



The reaction of German farmers to stricter nutrient legislation: an empirical analysis

Die Reaktion deutscher Landwirte auf die angepasste Düngeverordnung:
eine empirische Analyse

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Summary

Several EU countries have introduced a stricter nutrient legislation in recent years. In Germany, the corresponding instrument for implementing the EU Nitrate Directive, the Fertilization Ordinance (DueV) has been significantly tightened. This paper analyzes adaptation strategies among 426 German farmers to comply with the revised DueV and how these strategies correlate with farm characteristics and farmers' attitudes. The surveyed farmers primarily chose technological adaptations, followed by structural adaptations and manure relocation, while farm system conversion was rarely selected. Farmers' views on the DueV coincided with their assessment of its environmental impact and the burden it places on the farm. Our findings indicate that command-and-control instruments, such as the DueV, mostly stimulate least-cost adaptation strategies, rather than fostering transformative changes towards sustainability.

Keywords: nutrient surplus, farmers' perception, slurry, structural equation modelling, farm adaptation

Zusammenfassung

Mehrere EU-Länder haben in den vergangenen Jahren ein strengeres Düngerecht eingeführt, wobei Deutschland sein entsprechendes Instrument zur Übersetzung der EU-Nitratrichtlinie, die Düngeverordnung (DueV), deutlich verschärft hat. Dieser Beitrag analysiert die Wahl von Anpassungsstrategien bei 426 deutschen Landwirten zur Einhaltung der überarbeiteten DueV und wie diese Strategien mit Betriebsmerkmalen und Einstellungen der Landwirte korrelieren. Die befragten Landwirte entschieden sich in erster Linie für technologische Anpassungen, gefolgt von strukturellen Anpassungen und Gülleverlagerungen, während eine Umstellung des Betriebs selten gewählt wurde. Die Ansichten der Landwirte zur DueV deckten sich mit ihrer Einschätzung der Umweltauswirkungen und der Belastungen, die sie für den Betrieb mit sich bringt. Unsere Ergebnisse deuten darauf hin, dass regulative Instrumente wie die DueV meist kostengünstigste Anpassungsstrategien stimulieren, anstatt transformative Veränderungen in Richtung Nachhaltigkeit zu fördern.

Schlagworte: Nährstoffüberschuss, Wahrnehmung von Landwirten, Gülle, Strukturgleichungsmodell, betriebliche Anpassung

1 Introduction

Environmental and societal pressure, along with the need to comply with international commitments to reduce nutrient surpluses and emissions, have motivated the introduction of various nutrient-related legislations and programs worldwide (Giannakis et al., 2019; Méité et al., 2024). Several countries in Europe with long-term high nitrogen (N) surpluses and emissions, such as the Netherlands and Belgium, have faced severe N-related environmental damages and, in response, have taken action to address their “nitrogen crises” (Flanders; e.g. Stokstad, 2019).

In Germany, the national policy instrument for the implementation of the EU Nitrate Directive is the Fertilization Ordinance¹ (ger. Düngeverordnung, DueV). The DueV was introduced in 1996 to reduce nitrate pollution in groundwater from fertilizer and manure application (Hu et al., 2024). It underwent major revisions in 2017, introducing stricter nitrogen limits and mandatory buffer zones near water bodies, and in 2020, imposing stricter regulations, such as low-emission manure application techniques (e.g. trailing hose or injection of slurry) and limiting nitrogen fertilization in red zones (DüV, 2020). The detailed changes of the latest reform are shown in Table 1.

From an institutional economics perspective, the DueV is a command-and-control instrument that regulates fertilization by setting emission thresholds or target values for nutrient emissions and prescribing the allowed fertilization technologies (Méité et al., 2024). Farmers across various German regions face difficulties in adapting to the revised ordinance, particularly in livestock-intensive areas (Ivens et al., 2020).

Farmers must operate within the constraints established by the DueV or face sanctions for violations, e.g. through reduced Common Agricultural Policy (CAP) farm payments. Compared to the less regulated fertilization situation in the 1970s, each reform since 1996 has progressively restricted

farmers’ operating space (for simplification, a loss of pollution rights), and this loss causes adaptation pressure on the farms (Figure 1; for simplification, only the latest DueV reform from 2017/2020 is shown).

Farmers have different options to react upon this adaptation pressure. Possible adaptation strategies include technological adaptation (more manure processing), structural adaptation (e.g. reducing farm size, reducing livestock numbers), nutrient relocation (e.g. manure exports, relocation of farm), or farm system conversion (e.g. organic farming) (Méité et al., 2024). According to Kuhn et al. (2019) farmers primarily seek cost-minimizing strategies to comply with the DueV. However, farmers’ adaptation behavior to environmental policies can be influenced by several behavioral factors, including risk perception, social norms, and attitudes toward environmental regulations (Huber et al., 2024). Although some studies, such as Tietjens et al. (2024) have analyzed the optimal design of funding support for DueV-compatible technologies, there remains a lack of empirical knowledge on farmers’ acceptance, perception, and implementation of adaptation strategies. The objective of this paper is to empirically analyze the choice of adaptation strategies among German farmers and investigate how perceived adaptation pressure relates to farm characteristics and farmers’ perception of the DueV impacts. Specifically, we aim to address the following research questions (RQ):

- RQ1: How do farmers perceive the adaptation requirement caused by changes in the recent DueV reform?
 RQ2: How do farmers perceive the impacts of the DueV on their farm, on their knowledge, and in terms of its ecological effectiveness?
 RQ3: What is the relationship between adaptation requirements and perceived impacts?
 RQ4: What strategies are adopted by farmers to comply with the reformed DueV?

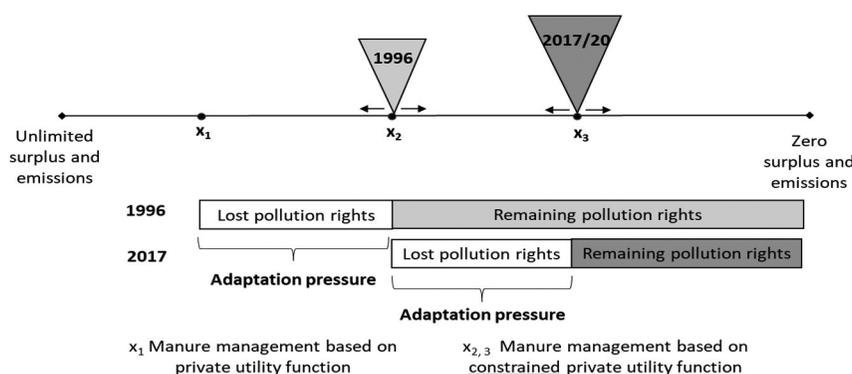


Figure 1. The interplay between tightened environmental legislation, pollution rights, and farm adaptation requirements.

¹ No official English translation of the DueV exists; synonyms used in ministerial working documents include: “Fertilizer Application Ordinance”, “Fertilizer Ordinance” or “Ordinance redefining best practice in the application of fertilizer”

2 Material and methods

2.1 Online survey

To address our research questions, we conducted an online survey among German farmers between September 2022 and April 2023, which was embedded into a larger study on the acceptance and governance of manure management practices in Germany. The survey was developed by an interdisciplinary team of social and applied researchers and implemented and executed by a professional marketing research institute. The questionnaire was structured along the following themes:

- General information on the farm
- Information on manure management
- Emission-reducing practices
- Manure processing practices
- Perceived extent to which farmers believe they need to change their practices (e.g. manure management, fertilizer application, or livestock feeding) to comply with the revised DueV (perceived adaptation requirement)
- Perception of farm situation and influence of external factors
- Future perspective of the farm
- Changes implemented in response to the DueV
- Reaction upon increasing mineral fertilizer prices
- Demographic information

The following variables were calculated for each farm:

- Average standard gross margin [Euro/ha], using average regional gross margin per crop and livestock activity².
- Livestock density [livestock units (LSU)/ha], using the total animal numbers reported in our survey and their respective livestock unit coefficient³ per the total reported farm area.

The farm production information from the survey was used to classify the farms according to the FADN general types of farming⁴ (specialist grazing, specialist granivores, specialist field crops, mixed livestock, and mixed crops-livestock).

2.2 Statistical analysis

A total of 426 farmers completed the survey. We calculated standard metrics for all farm characteristics and indicators, including mean, frequency, and standard deviation to summarize the data's central tendencies, identify patterns, and assess variability. In addition, a correlation analysis was conducted to examine the relationships between the perceived positive and negative impact of the reformed DueV and

other survey variables. All statistical analyses were performed using SPSS version 22.

2.3 Structural equation modelling (SEM)

To analyze the relation between the perceived adaptation requirement caused by the reformed DueV and the attitudes of the surveyed farmers towards the impacts of the DueV (statements in Table 1), we used structural equation modelling (SEM) with latent constructs, which are unobserved variables represented by measurable or observable variables (Hair et al., 2010).

SEM is a multivariate quantitative technique widely employed to describe the relationships among one or more observed variables by simultaneously solving systems of linear equations (Anderson and Gerbing, 1998). To test the association between the perceived adaptation requirement caused by the reformed DueV and how farmers perceive the DueV impacts, we applied a two-step approach of Structural Equation Modeling (SEM) as proposed by Anderson & Gerbing (1988). This approach involves two main stages: Confirmatory Factor Analysis (CFA), used to obtain a satisfactory Measurement Model (MM), and the development and testing of a full structural equation model (SEM). MM specifies the relationships between observed variables and their underlying latent constructs, ensuring that the indicators accurately measure the constructs (Hair et al., 2010).

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) was used to assess the MM with three latent constructs: perceived DueV adaptation requirement, perceived positive DueV impact, and perceived negative DueV impact, as shown in Table 1. The items used to measure each construct were rated on five-point scales (adaptation requirement: very high to very low; impact perception: fully agree to completely disagree). We deleted all observations with missing values in a robustness test.

Using the software AMOS (version 26), the three constructs were allowed to freely correlate, while each item was assigned to a single construct (e.g., 'DueV1' to 'DueV adaptation'). The error terms (e1 to e18) were restricted from correlating with any other items. Factor loadings were tested, with values below 0.5 removed to maintain model integrity and ensure the constructs were accurately represented by their items (Hair et al., 2010).

Following Hair et al. (2010), we used a stepwise approach with multiple indices to develop and improve the model, ensuring its validity. The model fit was evaluated with chi-square ($\chi^2/df < 5$), the Root Mean Square Error of Approximation (RMSEA < 0.08), the Comparative Fit Index (CFI > 0.90), the Tucker-Lewis Index (TLI > 0.90), and the Standardized Root Mean Squared Residual (SRMR < 0.08) (Hair et al., 2010). Convergent and discriminant validity were tested using Average Variance Extracted (AVE > 0.5) and Composite Reliability (CR > 0.7). Discriminant validity was also confirmed using the Heterotrait-Monotrait Ratio (HTMT < 0.90) (Haider and Kayani, 2021). These criteria collectively

² <https://daten.ktbl.de/sdb/welcome.do?lang=en>

³ [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Livestock_unit_\(LSU\)](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Livestock_unit_(LSU))

⁴ <https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADN-PublicDatabase.html>

Table 1: Questionnaire items used to measure each of the constructs.

Construct	Items	Corresponding statements
DueV adaptation	DueV1	Manure application limited to 170 kg/N ha
	DueV2	No manure application in fall (exception: rapeseed, barley)
	DueV3	Covered manure storage
	DueV4	Ban period for manure application/ manure storage capacities for 9 months
	DueV5	Documentation of all manure applications within 2 days
	DueV6	Rules for field application (close to soil, incorporation)
	DueV7	Fertilization requirement planning
	DueV8	Greater distance to water bodies, stricter rules on slopes
	DueV9	Reduced fertilization in „red areas” ¹
Perceived negative impact	Neg1	The reformed DueV caused a considerable increase in bureaucracy and administration work.
	Neg2	The reformed DueV has increased the workload on my farm.
	Neg3	The reformed DueV has a negative impact on yields and production.
	Neg4	The reformed DueV reduces the potential for the future development of my farm.
	Neg5	The reformed DueV causes an additional financial burden to my farm.
	Neg6	The reformed DueV (ban periods, red areas) causes farmers to orient themselves along calendar data and zones but less along plant-production and natural factors.
Perceived positive impact	Pov1	The reformed DueV contributes to reducing nitrogen emissions (ammonia, nitrate) and improving air and water quality.
	Pov2	The reformed DueV has increased my knowledge of the relation between agriculture and environmental impacts.
	Pov3	The reformed DueV supports the transition towards environmentally friendly technologies.

¹ "red areas" (ger. Rote Gebiete) in the context of the Düngeverordnung (Fertilizer Ordinance) in Germany refer to areas identified as having high nitrate levels in groundwater. These zones require stricter regulations for fertilizer application to reduce nitrate pollution and protect water quality. Farmers in these areas must follow specific guidelines to minimize environmental impact, such as reduced fertilizer usage and improved nutrient management practices.

ensured a rigorous assessment of model validity. Modification indices (MI) were examined to explore potential model improvements. Based on MI suggestions, two error terms (e7 and e8) were correlated to improve model fit. Diagnostic measures such as standardized estimates, normality, outliers, and modification indices were employed to ensure model evaluation (Hair et al., 2010). We ensured that all thresholds were met by dropping items with low factor loadings. The items, DeuV2, DeuV3, DeuV6, DeuV9, and Neg6, were excluded from the analysis due to factor loadings below 0.5.

Structural model (SM)

After obtaining a satisfactory measurement model through CFA, the structural model (SM) was run to examine the relationships between latent constructs (Hair et al., 2010). The SM estimates a set of multiple regressions and helps in understanding the relationships between constructs and testing underlying assumptions (Haider and Kayani, 2021).

Figure 2 shows the SM that was used to analyze the relationships between the perceived need for adaptation caused by the reformed DueV and farmers' attitudes towards its impact, including environmental impact, knowledge requirements, bureaucracy, or financial burden (specified in Table 1).

The following hypotheses were tested:

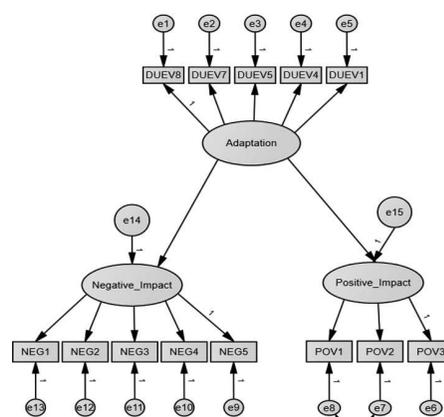


Figure 2. Structural Equation Model (SEM). Abbreviation: e means error term.

H_1 : There is a significant association between the perceived DueV adaptation requirement and the perception of the negative impacts of the DueV on the farm and the environment.

H_2 : There is a significant association between the perceived DueV adaptation requirement and the perception of the positive impacts of the DueV on the farm and the environment.

Table 2: Average perceived adaptation requirement of different changes implemented in the DueV2017/2020 reform, by farm type.

Changes implemented with the DueV 2017/2020	Specialist field crops	Specialist grazing livestock	Specialist granivores	Mixed livestock	Mixed crops-livestock	Non classifiable	All farms
Manure N application limited to 170 kg/ha	3.0	3.0	3.2	3.4	3.9	2.8	3.2
Fall manure application prohibited	2.7	2.9	2.9	2.4	2.6	4.3	2.8
Covered manure storage	3.5	3.2	3.6	3.8	3.2	2.5	3.4
Ban period for manure application/storage capacity extended to 9 months	3.1	2.7	3.2	2.1	2.9	2.8	2.9
Documentation of all fertilizer applications within 2 days	2.9	2.7	2.7	2.3	3.0	2.5	2.8
Rules for field application (near soil, incorporation)	3.5	2.9	3.6	3.2	3.2	3.0	3.2
Mandatory fertilization requirement plan	2.9	2.8	3.0	2.7	3.0	2.5	2.9
Spatial rules (distance to water bodies, slopes)	3.3	3.1	2.9	2.8	3.2	3.0	3.1
Reduced fertilization in “red” areas	3.0	3.5	3.0	3.3	4.0	3.8	3.4
Overall adaptation requirement	2.6	2.4	2.7	2.3	2.6	2.5	2.5

Scale: 1 = very high, 2 = rather high, 3 = neither high nor low, 4 = rather low, 5 = very high

3 Results and Discussion

3.1 Characteristics of the farm sample

Specialist grazing livestock farms constituted the largest group in the farm sample (43%), followed by specialist granivores (19%) and specialist field crops (19%). Mixed livestock and mixed crops-livestock farms together accounted for 18%. This diversity in farm types and characteristics provides generally a comprehensive overview of the agricultural landscape in Germany. The average farm size of the farm sample of 155 ha, indicating a tendency towards larger farms.

3.2 Perceived farm adaptation requirement

The average adaptation requirement perceived by the surveyed farms in reaction to the reformed DueV was on average 2.5 on a 5-point Likert scale (Table 2), and thus in between the scale items “rather high” (2) and “neither high nor low” (3). Mixed livestock farms perceived on average the highest adaptation requirement (2.3; Table 2).

Across the sample, the highest perceived adaptation (lowest values) was observed for manure-related rules (prohibited fall application, storage capacities), documentation of fertilizer applications within two days and the requirement to prepare a fertilization requirement plan.

3.3 Perceived impacts of the DueV

The surveyed farmers had on average a rather negative perception of the impacts of the DueV (Figure 3). The highest agreement was observed for statements of increased bureaucracy and administration work (mean: 4.6), orientation along plant production/natural factors (4.4), financial burden (4.3), and increased workload (4.2), while the knowledge and eco-

logical-effectiveness-related statements faced considerable disagreement (Figure 3).

This pattern was comparatively consistent across the farm sample, as there were no significant differences between farm types (not shown).

3.4 Perceived adaptation requirement versus perceived DueV impacts

The model estimates show standardized direct effect coefficients (β) along with their 95% confidence intervals (CI). The confidence interval reflects the degree to which our data support the model and hypotheses. If a value of zero does not appear within the CI, the effect is considered significant, and the Z values were all greater than 1.96. The results support the alternative hypotheses regarding the association between DueV_adaptation and perceived impacts. Specifically, ‘DueV_adaptation’ was negatively associated with perceived negative impact ($\beta = -0.338$, 95% CI [-0.377, -0.169]), supporting H1, and positively associated with perceived positive impact ($\beta = 0.19$, 95% CI [0.019, 0.36]), supporting H2. Both hypotheses were thus supported. The squared multiple correlation values (negative impact: 0.11; positive impact: 0.04) indicate that perceived adaptation requirements explain 11% of the variance in negative impacts and 4% in positive impacts. These results suggest that farmers who perceive a high adaptation requirement perceive the reformed DueV to have a negative impact on their farms, while those with lower adaptation requirements see the reform as having positive effects.

The SEM results indicate that the impact of DueV adaptation varies significantly across different farm types (Table 3). Mixed livestock farms are the most affected by DueV adaptation, showing the highest perceived negative and positive impacts.

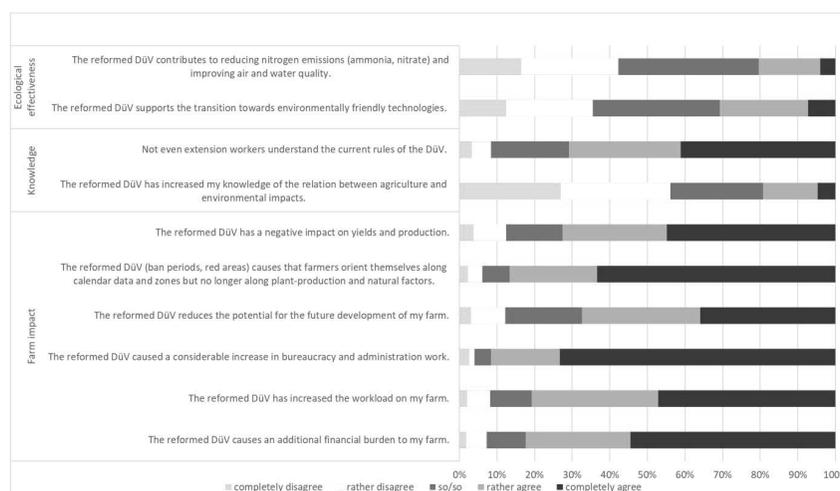


Figure 3. Proportion of farmers agreeing to statements expressing the perceived impacts of the DueV, grouped into farm-, knowledge-, and ecological effectiveness-related impacts [n=426].

Table 3: Squared Multiple Correlations (R^2)

Farm type	DueV adaptation to perceived negative impact	DueV adaptation to perceived positive impact
Specialist field crops	-0.102	0.058
Specialist grazing livestock	-0.077	0.033
Specialist granivores	-0.034	0.011
Mixed livestock	-0.486	0.300
Mixed crops-livestock	-0.254	0.012

3.5 Correlation with other variables

A correlation analysis revealed significant positive correlations between the perception of negative impacts from the DueV adaptation, and the significance attributed to several factors influencing the farm such as stricter environmental laws in general ($r = 0.386, p < .001$), increased demands towards livestock production ($r = 0.369, p < .001$), or the perceived overwhelming complexity of new demands ($r = 0.332, p < .001$) (Table A; Appendix).

Farmers with a more negative perception of the DueV tended to perceive their general farm situation worse than farms with a more positive perception of the DueV (Table A; Appendix); they perceived their market environment, opportunities for construction projects, the availability of qualified farm labour or the potential for diversification more negative and were less likely to achieve satisfactory income levels from their agricultural activities (Table A; Appendix).

The comparatively high correlations with the future potential-statements “The demands towards livestock production have generally increased” and “The complexity arising from new demands is increasingly overwhelming me” (Table A; Appendix) suggest that the negative perception of the DueV is not the isolated result of the 2017/2020 reform, but the combined effect of several negative developments and trends affecting the farms. Demographic factors were largely insignificant; low significant correlation values occurred

for the factors age (older = more negative perception of the DueV), livestock density (the lower the livestock density the better the positive perception of the DueV), and vicinity to urban areas (the closer to urban areas the more positive perception of the DueV).

3.6 Choice of adaptation strategies

Technological-organizational changes, such as changes in cropping patterns and investments in new technologies, were the most frequently mentioned strategies, followed by adaptations of farming operations and more contractual work. 23% of the farms indicated that they would reduce livestock numbers, and 7% would exit farming. Other strategies were less often mentioned. 9% of the farms perceived no adaptation requirement (Figure 4). Increased use of contractual work was often selected by crop-oriented farms, while livestock-oriented farms chose this option less often (e.g. specialist field crops: 35.08%; mixed farms: 16.7%). As regards the other technological and organizational strategies, they do not differ between farm types.

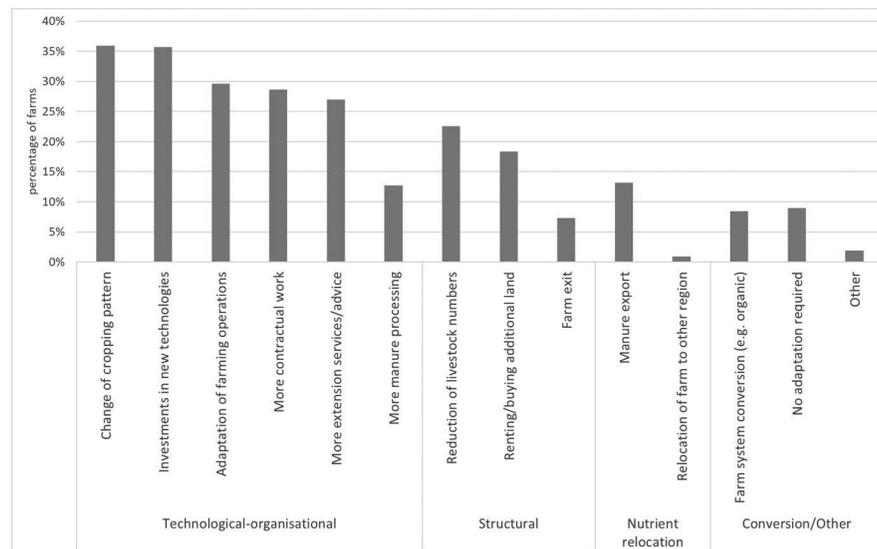


Figure 4. Choice of adaptation strategies in the farm sample [n=426].

4 Discussion

Our study shows that farmers adopted various strategies to adapt to stricter nutrient legislation, yet technological-organisational options dominated, aligning with theoretical considerations and literature (cf. Méité et al., 2024). The stricter DueV rules limit the “room of manoeuvre” of the farms, without financial compensation. Farmers selected low-cost adaptation options, some of which qualify for public investment schemes (cf. Hu et al., 2024; Kuhn et al., 2019; Schaub et al., 2023). Some of these measures are eligible for public investment schemes, e.g. through the so-called Bauernmilliarde (farmer-billion) investment program (2020-2024), which cofinances investments into DueV compatible manure field application technology, low-emission storage tanks, and solid-liquid phase separation technology.

The negative association of the DueV and the perception of negative impact suggests that farmers who perceive their operations as not compatible with regulatory standards are more likely to view the regulations as having detrimental effects on their farms. Mixed livestock farms may be more affected due to their operational complexity. Critiques raised included poor policy design and implementation, increased bureaucracy, lack of flexibility for specific farms and spatial conditions, and justice (e.g. perceived unfair zonation of red areas). These critiques align with Massfeller et al. (2022) who found that excessive paperwork and inflexible regulations hinder agri-environmental scheme uptake. Such challenges can lead to policy fatigue and adverse behavior, potentially reducing the DueV’s environmental effectiveness (cf. Schaub et al., 2023). The comparatively low percentage of variance explained by our model indicates that additional factors beyond farm compatibility influence farmers’ perceptions of environmental legislation.

Overall, our study was exploratory. Voluntary participation may have introduced self-selection bias, and our partici-

pant recruitment tended towards larger farms, common for online surveys. Online surveys typically reach rather full-time farms with younger farm managers, while having difficulties including smaller, part-time farms or farms with older farm managers, which were also not our particular focus.

5 Conclusions

Our study showed that farmers had a rather pessimistic view of the revised German Fertilization Ordinance (DueV) and its impacts. They experience high pressure to adapt, particularly due to stricter manure management rules and documentation obligations. Farmers perceived the DueV to decrease their productivity and increase their workload due to more bureaucracy. Farms with higher adaptation needs tended to perceive more negative impacts from the reform, while farms with lower adaptation needs viewed the reform more positively.

Contrary to the main goal of the DueV, to reduce the negative environmental impact of farms, the majority of the surveyed farmers disagree that DueV supports more environmentally friendly agriculture.

Although farmers adopted various adaptation strategies, technological adaptation was the most common, which is to be expected given the technological focus of the ordinance. However, this technology-focus coupled with financial support through farm modernization programs creates some path-dependency. Farmers invest into the currently prescribed “best available technologies”, take loans that they must repay over several years, thus causing them to commit to these technologies and not consider other, potentially more transformative options.

A considerable proportion of farms opted for shrinking strategies, such as reducing livestock numbers or farm exit, showing that the DueV may contribute to accelerating farm

structural change towards more intensive livestock farms and overall lower livestock numbers. The current political discourse, however, is two-fold, aiming at reducing livestock numbers for environmental reasons (GHG emissions), but also at conserving farm structures and supporting family farms. The reformed DueV appears only to be contributing to the first objective, while missing the second. Taking farmers' perceptions better into consideration could help policy makers to gain insights on the possible constraints for the affected target group, avoiding marginalizing specific subgroups and driving structural change while potentially increasing the acceptance of the DueV.

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Appendix

Table A: Correlation of perceived adaptation requirement and DueV impacts with other farm variables and statements (spearman rho; only significant correlations are shown; $p=0.05$)

Survey part	Survey statement or variable	Negative perception of DueV	Positive perception of DueV	Adaptation requirement
Adaptation requirement	Total adaptation requirement by the DueV	-.343	.169	
Perception of farm situation (very good to very bad)	Market environment	-.226	.121	.156
	Construction/building projects	-.223		.218
	Availability of qualified farm labor	-.167	.118	.204
	Availability of land for buying/renting	-.199	.178	.145
	Non-agricultural income opportunities	-.101		.172
	Funding for manure processing	-.162	.203	.109
	Potential for diversification	-.246	.154	.205
Influence of external factors on my farm (very high to very low)	Supply chain demands (quality, animal welfare)	.149		-.203
	Increase of zoonoses (e.g. African swine fever, avian flu)	.138		-.126
	Global population development	.100		
	Digitalisation (precision farming, apps)		.128	
	Innovations (e.g. cultured meat, vertical farming)			-.133
Future perspective of the farm (fully agree to completely disagree)	Stricter environmental legislation (DueV, TA-Luft)	.386	-.190	-.277
	The existence of my farm is certain in the medium run.	-.116	.103	
	I produce a reasonable income from my farm.	-.222	.195	.124
	My farm has a future perspective.	-.111		
	My farm is within its possibilities as animal friendly as possible and in alliance with nature.	.132	-.187	
	The demands towards livestock production have generally increased.	.369	-.171	-.166
	The complexity arising from new demands is increasingly overwhelming me.	.332		-.269
	The conflicts in my region with regard to agriculture and livestock production have increased.	.129		
	Livestock production continuous to play an important role in Germany in the future.	-.170		.165
	Manure processing will become a standard practice in the future.		.178	
Demographics	Age	.109		
	Livestock density		-.124	
	Vicinity to urban areas		.118	