	0.898
Jizzakh	91	0.900	0.937
Karakalpakstan	80	0.957	0.985
Kashkadarya	82	0.902	0.946
Namangan	84	0.883	0.918
Navoiy	84	0.915	0.949
Samarkand	75	0.901	0.942
Sirdaryo	83	0.903	0.943
Surkhondaryo	82	0.909	0.955
Tashkent	82	0.883	0.919

b, Paired estimates by variety class for 2026.

Variety class	Pairs	Programme area (ha)	Mean	95% CI low	95% CI high	Weighted mean
New	10	55,361	0.865	0.679	1.051	0.902
Russian	52	246,326	0.920	0.861	0.979	0.951
Uzbek	30	145,059	0.886	0.824	0.949	0.934

Notes: Yield differences are in t ha−1. Sensitivity analyses evaluate the consistency of estimates across regional influence and broad variety-class composition.

Supplementary Table S9 | Additional robustness and subset checks

Check	Statistic	P value	Group means or interpretation
Cell area versus within-region dispersion	$\rho = -0.187$	0.074	No monotonic relation detected; total area is not a count of independent fields.
Region-centred traditional-area share versus difference	$\rho = -0.158$	0.132	No within-region association detected.
Fully converted versus matched regions: 2026 yield	$U = 11$	0.573	9.809 versus 9.815 t ha−1.
Fully converted versus matched regions: 2016–2026 change	$U = 9$	0.371	3.681 versus 4.426 t ha−1.

Notes: The two correlations use 92 matched aggregates. Cell area is total programme plus traditionally stored area, and dispersion is calculated within region. Group comparisons involving fully converted regions provide programme-level context because those regions lack a within-region traditional comparator.

Supplementary Table S10 | District field-monitoring contrasts in mixed-adoption districts

a, Phenology.

Stage	n	Traditional mean	Programme mean	Difference (95% CI), days	Direction	Holm P
Emergence	106	7.03	4.43	−2.59 (−3.18 to −2.01)	106/106 earlier	1.53e-05
Tillering	106	40.54	36.86	−3.68 (−4.33 to −3.03)	106/106 earlier	3.10e-06
Jointing	106	171.89	168.65	−3.24 (−3.94 to −2.53)	105/106 earlier	1.53e-05
Heading	106	202.83	199.73	−3.10 (−3.79 to −2.42)	106/106 earlier	1.53e-05
Full maturity	106	241.79	238.15	−3.64 (−4.81 to −2.48)	104 earlier; 1 same; 1 later	1.16e-04

b, Stand traits.

Outcome	n	Traditional mean	Programme mean	Difference (95% CI); relative difference	Direction	Holm P
Plant density, plants m−2	106	460.75	641.00	+180.25 (162.56 to 197.94); +39.1%	106/106 higher	2.07e-08
Plant height, cm	105	72.79	79.26	+6.47 (4.40 to 8.54); +8.9%	105/105 higher	1.16e-04
Productive stems, stems m−2	106	568.30	622.63	+54.33 (42.22 to 66.44); +9.6%	105/106 higher	1.53e-05

Notes: Differences are programme minus traditional treatment. Emergence and phenological-stage timing is expressed as days after sowing, based on dates recorded in the standardised field-monitoring notebooks; negative timing differences denote earlier emergence or development under the programme. Confidence intervals and unadjusted *P* values were calculated using two-sided *t* inference with province-clustered, finite-sample-corrected cluster-robust variance estimation (CR1; 10 provinces; 9 d.f.). Holm-adjusted *P* values were obtained by adjustment across the eight prespecified traits. Plant height was analysed using 105 complete district pairs; all other outcomes used 106 pairs.

Supplementary Table S11 | Descriptive summaries by district adoption category

a, Coverage.

District category	Treatment	Districts	Provinces	Farms	Area (ha)
Mixed adoption	Programme	106	10	26,497	477,400
Mixed adoption	Traditional	106	10	26,497	256,101
Programme-only	Programme	46	9	8,979	207,665
Traditional-only	Traditional	2	1	399	5,944

b, Descriptive district means.

District category	Treatment	Emergence (days)	Plant density (plants m−2)	Full maturity (days)	Yield (t ha−1)
Mixed adoption	Programme	4.43	641.00	238.15	10.080
Mixed adoption	Traditional	7.03	460.75	241.79	9.101
Programme-only	Programme	4.35	644.50	236.13	9.766
Traditional-only	Traditional	7.50	486.30	261.50	9.638

Notes: Farm counts are district coverage counts and repeat across treatment rows within mixed-adoption districts. Programme-only and traditional-only districts provide programme-level context; within-district contrasts are estimated from the 106 mixed-adoption districts. Yield is derived from the national administrative harvest framework in Data File 1 and is not an independent plot-level endpoint.

Supplementary Table S12 | Comparison of independently defined Ministry and FAOSTAT wheat series, 2016–2024

Year	Ministry area (Mha)	FAOSTAT area (Mha)	Area difference FAOSTAT − Ministry (Mha)	Ministry yield (t ha−1)	FAOSTAT yield (t ha−1)	Ministry production (Mt)	FAOSTAT production (Mt)	Production difference FAOSTAT − Ministry (Mt)	FAOSTAT status
2016	1.133	1.444	0.311	5.641	4.802	6.389	6.935	0.546	NA
2017	1.123	1.408	0.286	5.866	4.316	6.585	6.079	−0.506	NA
2018	1.107	1.311	0.204	5.531	4.126	6.124	5.411	−0.713	NA
2019	1.092	1.311	0.219	6.530	4.649	7.128	6.093	−1.035	NA
2020	1.078	1.352	0.274	5.755	4.556	6.202	6.158	−0.044	NA
2021	1.038	1.240	0.202	6.412	4.824	6.657	5.985	−0.672	NA
2022	1.030	1.257	0.227	6.981	4.988	7.193	6.270	−0.923	A
2023	1.011	1.229	0.218	7.047	5.266	7.124	6.472	−0.652	E
2024	1.013	1.244	0.231	8.512	5.410	8.620	6.729	−1.891	E

Notes: Differences are FAOSTAT minus Ministry. The Ministry series covers irrigated harvested area and uses the final grain-reception weight recorded through its administrative workflow. FAOSTAT values are from the Crops and livestock products series (ref. 36), andFAO recommends that cereal production be reported as clean, dry grain (ref. 37). The two series are independently defined and are not treated as nested national and irrigated components; negative production differences therefore indicate non-comparability of their absolute levels, rather than negative production from the additional area reported by FAOSTAT. No post hoc moisture or foreign-material conversion was applied because the analytical Ministry records did not contain the required year-specific inputs. FAOSTAT status codes are reproduced as reported: A, official value; E, estimated value; NA, no flag displayed in the downloaded record. Values are rounded to three decimals. Mha, million hectares; Mt, million tonnes.

Supplementary Data Files

Supplementary Data File 1 (Supplementary_Data_File_1.csv) contains the 1,953 national wheat variety-by-province records analysed for 2016–2026. Supplementary Data File 2 (Supplementary_Data_File_2.csv) contains the 260 district-by-treatment field-monitoring averages analysed for 2026.