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Toward FSDN-type sustainability monitoring: readiness and data quality risks in Ukrainian agricultural enterprises under wartime conditions

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Abstract
The Farm Sustainability Data Network (FSDN) enlarges the Farm Accountancy Data Network from economic accounting into multi-domain sustainability monitoring. Its usefulness, however, depends on whether enterprises and institutions can jointly produce data that are consistent, comparable, and trusted. We examine this problem in wartime Ukraine through 53 semi-structured interviews conducted in June–August 2025 with accounting professionals and enterprise managers from predominantly medium and large agricultural enterprises. Respondents generally did not reject sustainability reporting. They questioned whether it could be integrated into existing routines without duplicating administrative work, whether environmental indicators could be measured consistently, and whether commercially sensitive data would be protected. Preferences for voluntary or mixed participation, external technical support, cost compensation, and clear rules for data use indicate that perceived readiness is relational: it rests on the fit between enterprise capacity and the surrounding data-governance architecture. Wartime scarcity intensifies these concerns but does not alone explain them. The findings do not establish sector-wide readiness or validate a particular implementation model. They suggest that early implementation should privilege indicators with clear provenance, interoperability with existing records, transparent quality-control pathways, and credible reciprocal value for participants. Data quality, on this account, is an institutional outcome rather than a property of individual reports.

Keywords Farm sustainability data network, Farm accountancy data network, Ukraine

1 Introduction

The European Union's conversion of the Farm Accountancy Data Network (FADN) into the Farm Sustainability Data Network (FSDN) appears, at first, to be an expansion of scope: a mature economic database acquires environmental and social variables. In the present paper, we draw attention to a largely overlooked practical difficulty of implementing a FSDN-type sustainability monitoring: Each additional indicator must

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be produced through organizational routines, interpreted consistently across heterogeneous enterprises, and transferred through institutions that data providers regard as legitimate. A monitoring network can therefore become more ambitious on paper at precisely the moment when its evidence becomes less dependable. The question we want to raise is not whether sustainability deserves measurement, but how policy ambition survives the passage from indicator design to everyday data production [8, 43].

The FSDN forms part of a wider European effort to make agricultural policy answerable to environmental, economic, and social outcomes under the Green Deal, the Farm to Fork Strategy, the Biodiversity Strategy, and the evolving Common Agricultural Policy [9–11, 13, 31]. It builds on FADN, established under Council Regulation (EC) No 1217/2009, and on an existing infrastructure for harmonized farm-level economic data European Commission [14], [16, 21]. Regulation (EU) 2023/2674 formally converted FADN into FSDN, while Commission Delegated Regulation (EU) 2024/1417 specified rules for sustainability analysis and data access [19], European [12]. (In this article, ESG is used only as a broad shorthand for sustainability-related enterprise information, FSDN denotes the public statistical and policy-monitoring system.)

Prior research gives ample reason for our cautionary attitude to implementing a FSDN-type sustainability monitoring. The inherited network is already data-intensive, and extending it raises collection costs and interpretive demands [26, 54]. Indicator proliferation can obscure intended use, heterogeneous accounting and measurement practices weaken comparability; and uncertainty about confidentiality can discourage participation [29, 39, 40]. These are not separate inconveniences. Burden affects willingness to participate, ambiguous definitions invite approximation, weak interoperability multiplies manual handling, and uncertainty about downstream use encourages reticence. Data quality is thus produced at the enterprise-institution interface before any observation reaches a central database.

We doubt that digitalization may remove that dependence. Administrative registers, geospatial identifiers, and remote sensing can reduce duplication and enable cross-checking, but only when definitions, interfaces, ground truth, and responsibilities for data stewardship are sufficiently settled [32, 45, 46, 48, 50]. Existing scholarship has developed this system-level insight more fully than it has examined how prospective data suppliers themselves understand feasibility, value, and exposure. We argue, however, that it is precisely the judgments of these data suppliers that help determine both participation and the quality of what is reported.

Ukraine makes this problem unusually visible. European integration has raised the importance of FADN/FSDN-compatible monitoring, while war has shortened managerial time horizons, disrupted labor and production, and increased the sensitivity of enterprise information [2, 17, 35]. Reforms, pilot initiatives, and new legislation have begun to align agricultural statistics and governance with EU requirements, but Ukraine remains in transition rather than operating a mature FSDN system [4, 5, 20, 36, 37, 53, 55]. The wartime setting is therefore not merely a difficult backdrop. It is a stress test of whether a monitoring design can remain credible when business entities expected to provide data for the FSDN face acute constraints and heightened risk.

Against this background, we ask how Ukrainian agricultural enterprises perceive readiness for FSDN-type sustainability monitoring under wartime conditions. Three questions give this inquiry empirical form: how do enterprises situate sustainability

monitoring among their wartime policy and organizational priorities; what practical, technical, organizational and resource constraints do they associate with producing monitorable sustainability data; under what institutional and governance arrangements do they perceive such monitoring as feasible and legitimate?

Our study's contribution is to recast readiness as a relation rather than a possession. The interviews suggest that enterprises do not divide neatly into those that are ready and those that are not. Their willingness and perceived capacity depend on how indicator definitions, reporting costs, verification responsibilities, interoperability, incentives, and legal protections are arranged around them. This interpretation does not convert 53 interviews into an evaluation of national preparedness. It identifies a mechanism of implementation risk: when institutional design shifts too much of the cost and uncertainty of monitoring onto data providers, incomplete participation and heterogeneous reporting may compromise the public knowledge that FSDN is intended to create.

2 Literature review

2.1 From indicator expansion to monitorability

The literature on farm sustainability measurement has established a genuine design problem, but it often approaches that problem from the indicator outward. FSDN is expected to connect farm-level evidence with policy evaluation, benchmarking, and future incentive design. This gives indicators several masters: they must be scientifically meaningful, comparable across diverse farm systems, feasible to collect, and intelligible to users. Diazabakana et al. [8] documented the proliferation of possible farm-level measures, Poppe and Vrolijk [40], Rega et al. [41], and Robling et al. [43] show why a larger set does not necessarily produce more useful knowledge. Monitorability is therefore more demanding than formal definition. It joins conceptual clarity to provenance, collection frequency, organizational feasibility, and a credible route for verification.

The inherited FADN architecture sharpens the trade-off. Kelly et al. [26] report that the network already collects roughly 1000 variables while remaining limited in its treatment of environmental and social outcomes. Vrolijk and Poppe [54] estimate that an FSDN extension would raise collection costs per farm from EUR750 to EUR1040 and require difficult choices between resources, sample size, and scope. Pilot and implementation studies likewise report burdens associated with additional sustainability variables and uneven capacity to produce them [1, 29]. These findings invite a more critical conclusion than the familiar call for better indicators. A variable that can be defined in regulation but cannot be produced consistently in ordinary enterprise practice enlarges the reporting catalogue while diminishing the evidential coherence of the system.

This tension is clearest in the relation between practice indicators and outcome indicators. Input use or participation in an agri-environmental scheme may be recoverable from existing records, although still vulnerable to inconsistent classification. Soil condition, biodiversity, or water impacts are closer to the outcomes that policy seeks to understand, but demand additional measurement, expertise, and temporal consistency [38, 48]. Nor is the problem solved by selecting only technically capable participants. Konrad and Anderson's [28] work on monitoring networks shows why coverage and representation are part of data quality itself. In an FSDN setting, voluntary participation or capacity-dependent completion may systematically exclude precisely those enterprises whose conditions are hardest to observe. Khafagy and Dwyer [27] similarly emphasize

the importance of combining farm and non-farm micro-level data rather than assuming that one source can represent rural sustainability in full.

2.2 Data quality as an institutional outcome

FSDN scholarship commonly treats data quality as the binding constraint, but the phrase can conceal two different diagnoses which we want to distinguish. One locates error in individual records: missing values, imprecise estimates, or inconsistent accounting. The other locates it in the architecture through which records are requested, interpreted, transferred, and checked. Experience from Italy, Croatia, and other European settings points toward the latter. Limited registry integration, uneven digital maturity, and weak perceived usefulness create duplication and participation problems even where administrative capacity is comparatively developed [24, 25, 32, 50, 51]. The relevant unit of diagnosis is consequently not the farm report alone, but the chain that connects enterprise records to public use.

Participation sits inside that chain. Reporting costs may encourage superficial compliance or non-response; weakly specified rules for access and reuse may encourage strategic silence; and benefits that accrue only to regulators leave enterprises with little reason to improve the underlying information [39, 54]. Snoek et al. [48] show that data integration becomes credible only when governance, access, and intended use are defined alongside technical standards. Antonioli et al. [1] reach a related conclusion from EU certification schemes: collection is shaped by the practical costs and opportunities facing the organizations that supply data. Trust is not an ethical supplement to an otherwise technical system. Because willingness affects coverage and candor, it is one of the conditions under which the system can know what it claims to measure.

Quality assurance and quality control (QA/QC) give this relational view an operational form. Rozemeijer et al. [44] show that large monitoring systems depend on decision rules, validation routines, and procedures for handling anomalies, not on sensors alone. McCarty et al. [34] demonstrate, in a different low-resource monitoring domain, how modest digital assistance can reduce interpretive subjectivity without pretending that automation eliminates judgment. The analogy should not be overstated: water testing is not farm sustainability reporting. Its value lies in exposing a common sequence from definition to observation, validation, correction, and use. EU law offers a parallel benchmark. Regulation (EU) 2022/590 concerns regional economic accounts for agriculture, not FSDN, but its insistence on quality assessment and minimizing response burden expresses a wider statistical principle that FSDN design cannot evade [18].

2.3 Interoperability and readiness under constrained capacity

Interoperability is often presented as the release from this burden. Stable enterprise and parcel identifiers, links to administrative registers, and software interfaces can allow data to be collected once and reused. Remote sensing can supply consistent proxies for land cover, crop condition, drought stress, or soil sealing without assigning every observation to the enterprise [46, 48, 50]. Yet the promise is conditional. Registers may be incomplete, definitions may not align, and model outputs require dependable reference data. Sabo et al. [45], for example, find that yield forecasting under small-data conditions remains sensitive to the quality of statistics and satellite inputs. Digitalization can relocate uncertainty, it does not abolish it.

Ukraine's institutional setting makes the conditional character of interoperability especially important. The Ukraine Plan and the Strategy for the Development of Agriculture and Rural Areas until 2030 envisage alignment with EU agricultural policy, digital governance, and stronger monitoring capacity [4, 5]. The State Agrarian Register supplies part of the legal infrastructure, while pilot FADN/FSDN activity and EU-supported agricultural-policy reform have begun to develop the relevant administrative practices [52], European [7, 20, 36, 37]. Recent legislation and statistical work extend this trajectory [49, 53, 55]. These measures establish direction, not readiness. They leave open how enterprise records, official registers, measurement expertise, confidentiality, and feedback will be joined in practice, especially while reconstruction and future CAP alignment compete for scarce capacity [15].

The unresolved issue is therefore institutional rather than merely technical: under what arrangements will enterprises produce information that is both feasible for them and credible for public use? Our earlier study examined ESG perceptions, corporate reporting, and double materiality in Ukrainian agriculture [35]. The present research draws on a different interview sample and addresses a narrower problem: FSDN-type public monitoring, data quality, verification, and governance. It treats readiness as a property of the enterprise-institution relationship and asks what the wartime setting reveals about that relationship.

3 Materials and methods

3.1 Research design and analytical framework

This study adopts a qualitative interpretative research design to examine how agricultural enterprises in Ukraine perceive (1) sustainability reporting requirements associated with the FADN→FSDN transition and (2) their own capacity to generate monitorable, comparable, and verifiable sustainability data under crisis conditions. The study is exploratory in nature and combines qualitative interview evidence with descriptive quantitative summaries intended to support interpretation rather than statistical generalization. A qualitative approach was selected because the study focuses on enterprise perceptions, institutional expectations, implementation feasibility, and practical reporting constraints under wartime conditions, while quantitative approaches and secondary datasets are currently constrained in the Ukrainian context by fragmented ESG disclosure, the prevalence of informal practices, and limited institutional coherence of relevant national data systems.

Data were collected through semi-structured interviews, combining standardized questions (to support cross-case comparability) with open-ended probes to capture contextual mechanisms—wartime risks, resource constraints, and the practical realities of accounting, tax, and statistical reporting. This design follows established qualitative guidance on using semi-structured protocols to elicit not only whether practices exist, but also the managerial logic and institutional expectations that shape behavior [22, 33].

To align the study with a monitoring-systems perspective, we do not treat readiness as an individual attitude or a fixed stock of enterprise capabilities. We define it as a property of the enterprise-institution interface: the extent to which organizational routines, data provenance, measurement expertise, reporting incentives, and governance arrangements can jointly support monitorable, comparable, and verifiable information. Five interrelated dimensions, derived primarily from FSDN and monitoring-systems

scholarship and refined through the authors' prior research in Ukrainian agriculture, guided the questionnaire and analysis (Table 1).

These dimensions mirror common "failure points" of large-scale monitoring systems: participation and coverage bias, inconsistent indicator interpretation, weak data provenance and verification pathways, limited interoperability, and strategic under-reporting driven by trust and legal concerns. They were formalized into an analytical structure used both to design the questionnaire and to organize the results.

3.2 Data collection and sample characteristics

The empirical material comprises 53 semi-structured interviews with representatives of agricultural enterprises in Ukraine conducted in June–August 2025. Information about the study was disseminated through the professional accounting-information platform Uteka. Respondents who expressed willingness to participate were subsequently selected using purposive sampling criteria related to enterprise size, organizational form, regional context, and market orientation. Interviews were conducted by telephone, which enabled access to respondents across multiple regions amid wartime instability and logistical constraints.

The sample was built using purposive sampling to capture diversity in farm size, organizational form, regional context, and market orientation—an approach appropriate when the objective is to identify typical logics and structural constraints rather than to achieve statistical representativeness [42, 47]. Farm size (land area) was used as a key stratification criterion, consistent with the use of land area as a proxy for structural position in agricultural policy analysis [6].

The final sample comprised 34 large enterprises (> 1000 ha; 64%), 17 medium enterprises (100–1000 ha; 32%), and 2 small enterprises (< =100 ha; 4%). This composition reflects the purposive recruitment strategy and the greater visibility of business entities with formal accounting systems within the professional network through which invitations to participate in the study were distributed**.** It permits close examination of

Table 1 Typology of implementation challenges for the Farm Sustainability Data Network. Source: systematized by the authors on the basis of a literature review

Problem type	Description
Institutional	Low efficiency of use for agricultural policy at the country level and for management decisions at the farm level Insufficient feedback from farms and low farmer motivation Structural barriers, dependence of farms on subsidization
Organizational and methodological	Low representativeness of the farm sample Insufficient representation of social and environmental indicators Lack of harmonization of data collection forms and methods Limited comparability of indicators across farming sectors and countries Low communication with end users of information (advisory services, universities, scientific projects)
Technical	Risks of low data quality (manual collection, approximate estimates, different interpretations) Low level of digitalization of data collection Weak integration of the system with IACS, geosystems, LPIS, and water user registers
Financial	Insufficient financial support for data collection and a budget deficit for personnel Rising costs of collecting a complex of environmental and social indicators and for auditing ESG data
Legal	Legal barriers to data collection, storage, and use Risks associated with concentration of large volumes of data in a single set of hands Lack of guarantees of data protection

enterprises likely to encounter FSDN-style reporting, but it does not represent the size distribution of Ukrainian agriculture. In particular, the two small-enterprise interviews cannot support comparisons or conclusions about small farms, whose recording practices and constraints may differ substantially [24].

Respondents were selected based on their involvement in enterprise management and reporting systems, including chief accountants (49%), accountants (25%), directors/heads (19%), and other specialists (7%) (Table 2). Chief accountants were particularly relevant informants because FSDN-type sustainability monitoring depends heavily on accounting routines, reporting workflows, documentation practices, and the integration of enterprise-level data into external statistical and reporting systems. Interviews typically lasted 45–60 min and followed a unified semi-structured interview form that combined closed-ended questions for comparability with open-ended questions to capture reasoning, constraints, and contextual nuance. Interviews were conducted in Ukrainian. Responses were documented directly in structured interview forms, including scaled responses, written summaries, and direct quotations. Selected quotations were translated into English by the authors for publication purposes.

3.3 Questionnaire structure and operationalization of key constructs

The interview protocol was designed to elicit evidence relevant to both (1) the feasibility of enterprise-level sustainability reporting and (2) the monitoring-system properties that determine whether FSDN data can be used for policy evaluation and environmental assessment.

The questionnaire followed the five analytical blocks (Table 1) and included:

- Closed items capturing priorities, expectations, and preferences using ordinal/Likert-type scales (typically 1–5), Likert [30] enabling structured comparison across enterprise types;
- Categorical questions capturing governance preferences (e.g., voluntary vs mandatory collection; distribution of measurement/verification responsibilities). As the FSDN framework in Ukraine is still emerging, responses on voluntary versus mandatory participation reflected broader sustainability-reporting expectations;

Table 2 Key characteristics of the sample of agricultural enterprises. Source: developed by authors based on interview data

Criterion	Category	Quantity	Share (%)
Size of enterprise (hectares)	Large (over 1000)	34	64
	Medium (100–1000)	17	32
	Small (up to 100)	2	4
Region	Center	31	58
	East	12	23
	North	5	9
	South	4	8
	West	1	2
Specialization	Cereals, technical crops	23	43
	Cereals, legumes	21	40
	Other	9	17
Respondent's position	Chief accountant	26	49
	Accountant	13	25
	Director, head	10	19
	Other	4	7

- Open questions eliciting explanations of constraints, perceived risks, and conditions under which participation becomes realistic and valuable.

Table 3 summarizes how specific items were coded. For example, institutional expectations were captured through (1) a 1–5 importance rating of policy priorities and (2) categorical expectations about the role of the state; organizational feasibility was captured through governance preferences (voluntary/mandatory/mixed) and perceived obstacles; technical feasibility was elicited through preferences over who should measure/verify indicators; resource feasibility through preferences for outcome- vs process-based incentives; and regulatory feasibility through stated concern about reputational risks and legal exposure. (See Table 3 for the full coding scheme.)

We treat responses as evidence about monitoring readiness along four practical axes that cut across the five analytical blocks:

1. *Data provenance*: whether enterprises can trace indicators to consistent internal records (accounting, production logs) versus ad hoc estimates;
2. *Comparability*: whether enterprises perceive indicator definitions as unambiguous and transferable across farm types;
3. *Verification pathway*: who is seen as responsible and credible for measurement/audit (state, consultants, mixed arrangements);
4. *Digital transferability/interoperability*: the perceived ability to exchange data with registers and/or integrate remote-sensing or geospatial identifiers without disproportionate manual burden.

These practical dimensions were used as cross-cutting interpretative elements, while the five analytical blocks remained the primary organizational framework for questionnaire

Table 3 Analytical structure of the questionnaire and data coding scheme. Source: developed by authors based on interview data

Analytical theme	Questionnaire item	Coding
1. Institutional context	Priorities of state policy in the agricultural sector	Likert scale 1–5: 1 = not important at all … 5 = very important
	Role of the state in stimulating ESG practices	Role: 0 = no answer; 1 = incentives; 2 = mandatory reporting; 3 = measurement instruments; 4 = private sector; 5 = active role
2. Organization and methods of data collection	Organization of the collection and disclosure of enterprise's ESG data	Organization: 1 = voluntary; 2 = mandatory; 3 = mixed
	Why should ESG data collection and reporting be organized in this way?	Rationale: 1 = level playing field; 2 = market usefulness; 3 = voluntary quality; 4 = minimization of burden; 5 = lack of technologies; 6 = transition period
3. Technical capacity of the system	Who should measure and verify ESG indicators in agriculture?	Authority: 1 = enterprises or farmers; 2 = the state; 3 = consultants and researchers; 4 = all
4. Resource provision	Should public support reward outcomes or the work undertaken to achieve outcomes?	Orientation: 0 = process-based; 1 = result-based; 2 = process- and result-based; 3 = market-based reward
	Why should public support in agriculture be organized in this way?	Rationale: 1 = resource support; 2 = incentivizing results; 3 = reduction of bureaucracy; 4 = control and transparency; 5 = preferential incentives; 6 = innovation
5. Regulatory conditions	What is of greater concern: risks to the enterprise or the enterprise's impact on others?	Concern: 0 = impact on others; 1 = risks to the enterprise; 2 = both aspects

design and results analysis. They guided the thematic coding and the interpretation of "implementation gap" mechanisms in the Results and Discussion sections.

3.4 Data analysis

Analysis combined descriptive statistical processing of structured responses and interpretative analysis of open-ended narratives. The analysis combined deductive and inductive coding approaches. Deductive coding was initially guided by the predefined analytical blocks embedded in the questionnaire structure, while inductive coding was applied to identify recurring themes and emergent response patterns arising from the open-ended interview material.

Closed items were coded as ordinal or non-binary variables and summarized using descriptive statistics to identify patterns by enterprise size and respondent role. The purpose of these summaries was not inferential generalization, but to provide a compact representation of tendencies in priorities, governance preferences, and perceived feasibility across the purposive sample. Accordingly, subgroup comparisons and percentage-based summaries should be interpreted as exploratory and illustrative rather than representative.

Open-ended responses were analyzed using inductive thematic analysis, appropriate for contexts where formalized practices are uneven and where contextual constraints (e.g., wartime risks) materially shape reporting behavior [23]. Coding focused on recurrent meanings and mechanisms relevant to monitoring-system performance: (1) perceived costs and benefits of data provision, (2) practical bottlenecks in measurement and documentation; (3) definitional ambiguity and comparability concerns; (4) trust, confidentiality, and perceived legal exposure; and (5) preferences for governance arrangements that could increase participation and data reliability. Structured coding matrices and thematic comparisons were organized using Microsoft Excel. The thematic structure and coding logic are summarized in Table 3.

3.5 Analytical reliability, ethics, and limitations

Analytical reliability was supported through coherence between (1) the semi-structured interview design, (2) the coding logic, and (3) interpretation aligned to the five-block framework. Following qualitative thematic analysis guidance, inductive coding was used as an interpretative tool to systematize managerial meanings rather than as a purely mechanical classification exercise [3]. This approach helped preserve the link between responses and the institutional/wartime context that shapes feasible reporting behavior and monitoring credibility.

Coding and interpretation were conducted collaboratively by the three researchers. They periodically compared their readings of the interview material, discussed ambiguous responses and category boundaries, and maintained structured analytical notes. Disagreements were resolved through discussion and consensus. Later interviews yielded few substantively new themes within the recruited sample, although this pattern should not be taken to imply saturation across the wider and more heterogeneous population of Ukrainian agricultural producers. Quotations in the Results section were selected to illustrate recurrent themes, contrasting perspectives, and viewpoints across enterprise-size categories.

Ethical safeguards were implemented through: voluntary participation, anonymization of respondent identities in reporting (e.g., "Respondent 18, Large, East"), and secure storage of interview notes and coded materials. Given wartime conditions and the sensitivity of enterprise data governance, the protocol avoided collecting confidential operational identifiers not required for analysis, and emphasized that participation concerned perceptions, constraints, and feasibility conditions rather than disclosure of proprietary data. The study was conducted in accordance with the principles of the Declaration of Helsinki (2013, as amended). Informed consent was obtained from all participants prior to the interviews. Participation was voluntary, and respondents could withdraw at any time without consequences. Gender-related data were not collected because the research questions concerned organizational reporting roles rather than individual-level characteristics.

Several limitations define what can be inferred. First, recruitment through a professional accounting-information platform and voluntary response are likely to favor enterprises that are more digitally connected, administratively formalized, and interested in reporting questions. The sample is therefore not statistically representative of Ukrainian agriculture and may understate the difficulties faced by less formalized enterprises. Second, 51 of the 53 enterprises are medium or large; the two small-enterprise interviews cannot sustain claims about size differences. Third, chief accountants and accountants constitute most respondents. Their proximity to reporting systems is analytically valuable, but it may privilege administrative burden, documentation, and legal exposure over the perspectives of production staff, workers, environmental specialists, smallholders, or public officials. Fourth, the five-block framework structured both the protocol and the analysis and may have made some concerns more visible than others, notwithstanding the inductive treatment of open responses. Fifth, the study records perceptions and reported practices at one point in a rapidly changing wartime and accession context. It neither audits actual sustainability data nor tests whether a proposed governance arrangement would improve participation or quality. Telephone interviews and the absence of access to some territories further narrow contextual depth. The findings should thus be read as an analytically grounded account of perceived implementation mechanisms within this purposive sample, not as a national readiness assessment or a forecast of FSDN performance.

4 Results

The results are organized into the five analytical blocks used in the interview protocol. Figures 1, 3, 5, and 6 summarize structured responses; Figs. 2, 4, and 7 synthesize explanations given in the more open parts of the interviews. Counts, percentages, quotations, and interpretive themes are used together, but they carry different evidential weight. Subgroup patterns, especially those involving the two small enterprises, are descriptive only, and respondent accounts are not independently verified evidence of sector-wide practices.

4.1 Institutional constraints on the implementation of FSDN in the agricultural sector

Respondents primarily framed state agricultural policy as a means of sustaining rural areas and production under wartime uncertainty. Rural development/employment and food security received the highest average ratings. Environmental and social

Indicator / Size	Rural development / employment	Food security	Production and productivity growth	Environmental and social sustainability	Innovation and digitalization
Average	4,66	4,57	4,40	4,32	3,87
Small (n=2)	5,00	5,00	4,50	2,50	4,50
Medium (n=17)	4,82	4,76	4,24	4,53	4,00
Large (n=34)	4,56	4,44	4,47	4,32	3,76

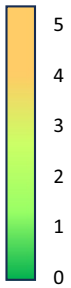


Fig. 1 Priorities of state policy: average evaluation by enterprise size (mean values on a 1–5 Likert scale; subgroup sizes shown in labels; color intensity reflects higher mean evaluation scores). *Source:* developed by authors based on interview data

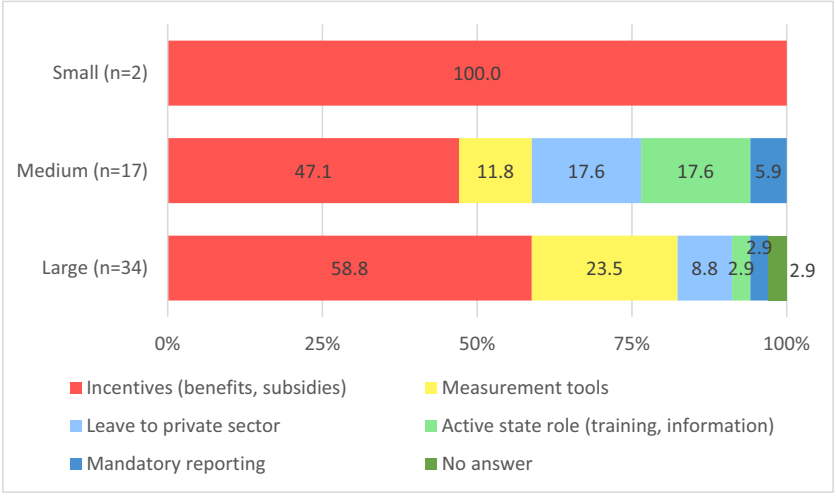


Fig. 2 Role of the state in promoting ESG-practices (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

sustainability also received a high mean in the sample (4.32), although it was ranked below the first three priorities; the 2.50 mean among the two small enterprises is reported descriptively and should not be interpreted as a group difference. The pattern suggests that sustainability measurement is more likely to command managerial attention when it can be connected to employment, production continuity, or support instruments (Fig. 1).

As the respondents noted:

> *During the war, social factors are the most important. First of all, it is necessary to create conditions for workers and to develop infrastructure in villages so that people want to live in rural areas. Then there will be people to work, and there will be economic development in agriculture.*
> *(Respondent 18, Large, East)*
> *The state should create conditions so that enough wheat remains in Ukraine and there is no threat of hunger. Many crops are lost due to frost, drought, and fires caused by shelling.*
> *(Respondent 7, Medium, Center)*

Expectations toward the state follow a similar logic. Financial incentives were the most frequent preference among medium enterprises (8 of 17; 47.1%) and large enterprises (20 of 34; 58.8%), and were selected by both small-enterprise respondents. In the interviews, this preference was connected to the allocation of wartime risk and transition costs rather than to rejection of measurement or training (Fig. 2).

Respondents explained this preference in wartime terms:

> *Weather conditions and the war create obstacles for enterprises that are in the process of transitioning to new technologies … They become very vulnerable and require state financial support in order to complete the transition and achieve results.*
> *(Respondent 5, Large, Center)*
> *State financial and informational support is needed at all stages of the implementation of sustainable practices … but without effective measurement instruments this process will be complicated.*
> *(Respondent 10, Medium, East)*

4.2 Organizational and methodological challenges of FSDN data formation

Respondents did not generally reject sustainability indicators; they questioned the terms of participation. Voluntary reporting was selected by both small-enterprise respondents, 12 of 17 medium enterprises (70.6%), and 18 of 34 large enterprises (52.9%). Mandatory reporting was selected by 3 medium (17.6%) and 4 large enterprises (11.8%). The structured responses indicate a preference for discretion, while the open comments connect that preference to unequal capacity, proportionality, and the risk of uniform requirements across heterogeneous enterprises (Fig. 3).

The preference was expressed in terms of both capacity and comparability:

> *Data collection should be voluntary so that it does not become pressure on those who do not have the capacity to produce new reports.*
> *(Respondent 26, Large, Center)*
> *ESG-data tables should to the maximum extent take into account sector-specific characteristics of enterprises' activities … and take into account their size. These*

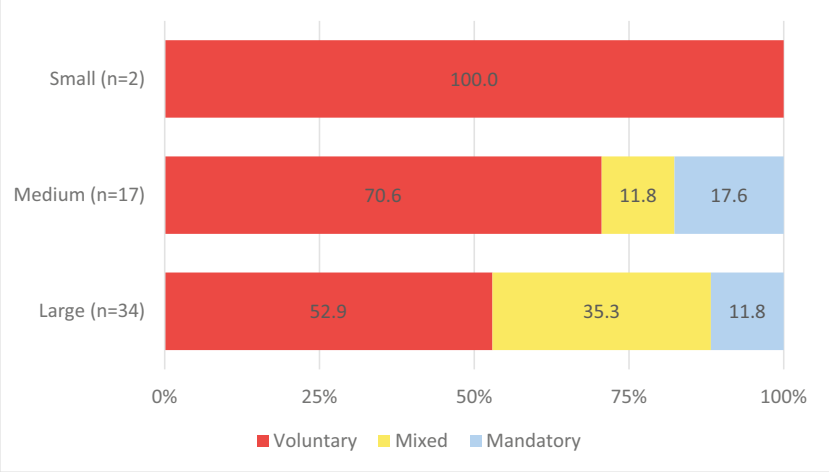


Fig. 3 Organization of enterprise-level ESG data collection and disclosure (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

data should fully meet the needs of users … (public authorities, banking institutions, counterparties).
(Respondent 22, Large, Center)
Reporting should be based on actual data and indicators, and its format should allow the company's results to be compared with other companies in the sector.
(Respondent 33, Large, North)

Minimizing administrative burden was the most frequent rationale among large enterprises (16 of 34; 47.1%) and was also selected by 5 of 17 medium enterprises and 1 of the 2 small enterprises. Other comments called for a transition period and alignment with existing reporting circuits. The evidence therefore supports gradual integration more clearly than immediate standardization (Fig. 4).

The preference for gradualism was expressed plainly:

Reporting should be voluntary for small and medium-sized businesses and mandatory for large agroholdings, with the possibility of online submission.
(Respondent 17, Large, East)
Some kind of transition period is needed so that we can prepare and bring our already collected ESG indicators into compliance.
(Respondent 10, Medium, East)
The best format of ESG data is a small report with specific indicators without appendices.
(Respondent 43, Medium, Center)

4.3 Technical barriers to data quality and integration

Respondents associated data-quality risk with manual collection, uneven expertise (particularly for environmental measures), and inconsistent interpretation of indicators. They also described fragmented sustainability information across statistical, tax, environmental, and agricultural reporting systems. These observations concern perceived

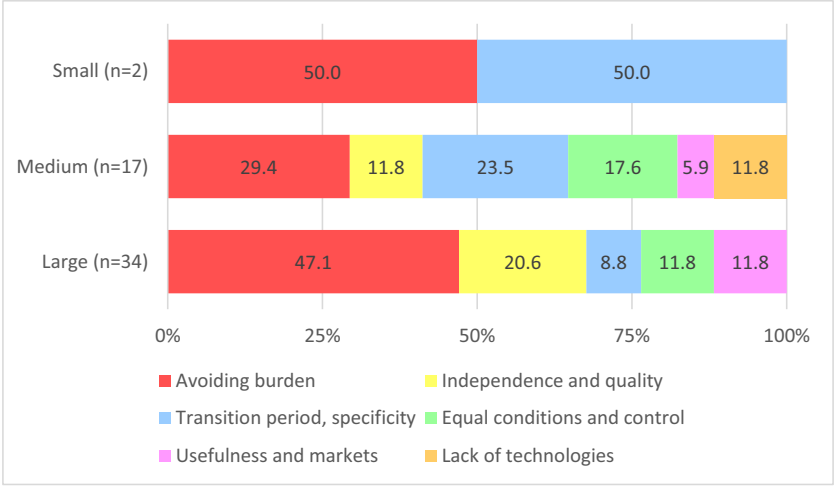


Fig. 4 Rationale for the preferred organization of ESG data collection and reporting (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

capability and system integration; the study did not audit the completeness or accuracy of the underlying records.

At the same time, many respondents show limited confidence that state registers and administrative systems can reduce burdens through automation. This is reflected in preferences regarding who should measure and verify ESG indicators: only 1 of 17 medium enterprises (5.9%) and 2 of 34 large enterprises (5.9%) assign this function primarily to the state, while consultants/researchers are preferred by 1 of 2 small enterprises, 7 of 17 medium enterprises (41.2%), and 17 of 34 large enterprises (50.0%). These preferences differ by enterprise size (Fig. 5).

Respondents often assigned measurement to actors with specialized expertise:

> *Measurement and data collection should be carried out by competent … consultants. Farmers and entrepreneurs do not know how to do this, and training requires time.*
> *(Respondent 3, Medium, Center)*
> *It is best when farmers, enterprises, the state, consultants, and academia interact with each other, where everyone contributes their value and in a certain way influences ESG indicators in agriculture: farmers or enterprises provide primary data, researchers develop methodological guidelines, and the state stimulates better results and establishes certain rules.*
> *(Respondent 19, Large, South)*
> *Farmers should have the opportunity to carry out ESG data collection with the support of researchers, in a format that would be suitable for automated processing of reporting data.*
> *(Respondent 23, Small, North)*

4.4 Financial and human resource constraints on the expansion of FSDN

Financial and staffing constraints were repeatedly described as barriers to FSDN participation. Respondents treated sustainability-data collection as additional work requiring time, skills, and money at a moment of labor scarcity and wartime uncertainty. Their accounts therefore returned to the distribution of transition costs.

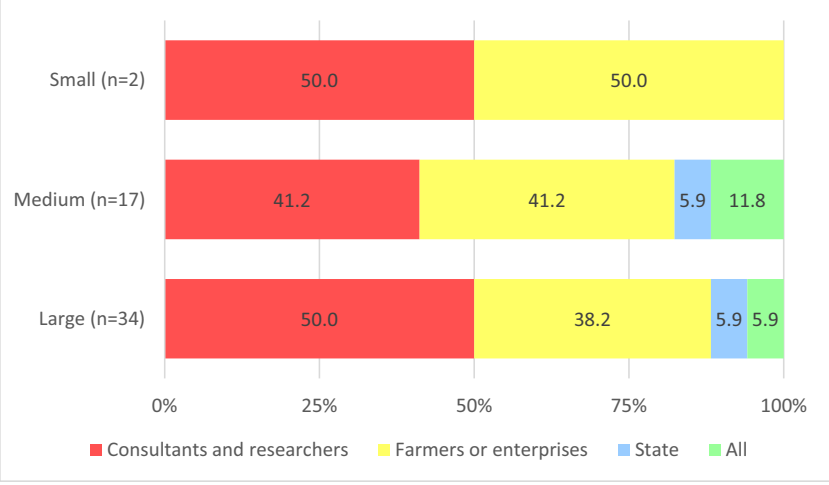


Fig. 5 Who should measure and verify ESG indicators? (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

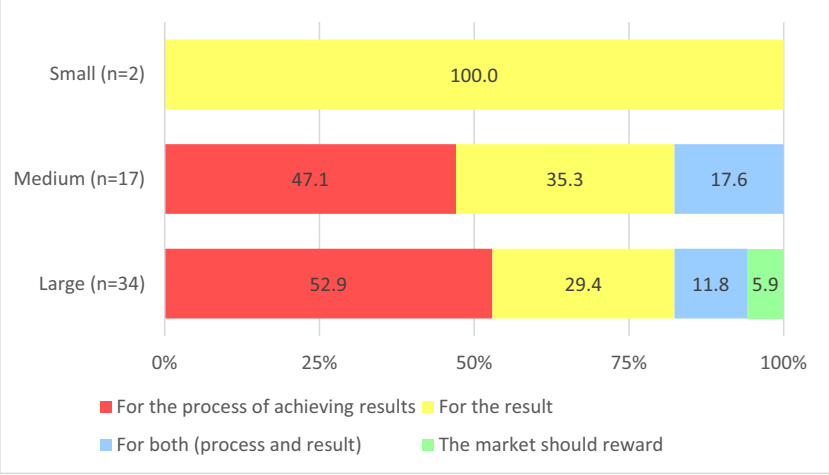


Fig. 6 Direction of state support (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

Small enterprises unanimously support public support tied to achieving results, whereas among medium and large enterprises, preferences tilt toward compensating the work undertaken to reach outcomes (8 of 17 medium enterprises (47.1%) and 18 of 34 large enterprises (52.9%), respectively), indicating reluctance to self-finance sustainability transitions without cost recovery. This distribution reflects differing expectations regarding the appropriate focus of public support (Fig. 6).

The following accounts connect reporting capacity to measurable support and labor scarcity:

> *Under conditions of war, public support for the agricultural sector cannot be provided exclusively to those who implement sustainable practices. However, … if this is one type of public support, then … it should … reward results. The indicators of such results should be clearly … measurable in order to minimize abuse and corruption. (Respondent 46, Medium, North)*
>
> *At present, we have a problem … with recruiting workers. Young people do not want to work or do not know how. The existing workers are ageing, and we have no replacement. Many people have also left because of the war. Mobilization also negatively affects staffing. In addition, new workers need to be trained. (Respondent 4, Large, Center)*

Respondents most often justified support in terms of resources and a level playing field (1 of 2 small enterprises, 5 of 17 medium enterprises, and 15 of 34 large enterprises). Nine medium enterprises emphasized incentives for measurable results. These categories are not mutually explanatory, but they show that the legitimacy of monitoring is judged partly through how its costs and rewards are distributed (Fig. 7).

One respondent connected financial support to the quality of public administration:

> *State financial support is a primary necessity, but … establishing high-quality public governance … without excessive bureaucracy … is also an important issue. Enterprises should not have to fight on their own with all authorities, not try to survive … Then it will not be frightening or risky to introduce new technologies and try innovative methods.*

(Respondent 51, Medium, East)

4.5 Legal risks and trust in the data collection system

The legal and trust block concerned perceived risks of disclosure and downstream use of ESG information. Risks to the enterprise were selected by 12 of 17 medium enterprises (70.6%) and 20 of 34 large enterprises (58.8%), whereas 3 medium and 5 large enterprises selected concern about the enterprise's impacts on others. Within this purposive sample, the structured responses direct attention to organizational vulnerability and survival; they do not establish a general absence of outward responsibility in Ukrainian agriculture.

Disclosure was therefore described conditionally:

We are ready to disclose ESG data provided that this does not violate business confidentiality and on the condition that it contributes to … access to financing. At the same time, it is important to have clear criteria regarding which data are being requested and for what purpose.
(Respondent 36, Medium, East)
We need to understand exactly which data are required and how they will be used in order to ensure the protection of confidential information.
(Respondent 19, Large, East)

5 Discussion

The interviews reveal a tension that an indicator-centered account of FSDN cannot fully explain. Public policy values the network for the knowledge it could produce: comparable evidence for agricultural policy, environmental assessment, and Ukraine's accession preparations. Respondents encountered the same prospective system from the other side, as a possible duplication of reporting, a demand for expertise they did not always possess, and a new channel through which sensitive information might travel. These views do not invalidate the public purpose of FSDN. They show that the credibility

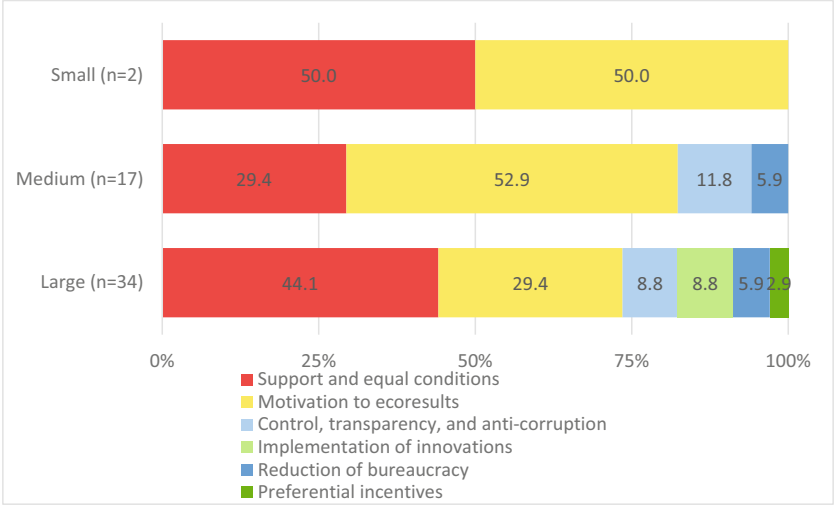


Fig. 7 Justification of the direction of state support (percentages are calculated within each enterprise-size subgroup; subgroup sizes shown in labels). *Source:* developed by authors based on interview data

of that purpose depends on how monitoring is translated into current organizational practice.

5.1 Monitoring readiness as an institutional relationship

Four findings sustain this interpretation. Respondents ranked food security, employment, and production highly; preferred voluntary or mixed participation and a transition period; assigned measurement and verification mainly to consultants or collaborative arrangements rather than the state alone; and linked disclosure to financial support, confidentiality, and usable benefits. Sustainability was not simply refused. It was accepted conditionally, when measurement appeared proportionate, intelligible, and connected to the enterprise's own continuity. This qualifies an easy reading of wartime priorities as short-term resistance. The more precise issue is a mismatch between the public use imagined for FSDN and the costs, capabilities, and risks experienced where data originate.

The relational view changes how data quality is understood. Existing research rightly identifies cost, missing environmental and social variables, fragmented sources, and limited comparability as obstacles [26, 40, 43, 54]. Our evidence suggests a sequence connecting them. When definitions demand expertise that enterprises lack, approximation becomes more likely. When reporting duplicates existing circuits, completion becomes more burdensome. When access and use are unclear, candor becomes less attractive. Error, non-response, and strategic reticence may therefore be produced by the institutional arrangement rather than discovered as defects in individual farms. Data governance is, in this limited but important sense, an epistemic condition of monitoring.

This inference also exposes a visibility paradox. A comprehensive system is intended to make heterogeneous agriculture more legible to policy. If early participation and complete reporting are easiest for enterprises with formal accounting, staff, and digital infrastructure, the resulting network may see the best-resourced part of the sector most clearly. Conversely, imposing uniform obligations before measurement and support capacities exist may yield nominal coverage but heterogeneous data. Our sample cannot estimate either selection effect; indeed, its own dominance by medium and large enterprises illustrates the limit. The mechanism is nevertheless consistent with respondents' concerns and with research on participation, burden, and representation [28, 39].

5.2 What the wartime setting adds

War intensifies scarcity, labor loss, risk aversion, and managerial attention to survival [35]. It would nevertheless be too convenient to treat every reported obstacle as temporary. Duplication, uncertain definitions, weak interoperability, and mistrust also appear in better-resourced European settings [32, 43, 50]. Ukraine's contribution is therefore not an exotic list of additional barriers. The setting makes the dependence of monitoring quality on institutional fit unusually visible. Crisis compresses the margin for badly coordinated reporting and reveals which parts of the architecture are doing substantive work: provenance, verification, reciprocal value, and legal clarity.

The argument remains bounded. The interviews establish how respondents perceive implementation and why particular arrangements appear feasible or risky to them. They do not show how enterprises would behave under an operational FSDN, whether their fears would materialize, or which governance model would maximize data quality. Nor

can the study separate the effects of war from longer-standing institutional conditions. Its contribution is analytical rather than evaluative: it identifies a plausible pathway through which institutional design can shape participation and reported quality, and it specifies where future pilots should look for confirming or disconfirming evidence.

6 Policy implications

The policy implications that we formulate here follow from the reported mechanisms, not from a trial of alternative FSDN designs. Across the interviews, participation was connected to burden, specialized expertise, compensation, confidentiality, and practical value. We accordingly suggest that the initial policy question should therefore be narrower than the construction of a complete sustainability catalogue: which observations can enterprises and public institutions presently produce with sufficiently clear provenance, limited interpretive discretion, and a credible route to validation?

An initial reporting layer could draw primarily on fields already present in accounting records, operational logs, and administrative registers. Its purpose would be to stabilize definitions and data flows, not to claim complete measurement of sustainability. More demanding observations, such as soil condition, nutrient balances, or biodiversity proxies, should enter only when measurement responsibility, frequency, and validation are specified. Remote sensing and modeled estimates can reduce enterprise burden for some land-based indicators, but they require ground truth and transparent uncertainty rather than being treated as substitutes for local information [45, 46].

Quality control belongs inside this sequence from the outset. Controlled definitions, automated plausibility checks, and selective cross-source verification can reduce interpretive drift; risk-based follow-up can limit costly audit requirements to cases involving significant anomalies, thereby reducing the financial burden on enterprises.

The lesson from other monitoring domains is modest but useful: workflows and error-handling rules must mature with measurement technologies [34, 44]. Interoperability should serve the same end. A 'collect once, use many times' principle is credible only if identifiers, formats, access rights, and institutional responsibilities align across tax, statistical, environmental, and agricultural systems.

Participation design presents a harder choice. Purely voluntary reporting may favor enterprises already equipped to comply; undifferentiated mandates may produce formal completion without comparable substance. The interviews support a staged or mixed arrangement in which less-equipped participants receive simpler templates, technical assistance, and proportionate compensation, while all participants receive clear statements of purpose, differentiated access rights, and useful feedback. These are propositions for piloting, not conclusions about an optimal national model. Their value should be judged by observable effects on coverage, missingness, consistency, correction rates, and participants' willingness to disclose.

7 Conclusions

We examine how a purposive sample of Ukrainian agricultural enterprises understood readiness for FSDN-type sustainability monitoring under wartime conditions. Respondents did not generally reject sustainability measurement. They located its feasibility in the arrangements surrounding it: whether indicators could be recovered from existing routines, whether specialized measurement and verification were available, whether

reporting costs were recognized, and whether data would be protected and returned in a useful form. Readiness, on this evidence, is less a threshold that individual enterprises cross than a relationship that institutions must make workable.

This conclusion is deliberately limited. The interviews capture perceptions, not audited reporting behavior; the sample is dominated by medium and large enterprises and cannot represent Ukrainian agriculture as a whole; and the study does not test an operational FSDN or isolate the effects of war. It nevertheless clarifies why indicator ambition and data quality cannot be separated. If demands expand faster than provenance, interoperability, expertise, and trust, a formally comprehensive network may acquire incomplete participation and internally uneven evidence.

We suggest that for Ukraine, a prudent implementation path would begin with a narrow, verifiable core; build quality control and legal safeguards into the data flow; and expand only as pilots show that coverage and comparability can be preserved. The deeper implication reaches beyond the wartime case. Sustainability monitoring becomes a public knowledge infrastructure only when the organizations being rendered visible can participate without surrendering the practical conditions under which reliable knowledge is made.

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Author contributions
V.M., V.V., and T.G. wrote the manuscript text. All authors reviewed the manuscript.

Data availability
The interview data supporting the findings of this study are not publicly available due to confidentiality and sensitivity considerations but may be made available from the corresponding author upon reasonable request and subject to ethical and legal restrictions.

Declarations

Ethics approval
The study received ethical approval from the Ethics Committee of the Leibniz Institute of Agricultural Development in Transition Economies (IAMO, Halle (Saale), Germany). The research protocol was approved in accordance with the institutional ethical guidelines and regulations and with the principles of the Declaration of Helsinki.

Consent to participate
Informed consent to participate in the study was obtained from all participants prior to the interviews. Participation was voluntary and respondents could withdraw at any time without consequences.

Consent for publication
All participants provided informed consent to participate and to the publication of anonymized research results. No personally identifiable information is included in this manuscript.

Competing interests
The authors declare no competing interests.

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