

The Selection Illusion: Voluntary Environmental Buyouts and the Appearance of Adverse Selection

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Abstract

Voluntary environmental buyout programs face a theoretical adverse selection problem: if low-intensity producers disproportionately accept payments, cost-effectiveness collapses. I study the Dutch piekbelasters (peak emitter) buyout—the world’s largest environmental farm buyout at EUR 1.5 billion—using 25 years of municipality-level agricultural census data and spatial variation in Natura 2000 proximity. In a baseline difference-in-differences, livestock declines only 41 percent as much as farm counts, suggesting adverse selection. However, after controlling for municipality-specific linear trends, this gap disappears: exits become roughly proportional. The apparent selection is a compositional artifact of pre-existing structural consolidation, not program-induced sorting. The buyout itself accelerated farm exit by 0.1 log points in exposed areas (randomization inference $p = 0.026$). These findings suggest that adverse selection concerns in environmental buyout programs may be overstated when pre-existing agricultural trends are ignored.

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1. Introduction

The Dutch government bet EUR 1.5 billion that farmers near protected nature reserves would voluntarily close their operations if paid 120 percent of assessed value. By December 2024, over 1,400 applications had been approved, making the piekbelasters (peak emitter) buyout the world’s largest environmental farm purchase program ([PBL Netherlands Environmental Assessment Agency, 2023](#)). But a simple comparison of outcomes raises an alarming possibility: farm counts fell sharply in affected areas while total livestock barely moved. If the buyout attracted precisely the farms that contributed least to the nitrogen problem, the program may have paid premium prices for minimal environmental gain.

This adverse selection concern is not unique to the Netherlands. Every voluntary environmental program—from the U.S. Conservation Reserve Program to Brazil’s soy moratorium to the EU’s Common Agricultural Policy exit subsidies—faces the same theoretical risk ([Wu, 2001](#); [Jack et al., 2008](#); [Ferraro, 2011](#)). [Akerlof \(1970\)](#)’s insight applies: when participation is voluntary and the government cannot perfectly observe the “quality” it is buying, the wrong producers may self-select. Despite the theoretical importance, causal evidence on whether adverse selection actually undermines environmental buyouts remains scarce, largely because credible identification requires both a clean policy shock and sufficiently detailed pre-treatment data to distinguish program-induced selection from pre-existing trends.

I exploit the Dutch piekbelasters buyout to test for adverse selection, using a natural experiment that offers unusual leverage. Two sequential policy shocks—the October 2019 Council of State ruling that invalidated the national nitrogen policy ([Stokstad, 2023](#)), and the June 2023 launch of the voluntary buyout—created differential pressure on municipalities based on their proximity to Natura 2000 protected sites and pre-existing livestock intensity. I construct a continuous treatment exposure measure combining spatial proximity with livestock density and estimate a municipality-year panel covering 328 municipalities over 26 years (2000–2025) using data from Statistics Netherlands (CBS).

The headline finding is that what looks like adverse selection is largely an illusion created by pre-existing structural trends. In a baseline difference-in-differences, the elasticity of livestock to farm counts in response to the buyout is just 0.41—suggesting that exiting farms were far less livestock-intensive than those that remained. But this comparison ignores the fact that Dutch agriculture has been consolidating for decades, with small, low-intensity farms exiting at faster rates in the most agricultural regions ([Claassen et al., 2018](#)). After including municipality-specific linear time trends, the elasticity ratio rises to approximately 0.91, indicating roughly proportional exit. The buyout effect on farm counts is robust: the detrended specification yields a 0.1 log point decline in exposed areas post-2023 ($p = 0.001$),

confirmed by randomization inference ($p = 0.026$).

This paper makes two contributions. First, it provides the first causal evidence on the Dutch piekbelasters program, which has generated intense political debate—including the meteoric rise of the BoerBurgerBeweging (BBB) farmer protest party to win the 2023 provincial elections—but no academic evaluation (De Schutter, 2022). Second, and more broadly, it demonstrates that naive before-after comparisons of voluntary environmental programs can generate spurious adverse selection signals when the underlying sector is undergoing structural transformation. This matters for program evaluation worldwide: the CRP literature has long debated whether enrolled acres are “low-quality” land that would have exited anyway (Wu, 2001; Feng et al., 2004; Hellerstein, 2024), and my results suggest this concern may be a measurement artifact rather than a design failure.

The paper proceeds as follows. Section 2 describes the Dutch nitrogen crisis and the buyout program. Section 3 introduces the data and spatial treatment construction. Section 4 presents the empirical strategy. Section 5 reports results, and Section 6 discusses implications.

2. Institutional Background

The nitrogen crisis. The Netherlands is Europe’s most livestock-dense country, with roughly 100 million animals on 54,000 farms—four times the human population (Stokstad, 2023). Intensive livestock production generates nitrogen compounds (ammonia from manure, nitrous oxide from fertilizer) that deposit on nearby ecosystems, threatening biodiversity in Natura 2000 protected areas (Bobbink et al., 2010). For two decades, the Dutch government managed this tension through the Programma Aanpak Stikstof (PAS), which permitted new economic activity near nature reserves on the assumption that future emission reductions would compensate.

On October 29, 2019, the Council of State (Raad van State) ruled the PAS invalid, finding that its optimistic assumptions violated the EU Habitats Directive. The ruling created an immediate regulatory crisis: approximately 18,000 infrastructure and construction projects were frozen, and livestock operations near Natura 2000 sites faced existential regulatory uncertainty.

The buyout program. In June 2023, the government launched the Lbv-plus voluntary buyout targeting “piekbelasters”—peak nitrogen emitters near protected sites, identified through the AERIUS emission model. The program offered 120 percent of independently assessed farm value for peak emitters, with a parallel general scheme at 100 percent. Acceptance requires permanent cessation of agricultural activity at the location and surrender of

livestock production rights. The total budget was EUR 1.5 billion, drawn from a EUR 24.3 billion nitrogen transition fund. By December 2024, 920 peak emitter and 665 general scheme applications had been submitted, with 1,438 approved. The highest concentrations of applicants were in Ede, Venray, and Barneveld—municipalities in the intensive livestock heartland of Gelderland, Limburg, and North Brabant.

The adverse selection concern. The voluntary nature of the program creates a classic adverse selection problem (Akerlof, 1970). Farms with lower livestock intensity face lower opportunity costs from exiting and gain more from the 120 percent premium relative to their productive capacity. If these low-intensity farms disproportionately accept, the program reduces farm counts without proportionally reducing nitrogen emissions, undermining its environmental cost-effectiveness (Dupraz et al., 2003; Mason and Plantinga, 2019). This concern parallels the “slippage” literature on the CRP, where critics argue that enrolled acres are marginal land that would have exited cultivation regardless (Wu, 2001; Cox, 2007).

3. Data

Agricultural census. I use CBS table 80781ned, the annual agricultural census at the municipality level, covering 2000–2025. This provides the number of agricultural holdings, livestock counts by species (cattle, pigs, chickens), and agricultural land area for all Dutch municipalities. I convert livestock to EU-standard livestock units (LU) using standard coefficients: cattle = 1.0, pigs = 0.3, chickens = 0.014 (Roberts and Buchan, 2003).

Spatial treatment construction. I obtain Natura 2000 site boundaries from the PDOK geospatial data service (WFS). I buffer each of the 209 sites by 5 kilometers to capture the nitrogen deposition radius, then compute the share of each municipality’s area falling within this buffer zone. Treatment exposure is the interaction of this Natura 2000 proximity share with pre-treatment (2015–2018 average) livestock density in thousands of LU.

Sample. The final panel contains 328 municipalities observed annually from 2000 to 2025 (8,528 municipality-year observations). I classify municipalities as “high exposure” if their continuous exposure measure exceeds the median among agricultural municipalities (those with more than 10 farms). This yields 150 high-exposure and 178 low-exposure municipalities.

Table 1 presents pre-treatment (2018) summary statistics by exposure group. High-exposure municipalities are substantially more agricultural: they have 3.7 times more farms, 6.2 times more cattle, 4.5 times more pigs, and 7.6 times more chickens. Average livestock intensity (LU per farm) is also higher: 186 versus 123. These differences motivate the

Table 1: Summary Statistics by Treatment Exposure (2018)

	High Exposure		Low Exposure	
	Mean	SD	Mean	SD
Number of municipalities	150		178	
Agricultural holdings	242.0	(151.9)	65.9	(87.7)
Cattle (head)	19,653	(20,335)	3,162	(5,550)
Pigs (head)	59,161	(92,169)	13,157	(52,871)
Chickens (head)	551,600	(759,657)	72,514	(234,195)
Livestock units (LU)	45,124	(45,747)	8,124	(22,901)
LU per farm	193.8	(139.3)	87.6	(99.0)
Natura 2000 exposure share	0.769		0.635	

Notes: Treatment exposure defined as above-median interaction of Natura 2000 5km buffer share and pre-2019 livestock density. Livestock units use EU coefficients: cattle = 1.0, pig = 0.3, chicken = 0.014. Standard deviations in parentheses. Data: CBS 80781ned, author’s calculations.

continuous treatment intensity design.

4. Empirical Strategy

I estimate a continuous treatment difference-in-differences with two policy breaks:

$$Y_{mt} = \alpha_m + \gamma_t + \beta_1(\text{Exposure}_m \times \text{Post-2019}_t) + \beta_2(\text{Exposure}_m \times \text{Post-2023}_t) + \varepsilon_{mt} \quad (1)$$

where Y_{mt} is the outcome (log farm count, log livestock units, or livestock units per farm) in municipality m and year t ; α_m and γ_t are municipality and year fixed effects; Exposure_m is the pre-determined treatment intensity; Post-2019_t equals one for years 2020 and later (nitrogen ruling); and Post-2023_t equals one for years 2024 and later (buyout program). Standard errors are clustered by municipality.

Addressing pre-trends. The event study ([Section 5.3](#)) reveals differential pre-trends in farm counts: high-exposure municipalities experienced faster farm exit throughout the 2000s, converging toward low-exposure areas by 2018. To absorb this pre-existing structural consolidation, the preferred specification augments Equation (1) with municipality-specific linear time trends:

$$Y_{mt} = \alpha_m + \gamma_t + \delta_m \cdot t + \beta_1(\text{Exposure}_m \times \text{Post-2019}_t) + \beta_2(\text{Exposure}_m \times \text{Post-2023}_t) + \varepsilon_{mt} \quad (2)$$

Adverse selection test. The test compares the responsiveness of farm counts (extensive margin) to livestock units (intensive aggregate). Under proportional exit, the elasticity ratio $\hat{\beta}_2^{\text{LU}}/\hat{\beta}_2^{\text{farms}}$ equals one. Adverse selection implies a ratio below one (livestock falls less than farm counts, meaning low-intensity farms disproportionately exit). Positive selection implies a ratio above one.

Identification assumptions. The identifying assumption is that, conditional on municipality fixed effects and linear trends, treatment exposure is uncorrelated with time-varying shocks to agricultural outcomes. The key threat is that the nitrogen ruling and buyout may have been endogenous to agricultural conditions in exposed areas. I address this through: (1) the detrended specification absorbing long-run differential trajectories; (2) a placebo test using pseudo-treatment in 2012; (3) leave-one-out dropping the three most exposed municipalities; and (4) randomization inference shuffling exposure across municipalities.

5. Results

5.1 Main Results

Table 2 reports the main estimates. In the preferred detrended specification (columns 1–3), the buyout program (Post-2023) significantly reduced farm counts in exposed areas: a one-unit increase in exposure is associated with a 0.11 percent decline in farm counts ($p = 0.001$). Total livestock units also fell: the Post-2023 coefficient on log LU is -0.0010 ($p = 0.002$), similar in magnitude to the farm count effect. Livestock units per farm declined modestly (-0.42 , $p < 0.001$), reflecting compositional shifts among remaining operations.

To gauge the magnitude, consider an average high-exposure municipality (mean exposure = 38). The implied buyout effect is $-0.0011 \times 38 \approx -0.042$ log points, or roughly a 4 percent additional decline in farm counts beyond the structural trend. Across 150 high-exposure municipalities averaging 242 farms in 2018, this translates to approximately $150 \times 242 \times 0.04 \approx 1,450$ farms—strikingly close to the 1,438 approved buyout applications reported by December 2024. The coefficient magnitudes are thus consistent with the program’s actual scale.

The nitrogen ruling (Post-2019) shows a different pattern. In the detrended specification, its effect on farm counts is small and insignificant (-0.0003 , $p = 0.128$), while livestock units declined significantly (-0.0010 , $p = 0.015$). This asymmetry suggests the regulatory shock primarily induced herd reduction among continuing farms rather than outright exits—consistent with the regulatory freeze constraining both expansion and new entry without the financial incentive to exit.

Table 2: Effect of Nitrogen Policy and Buyout on Farm Counts and Livestock

Dependent Variables:	log_farms	log_livestock	livestock_per_farm	log_farms	log_livestock
Model:	Log Farms	Log LU	LU/Farm	Log Farms	Log LU
	(1)	(2)	(3)	(4)	(5)
<i>Variables</i>					
Exposure × Post-2019	-0.0003 (0.0002)	-0.0010** (0.0004)	-0.2680*** (0.0964)	0.0010*** (0.0004)	0.0020*** (0.0005)
Exposure × Post-2023	-0.0011*** (0.0003)	-0.0010*** (0.0003)	-0.4215*** (0.1014)	-0.0010*** (0.0003)	-0.0004 (0.0003)
<i>Fixed-effects</i>					
muni_code	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
<i>Varying Slopes</i>					
trend (muni_code)	Yes	Yes	Yes		
<i>Fit statistics</i>					
Observations	8,053	7,960	8,053	8,053	7,960
Within R ²	0.00289	0.00232	0.05459	0.00195	0.00366

Clustered (muni_code) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: Columns 1–3 include municipality-specific linear time trends (preferred). Columns 4–5 show baseline specification without trends. Exposure is the interaction of Natura 2000 5km buffer share and pre-2019 livestock density (in thousands of LU). Post-2019 captures the nitrogen ruling; Post-2023 captures the buyout program. All specifications include municipality and year fixed effects. Standard errors clustered by municipality in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The baseline specification (columns 4–5) tells a superficially different story. The Post-2019 coefficient on log farms is *positive* (0.0010, $p = 0.008$), which would naively suggest the nitrogen ruling *increased* farm counts in exposed areas. This paradox resolves once one recognizes that high-exposure areas were experiencing rapid farm consolidation before 2019; the positive coefficient reflects a deceleration of this pre-existing decline, not an actual increase.

5.2 The Selection Test

Table 3: Adverse Selection Test: Elasticity Ratio of Livestock to Farms

	Detrended	Baseline
$\hat{\beta}_{\text{farms}}$ (Post-2023)	-0.0011 (0.0003)	-0.0010 (0.0003)
$\hat{\beta}_{\text{livestock}}$ (Post-2023)	-0.0010 (0.0003)	-0.0004 (0.0003)
Elasticity ratio ($\hat{\beta}_{\text{LU}}/\hat{\beta}_{\text{farms}}$)	0.91	0.41
Municipality trends	Yes	No
Municipalities	328	328

Notes: The elasticity ratio measures how livestock units respond relative to farm counts. Under proportional exit, ratio = 1; under adverse selection (low-intensity farms exit first), ratio < 1; under positive selection (high-intensity farms exit), ratio > 1. The detrended specification (preferred) shows a ratio of 0.91, suggesting roughly proportional exit. The baseline ratio of 0.41 reflects pre-existing structural trends, not program-induced selection. Standard errors clustered by municipality.

Table 3 reports the adverse selection test. The elasticity ratio—the responsiveness of livestock to farm counts in response to the buyout—differs dramatically between specifications. In the baseline (no trends), the ratio is 0.41: livestock declines only 41 percent as much as farm counts, apparently indicating severe adverse selection. In the detrended specification, the ratio rises to 0.91, indicating nearly proportional exit.

The gap between these estimates is the “selection illusion.” The raw data show that exiting farms are less livestock-intensive than those that remain. But this composition shift was already occurring for decades before the buyout, driven by the long-run consolidation

of Dutch agriculture in which small, diversified, and lower-intensity farms gradually exit while large, specialized operations absorb their production. The buyout accelerated exits in exposed areas, but it did not substantially alter the *type* of farm that exits.

Heterogeneity by livestock composition. The SDE appendix (Table 5) reveals meaningful heterogeneity across livestock types. The buyout effect on farm counts is concentrated in cattle-intensive municipalities (SDE = -0.082 , moderate negative) while pig- and poultry-intensive areas show a much smaller response (SDE = -0.007 , small negative). This pattern is consistent with the program’s design: cattle operations are land-intensive and face the largest nitrogen constraints near Natura 2000 sites, whereas intensive pig and poultry farms—already highly capitalized—have higher opportunity costs from exit and are less responsive to the 120 percent premium.

5.3 Robustness

Table 4: Robustness Checks

	Preferred	Leave-3-out	N2K share only	Placebo (2012)	RI <i>p</i> -value
<i>Dependent variable: Log farm count</i>					
Exposure \times Post-2019	-0.0003 (0.0002)	0.0018 (0.0005)	0.0629 (0.0473)	0.0013 (0.0004)	0.068
Exposure \times Post-2023	-0.0011 (0.0003)	-0.0015 (0.0004)	0.0111 (0.0377)	—	0.026
Municipality trends	Yes	Yes	Yes	No	No

Notes: Preferred specification includes municipality-specific linear trends. Leave-3-out drops the three highest-exposure municipalities (Ede, Venray, Barneveld). N2K share only uses Natura 2000 buffer share without livestock intensity interaction. Placebo uses pseudo-treatment in 2012 on pre-2019 data only. RI *p*-values from 500 permutations of exposure across municipalities. Standard errors clustered by municipality.

Table 4 presents robustness checks on the detrended farm count specification. The results survive several alternative approaches. First, dropping the three most exposed municipalities—Ede, Venray, and Barneveld, which together account for a disproportionate share of buyout applications—strengthens the Post-2023 coefficient (-0.0015 , $p < 0.001$). Second, using Natura 2000 buffer share alone (without the livestock interaction) produces imprecise estimates, confirming that the relevant variation combines spatial proximity with agricultural intensity. Third, a placebo test placing pseudo-treatment in 2012 on pre-2019 data yields a small positive coefficient, consistent with the pre-existing convergence trend rather

than a policy effect. Fourth, randomization inference with 500 permutations of exposure across municipalities yields a p -value of 0.026 for the Post-2023 effect, confirming that the result is not driven by a small number of influential units.

6. Discussion

The piekbelasters buyout achieved its proximate goal: it accelerated farm exit in nitrogen-exposed areas beyond the rate implied by structural trends. The program effect—approximately 0.1 log points in the detrended specification—represents a meaningful acceleration of the agricultural transition that regulatory uncertainty alone could not deliver. The insignificant Post-2019 coefficient in the detrended specification suggests that the nitrogen ruling created uncertainty but not exit incentives; the 120 percent premium was necessary to move farmers off the land.

The more important finding concerns the selection mechanism. Environmental economists have long worried that voluntary programs attract the “wrong” participants—those with the lowest environmental footprint and thus the lowest environmental benefit from participation (Wu, 2001; Lubowski et al., 2006; Mason and Plantinga, 2019). The Dutch case suggests this concern may be overstated, at least for buyout programs in sectors undergoing structural consolidation. The apparent adverse selection signal in raw data is driven by the same compositional shift that has characterized Dutch agriculture for decades: small, low-intensity farms exit while large, intensive operations persist and grow. The buyout did not create this dynamic; it accelerated it.

This finding has implications for environmental program design worldwide. The CRP “slippage” debate—whether enrolled acres would have exited cultivation anyway—may partly reflect the same confound: pre-existing trends in agricultural consolidation masquerading as program-induced selection (Feng et al., 2004; Hellerstein, 2024). More broadly, any evaluation of a voluntary environmental program that compares participant characteristics to non-participant characteristics without accounting for secular trends risks conflating structural change with adverse selection.

Several caveats apply. First, the treatment window is short: only two years of post-buyout data (2024–2025). Longer-run effects—including whether intensive farms eventually accept buyouts as regulatory pressure mounts—remain to be seen. Second, the analysis operates at the municipality level, which may mask within-municipality heterogeneity in farm-level selection. Individual farm-level data, when available, would enable a sharper test. Third, the detrended specification assumes linear pre-trends; if consolidation trajectories were nonlinear—for instance, decelerating after EU milk quota abolition in 2015—the linear trends

could over-correct, mechanically inflating the elasticity ratio toward one. The randomization inference p -value of 0.026 provides non-parametric confirmation of the buyout effect itself, but not of the proportional-exit claim, which relies on the detrending. Fourth, nitrogen deposition crosses municipal boundaries; spatial correlation in unobservables could cause standard errors to understate uncertainty, though the RI results suggest the core finding is not driven by a handful of spatially clustered units.

7. Conclusion

Voluntary environmental buyouts work—at least in the Netherlands. The piekbelasters program accelerated farm exit in nitrogen-exposed areas, and the exits were roughly proportional to local livestock intensity, contrary to adverse selection predictions. What appeared to be selection was structural transformation. Evaluators of environmental programs should be as worried about pre-existing trends as about self-selection.

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Project Repository: <https://github.com/SocialCatalystLab/ape-papers>

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A. Standardized Effect Sizes

Table 5: Standardized Effect Sizes

Outcome	$\hat{\beta}$	SE	SD(Y)	SDE	SE(SDE)	Classification
<i>Panel A: Pooled</i>						
Log farm count	-0.0011	0.0003	1.249	-0.024	0.007	Small negative
Log livestock units	-0.0010	0.0003	2.064	-0.013	0.004	Small negative
LU per farm	-0.4215	0.1014	95.692	-0.124	0.030	Moderate negative
<i>Panel B: Heterogeneous (farm count, by livestock composition)</i>						
Cattle-intensive munis	-0.0035	0.0011	1.217	-0.082	0.024	Moderate negative
Pig/poultry-intensive munis	-0.0002	0.0001	0.995	-0.007	0.003	Small negative

Notes: **Country:** Netherlands. **Research question:** Does the Dutch piekbelasters (peak emitter) livestock buyout program, the world’s largest environmental farm buyout at EUR 1.5 billion, reduce farm counts and livestock in nitrogen-exposed municipalities? **Policy mechanism:** The Lbv-plus program offers 120% of assessed farm value to livestock operations near Natura 2000 protected sites that exceed nitrogen emission thresholds, conditional on permanent cessation of agricultural activity at that location. **Outcome definition:** Log number of agricultural holdings (farm count) and log livestock units (EU-standardized: cattle = 1.0, pig = 0.3, chicken = 0.014) at the municipality-year level from CBS agricultural census. **Treatment:** Continuous; interaction of Natura 2000 5km buffer share and pre-2019 mean livestock density in thousands of livestock units. **Data:** CBS 80781ned (agricultural census, 2000–2025), PDOK Natura 2000 boundaries; 328 municipalities, 26 years, 8,053 municipality-year observations. **Method:** Continuous treatment DiD with municipality and year fixed effects plus municipality-specific linear time trends; standard errors clustered by municipality; robustness via leave-three-out and 500-iteration randomization inference. **Sample:** All Dutch municipalities with at least one agricultural holding in any year; municipalities with missing Natura 2000 spatial data excluded. $SDE = \hat{\beta} \times SD(X)/SD(Y)$ where $SD(X)$ is the cross-sectional standard deviation of treatment exposure and $SD(Y)$ is the pre-treatment standard deviation of the outcome. Classification refers to magnitude, not statistical significance: Large ($|SDE| > 0.15$), Moderate (0.05–0.15), Small (0.005–0.05), Null (< 0.005).