ENVIRONMENTAL AWARENESS AND PARTICIPATION INTENTIONS IN MOLDOVA'S DEPOSIT RETURN SYSTEM

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The effectiveness of Deposit Return Systems (DRS) as tools for promoting circular economy largely depends on the degree of public participation. This study investigates the impact of consumer awareness regarding the environmental and economic benefits of DRS on their intention to participate, focusing on the context of the Republic of Moldova. Drawing on data obtained from a structured questionnaire administered to 608 respondents, the study empirically tests the hypothesis that awareness of the refund value, understanding of system operation, and perceived environmental benefits have a statistically significant effect on participation willingness in the Deposit Return System (DRS). The statistical analysis, conducted through multiple linear regression confirms significant effects of information level, environmental perception, and perceived barriers on participation intentions. However, results also show that participants prioritize operational clarity and economic aspects over environmental motivations. This discrepancy suggests that while consumers recognize the ecological value of DRS, their behavior is driven more by pragmatic considerations. Findings highlight the importance of comprehensive educational and communication strategies that articulate both environmental impact and practical benefits. The study contributes to the behavioral literature on sustainable waste management and provides actionable recommendations for policymakers seeking to optimize public engagement in the national implementation of DRS.

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INTRODUCTION

In the context of global environmental challenges and the accelerated transition towards sustainable development models, the circular economy has become a central pillar of public environmental policies (Losa 2025). Although a DRS can ensure higher collection rates than kerbside collection, the marginal costs are usually higher. The revenues from the recovery of materials only partially cover these costs, so the systems require financial support from producers or the public sector. At the same time, they generate important benefits that are not directly reflected in the market, such as reduced waste disposal, a cleaner environment and job creation, which are relevant aspects in assessing implementation (Laubinger *et al.* 2022). In this context, practical mechanisms that support circular material flows and incentivize responsible consumer behavior have become increasingly relevant (Morrissey and Browne 2004). Among these mechanisms, DRS is particularly effective due to their ability to directly link consumer behavior with environmental outcomes, offering tangible incentives that promote waste reduction and material recovery (Martinho *et al.* 2024).

In the Republic of Moldova, this system is planned to be implemented only in 2027. In this context, the present study makes a valuable empirical contribution, filling the existing gaps in the regional literature and at the same time providing practical bases for the formulation of public communication and education policies adapted to the local specifics.

Building on this context, the present study seeks to explore the behavioral and perceptual factors shaping participation intentions related to the DRS in the Republic of Moldova. Accordingly, the following research questions are formulated:

1. To what extent does the population's level of information regarding the environmental and economic benefits of the DRS influence the intention to participate in the system?

2. Does awareness of the refund value associated with the DRS affect individuals' willingness to engage in the system?

3. What is the effect of understanding the operational functioning of the system and perceived environmental benefits on participation intentions among Moldovan citizens?

Based on these research questions, the study advances the following research hypothesis: Awareness of the refund value, understanding of the system's functioning, and perception of environmental benefits exert a significant influence on the population's willingness to participate in the DRS.

The results obtained contribute to a better understanding of the role played by environmental communication and education in the implementation of the DRS in the Republic of Moldova

LITERATURE REVIEW

The literature review was conducted through a targeted search in the main academic databases, including Web of Science, Scopus, Google Scholar, etc., and the selection of papers was based on relevance to the research objectives and the timeliness of the sources. The identified works generally refer to waste management policies in general and to methods of streamlining recycling in general, packaging recycling, in particular (Iorga *et al.* 2025). The successful rollout of a DRS depends on substantial shifts in consumer practices, with research consistently highlighting the central role of public awareness and information in shaping participation outcomes. Consumer acceptance and active engagement represent critical prerequisites for system effectiveness, while practical considerations, such as the convenience and accessibility of return points, the presence of financial incentives, and the scope and quality of awareness-raising campaigns, significantly influence return behavior (Timofei, Iordachi and Perciun 2024). Evidence from well-established systems indicates that, when these elements are effectively aligned, deposit-return schemes can achieve recycling rates exceeding 90%, thereby reinforcing their role as a highly effective policy instrument within the circular economy framework (Iorga *et al.* 2025).

In the circular economy, active citizen participation cannot be achieved without a clear understanding of how the system works and the concrete benefits it brings both at the individual and societal level (Martinho *et al.* 2024; Milošević *et al.* 2025). The intention to adopt a behavior is influenced by the attitude towards that behavior, the perceived social norms and the perception of behavioral control (Ajzen 1991; Pisano and Lubel 2015). This theory (Ajzen 1991) has been applied extensively in research on recycling and sustainable behaviors (Kollmuss and Agyeman 2002; Bamberg and Möser 2007; Xingjun, Qin and Wang 2019), highlighting that a favorable attitude and an adequate understanding of the benefits of the system significantly increase the likelihood of active participation.

Numerous international studies confirm that adequate information plays an essential role in shaping attitudes towards DRS. Studies show that clear communication of economic and environmental benefits reduces uncertainty and increases trust in the system, thus facilitating its adoption (Lakhan 2024; Konstantoglou *et. al.* 2023). The high levels of knowledge about the circular economy are positively correlated with the intention to adopt recycling behaviors, including within the framework of deposit-return schemes (Xingjun, Qin and Wang 2019). Also, recent research conducted in the European context highlights that the success of the DRS is closely linked to the perception of the transparency and

efficiency of the system, but also to the coherence of the messages transmitted through public information campaigns (Broniewicz *et al.* 2023; Picuno *et al.* 2025; Iorga *et al.* 2025). Correct information also contributes to reducing the perception of risks associated with new systems. Lack of information or confusion regarding the functioning of the DRS can generate skepticism and reluctance, reducing the efficiency of the implemented measures (Zorpas 2024). In contrast, a good understanding of the positive impact of the system – by reducing pollution, conserving resources and reducing external costs, stimulates civic involvement and strengthens the intrinsic motivation of consumers (Picuno *et al.* 2025; Konstantoglou *et al.* 2023; Zheleva and Markov 2024).

In addition to the ecological dimension, the literature also emphasizes the role of perceived social responsibility. Participation in the DRS is perceived not only as a pro-environmental action, but also as a civic contribution, with ethical and community values (Martinho *et al.* 2024). Communication that integrates this component – along with economic and operational messages, has the potential to generate a broader and sustainable mobilization of the population.

The specialized literature indicates that the level of information and the perception of the benefits of the DRS are relevant predictors of the intention to participate.

The international experience shows that the DRS stands out as an efficient tool for collecting and recycling packaging, contributing to reducing the volume of waste, saving resources and diminishing the negative impact on the environment. For instance, countries that have implemented DRS, such as Germany, Norway, and Lithuania, have achieved container return rates exceeding 90%, which has significantly reduced littering and plastic pollution in urban and natural environments (Picuno *et al.* 2025; Zorpas 2024). Empirical assessments from different geographical contexts consistently indicate that deposit-return schemes are associated with substantially lower levels of beverage-container litter. Comparative field observations conducted on European beaches revealed a markedly higher concentration of discarded drink containers in countries lacking a DRS, with litter densities exceeding those observed in DRS-implementing countries by more than an order of magnitude. Similar patterns have been documented in the United States, where recent comparative analyses show that jurisdictions without bottle-deposit legislation experience significantly higher incidences of littered plastic bottles, glass containers, and aluminum cans. In such contexts, beverage containers represent a considerably larger share of total recorded litter, whereas in states operating bottle-deposit systems, their contribution to overall debris remains notably lower (RELOOP 2021).

Roadside litter surveys in Estonia demonstrate a substantial reduction in beverage-container waste following the introduction of the Deposit Return System, with their share declining from approximately 80% prior to implementation to below 10% within two years (RELOOP 2021).

The introduction of a deposit-return scheme should be accompanied by thorough pre-implementation consultations, with particular attention given to system-related costs and consumer responsiveness, as potential price adjustments may affect household budgets and exert broader inflationary pressures (Broniewicz *et al.* 2023).

Germany, one of the largest economies in Europe, introduced the Guarantee-Return System in 2003, drawing inspiration from the Nordic models. The German framework covers the return of bottles, metals, and plastics, and applies a deposit of €0.25 for PET bottles (significantly higher than the deposit for glass packaging, which ranges between €0.08 and €0.15) (TOMRA 2023). This pricing strategy has successfully encouraged the return of plastic containers, leading to high rates of collection and recycling (Iorga *et al.* 2025). International experiences show that the success of such a system does not depend exclusively on the logistical infrastructure or institutional regulations, but, to a large extent, on the degree of involvement and support from citizens (Martinho *et al.* 2024). For example, in Norway, where there are over 3,700 return machines and over 10,000 collection points, recycling rates reach 98%, thanks to attractive financial incentives and effective public information (AFAR 2020). In Germany and Denmark, return rates are 98% (TOMRA 2023) and 92% (TOMRA 2021; Plastic Action Centre 2020), respectively, highlighting the positive impact of awareness and well-developed infrastructure.

Moldova's regulatory framework includes several legislative and strategic instruments aligned with circular economy objectives, notably the Law on Waste (No. 209/2016), which introduced extended producer responsibility for the first time, and the regulation on packaging and packaging waste, partially harmonized with EU Directive 94/62/EC (Perciun 2023). Together, these acts establish the legal basis for environmentally sound waste management and resource efficiency.

METHODOLOGY

To investigate the relationship between the level of information on the benefits of the DRS and the intention of consumers to participate, we used a quantitative approach, based on the analysis of data obtained within a survey.

Data collection was carried out between December 2024 and February 2025. The survey instrument was reviewed and approved by the Ethics Committee of the National Institute for Economic Research of ASEM. Prior to large-scale administration, the questionnaire was pre-tested through a dedicated focus group established by the research team, which served to assess the clarity, coherence, and comprehensibility of the survey items and to ensure their appropriate interpretation by potential respondents.

Data were gathered using a mixed-mode approach, combining online questionnaire distribution with telephone interviews, in order to enhance coverage

and accessibility. As the survey targeted individual respondents, anonymity was fully preserved, and no records of survey refusals were maintained. The initial research design aimed to collect responses from a minimum of 500 participants; however, the final sample exceeded this threshold, resulting in a total of 608 valid responses.

The questionnaire comprised 26 items covering various dimensions of DRS perception and behavior. For this study, we analyzed questions directly related to our research objectives, specifically measuring:

– comprehensive knowledge of the DRS (including system concept, operating mechanism, eligible packaging types, and deposit values),

– awareness of the system's economic and ecological advantages,

– perceived environmental impact of the DRS,

– perceived barriers and difficulties in participating in the system.

All constructs were operationalized as composite measures aggregated through arithmetic mean calculation, following standard psychometric practice (DeVellis 2017). *Information Level* integrates four dimensions of DRS knowledge, awareness of the system concept, understanding of functioning, knowledge of eligible packaging, and deposit values -each assessed on 5-point Likert scales (1 = "strongly disagree" to 5 = "strongly agree"). *Environmental Impact* was similarly measured using Likert scaling. *Perceived Difficulty* was operationalized as a composite index aggregating assessments of eight potential barriers to participation.

Statistical analysis was performed using GRETL software, employing Ordinary Least Squares (OLS) multiple linear regression. The dependent variable was declared intention to participate in the DRS (*Participation*), measured on the same 5-point scale. The model examines three independent variables aligned with the Theory of Planned Behavior framework (Ajzen 1991): information level (representing the cognitive-informational component of attitudes), environmental impact perception (representing the affective-evaluative component of attitudes), and perceived difficulty (representing perceived behavioral control).

The regression model is specified as:

$$\boldsymbol{Participation_i = \beta_0 + \beta_1 \cdot Information_i + \beta_2 \cdot EnvironmentalImpact_i + \beta_3 \cdot PerceivedDifficulty_i + \varepsilon_i}$$

where:

– $Information_i$ reflects awareness of DRS environmental and economic benefits.

– $Environmental\ Impact_i$ captures perceived contribution to environmental protection

– $Perceived\ Difficulty_i$ represents aggregated perceptions of barriers to participation.

This specification tests two of the three components of the Theory of Planned Behavior (Ajzen 1991): attitudes toward DRS participation (through information and environmental impact perception) and perceived behavioral control (through perceived difficulties). While subjective norms represent an important third component of TPB, they fall outside the scope of this initial investigation focused on individual-level cognitions and perceptions.

OLS regression was selected for direct coefficient interpretability and because aggregated Likert scales can be treated as approximately continuous (Norman 2010; Sullivan and Artino 2013).

The validity of the model was ensured by standard diagnostic tests: multicollinearity, heteroscedasticity and normality of the residuals. Comprehensive tests confirmed all OLS assumptions: VIF values ranged from 1.151 to 2.065 (all < 3), indicating no problematic collinearity. The Belsley-Kuh-Welsch diagnostics showed maximum condition index of 11.06, within acceptable limits. Residual plots showed random scatter with no systematic patterns across the range of fitted values. Q-Q plots confirmed approximate normality of residuals, with minor tail deviations consistent with discrete Likert-scale data.

The sample size ($n = 608$) ensures methodological rigor through two criteria. First, it provides adequate statistical power ($1\text{-}\beta > 0.80$) for detecting medium effect sizes ($f^2 \geq 0.15$) in the multiple regression analysis with three predictors (Cohen 1988). Second, it ensures a margin of error of approximately ±4 percentage points at 95% confidence for descriptive proportion estimates reported in the study.

SAMPLE CHARACTERISTICS

The survey was completed by a total of 608 respondents, offering a robust basis for analysis. The gender distribution was composed of 48.7% women, 42.4% men, and 8.9% who chose not to disclose their gender, ensuring a broad and inclusive respondent profile.

Table no. 1

Age Composition by Residential Area

Age group	Rural	Urban	Total
18–25	38.8%	61.2%	116
26–35	73.5%	26.5%	117
36–50	64.2%	35.8%	148
51–65	40.9%	59.1%	132
Over 65	37.9%	62.1%	95
TOTAL	**52.0%**	**48.0%**	**608**

Source: Author's calculations based on survey data.

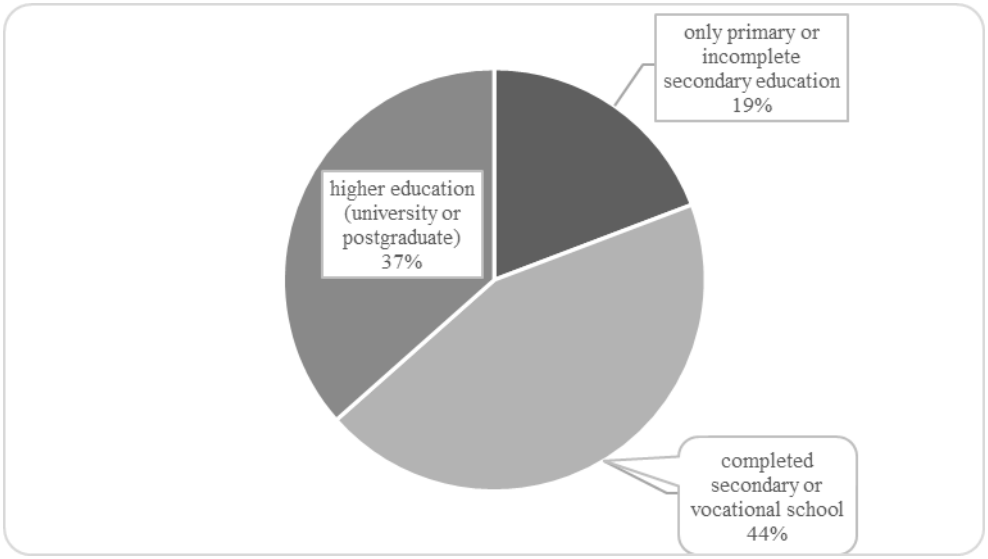
In terms of residence, the sample included 52% rural and 48% urban participants, presenting a near-equal division that enables meaningful rural–urban comparisons. This territorial balance is particularly relevant in evaluating attitudes toward the deposit-return system, as infrastructure and access often differ by location.

This distribution across age and location supports deeper segmentation of consumer profiles, offering insights into how demographic and geographic factors shape perceptions of and readiness to engage with the DRS system.

The level of education of the respondents is indicated in *Figure 1*.

Figure 1

The level of education of the respondents, %



Source: Developed by the authors based on the survey.

Compared to national education statistics, the sample includes a slightly higher proportion of individuals with university degrees, suggesting above-average educational attainment among participants. This could reflect a greater propensity toward participation in civic or sustainability-focused initiatives, as higher education levels are often associated with increased environmental awareness and openness to innovation.

To assess the extent to which the sample accurately represents the adult population of the Republic of Moldova, the margin of error and the confidence interval were calculated. The sample estimation was based on the total population aged 18 years and over in the Republic of Moldova, which amounted to 2,293,326 individuals in 2025 (STATBASE 2025).

The following formula was applied (Iorga *et al.* 2025):

$$ME = Z \times \sqrt{\frac{p(1-p)}{n}} \times \sqrt{\frac{N-n}{N-1}}$$

Source: Iorga *et al.* 2025.

Where:

Z = 1.96 (for a 95% confidence interval)
P = 0.5 (conservative value for maximizing the margin of error)
n = sample size 608 respondents
N = total adult population (18+) of Republic of Moldova (2293326)
Margin of error (ME) = ± 3.97%

In summary, the sample demonstrates a reasonably balanced demographic structure, with a slight overrepresentation of higher-educated individuals. This characteristic may influence the interpretation of results, particularly regarding consumer responsiveness to environmental information and system-related engagement.

EMPIRICAL FINDINGS

Current situation in the Republic of Moldova. Despite the adoption of multiple regulatory measures in the Republic of Moldova aimed at improving the management of packaging and packaging waste, particularly through the establishment of recovery and recycling targets, the most recent data reveal persistent structural challenges in waste management outcomes (Perciun 2023). According to official statistics, the total volume of waste collected in 2023 amounted to 834.7 thousand tonnes, representing a substantial decline compared to 1,122.0 thousand tonnes recorded in 2022 (Environmental Agency 2023). As in previous years, municipal waste continued to dominate the waste stream, accounting for 66.1% of total collected waste. However, of the 551.9 thousand tonnes of municipal waste generated, as much as 510.9 thousand tonnes (92.6%) consisted of mixed waste collected from the residential sector, largely comprising household waste. This distribution underscores the persistence of a waste management model heavily reliant on unsorted collection, reflecting limited effectiveness of source separation practices, both at the level of public authorities and among consumers (Environmental Agency 2023).

Further evidence of implementation gaps emerges from the most recent report on the Extended Producer Responsibility (EPR) system. In 2023, a total of 40.6 thousand tonnes of packaging falling under EPR obligations were placed on the Moldovan market, with plastic and glass packaging each accounting for approximately 11 thousand tonnes. Nevertheless, the quantities effectively

recovered remained modest, reaching only 1,370.76 tonnes for plastic packaging (12.22%) and 1,740.59 tonnes for glass packaging (15.52%) (*Table no. 2*). These figures point to a significant discrepancy between regulatory objectives and actual recovery performance, highlighting the need for more effective policy instruments, such as deposit-return systems, to enhance collection rates and support the transition toward a circular economy (Environmental Agency 2024).

Table no. 2

Types of packaging waste placed on the market in the Republic of Moldova and the quantities recovered under the EPR system in 2023

Type of packaging	Placed on the domestic market, tonnes	Recovered quantity, tonnes	Recycling rate, %
Paper/cardboard	9593.11	1584.14	16.5
Plastic	11216.47	1370.76	12.2
Glass	11218.56	1740.59	15.5
Wood	6448.89	331.39	5.1
Metal	2117,21	218.17	10.3
Total	**40594.24**	**5245.05**	**12.9**

Source: Environmental Agency 2024.

According to the Environmental Strategy for 2024–2030 (Government Decision No. 409/2024), the generation of packaging waste corresponds to an average indicator of 60 kg of packaging waste per capita per year (*Table no. 3*) (Environmental Agency 2023).

Table no. 3

The projection of packaging waste quantities, total and by material type, 2023–2030 (thousand tonnes)

Type of waste	2023	2024	2025	2026	2027	2028	2029	2030
Total packaging waste	**181.1**	**177.9**	**170.3**	**168.7**	**167.2**	**158.5**	**157.0**	**155.7**
Glass packaging waste	33.2	32.9	32.6	32.3	32.0	31.7	31.4	31.1
Plastic packaging waste	60.4	59.8	56.3	55.7	55.2	51.9	51.4	50.9
Paper packaging waste	69.4	68.8	68.1	67.5	66.9	63.4	62.8	62.3
Wood packaging waste	9.1	7.5	7.4	7.3	7.3	5.8	5.7	5.7

Source: Government of the Republic of Moldova. Government Decision No. 409/2024.

These projections indicate that by 2030 the Republic of Moldova will need to manage and recover approximately 343 thousand tonnes of waste, including around 112 thousand tonnes of plastic packaging waste.

According to the relevant Government Decision regulating the DRS, the system is scheduled to be implemented no later than 2027.

This context underscores the importance of examining public perceptions, awareness, and willingness to participate in the DRS, as consumer engagement will play a critical role in determining the system's effectiveness.

Survey data. The level of information estimated by the respondents of our survey themselves regarding the DRS is as follows:

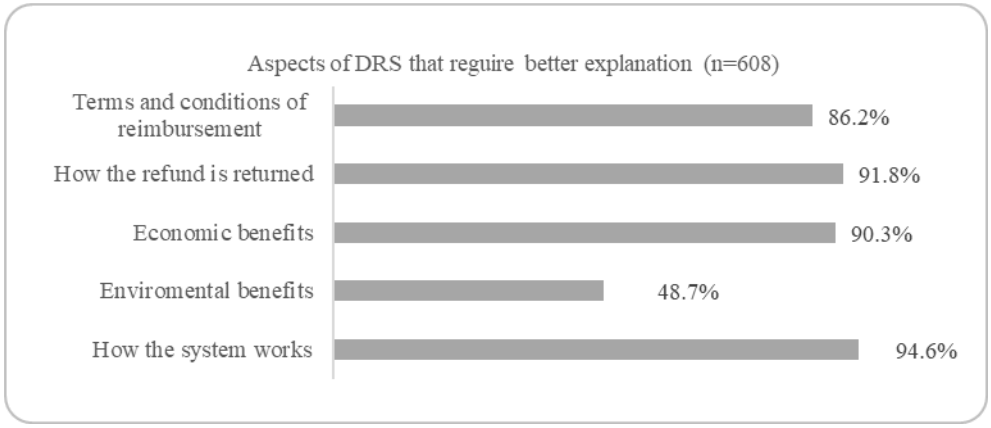
1. Yes, partially – 59.2%
2. Yes, well – 20.2%
3. I don't know – 20.6%.

So, in principle, 79.4% of respondents declare that they have at least some degree of knowledge of the DRS, but only 20.2% indicate a high level of information. This distribution allows us to conclude that the system is relatively well known in the Republic of Moldova. When asked where they learned about the DRS, the vast majority indicated the main source as Internet/Social media – 482 respondents (88.1%), from their own experience abroad – 332 respondents (60.7%). Unfortunately, the role of traditional mass media is marginal in relation to the online environment (0.5%). From an analytical perspective, this information structure suggests that the level of knowledge is strongly influenced by digital exposure and external experiences, rather than by systematic institutional campaigns.

Thus, in our case, respondents were asked about the aspects of the DRS that require better and more detailed explanation (see *Figure 2*). The vast majority advocated for such aspects as: the mechanism of operation of the DRS (about 95%), the method of returning the guarantee (about 92%), the economic benefits (90%), the terms and conditions of reimbursement of the guarantee (86%) and only about 49% of respondents wanted to know more about the environmental benefits.

Figure 2

The distribution of responses on aspects requiring better explanation regarding the DRS



Source: Developed by the authors based on the survey.

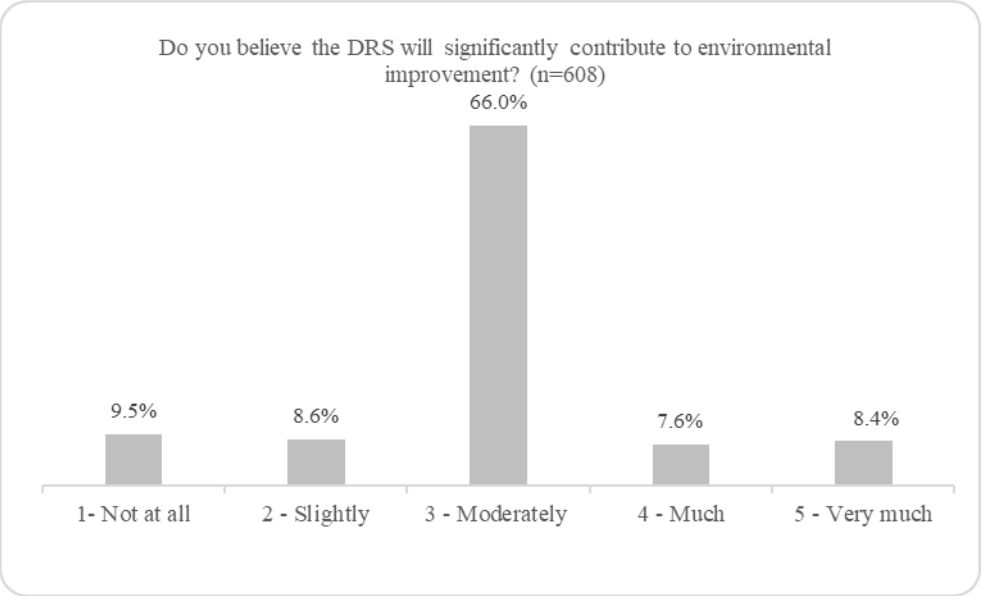
Thus, the study respondents prioritize operational and economic aspects (the vast majority is concerned with the clarity and efficiency of the operating process, *i.e*., how the system will work in practice); similarly, the respondents highlighted the economic benefits. The reduced interest in environmental benefits can be explained by the fact that the respondents are either more familiar with environmental concepts or focus on immediate and tangible aspects, since the DRS involves changes in consumption patterns and possible additional costs. Accordingly, the study participants tend to prioritize aspects that will directly influence their daily lives (operation, reimbursement conditions, economic impact). Positive attitudes towards a certain behavior and perceptions of control are key predictors of the intention to adopt that behavior (Ajzen 1991), this reduces the uncertainty and risk perception associated with adopting a new system, which makes participants feel more comfortable and willing to get involved (Konstantoglou *et al.* 2023). Better information can lead to increased environmental awareness. When consumers know the positive effects of DRS on waste reduction and resource conservation, they are motivated to actively participate in such initiatives, thus contributing to the development of a circular economy (Xingjun, Qin and Wang 2019). These results highlight that for a successful implementation of the DRS, it is imperative to provide clarity on the functioning and economic aspects, as these are critical points for public acceptance of the system. On the other hand, although environmental benefits are recognized, they seem to be perceived as secondary compared to the elements that have a direct and immediate impact on the consumer experience.

These arguments and assumptions of the authors are also supported by the answer to the question, whether respondents believe that the DRS will contribute significantly to improving the environment (*Figure 3*).

These results clearly reflect the general perception of respondents that the implementation of the DRS will bring benefits to the environment, but in a moderate way. The fact that 66% of respondents believe that the DRS will contribute moderately to improving the environment can be explained by the fact that there is a realistic expectation, based on the knowledge of the limitations of the system. This moderate assessment suggests that although there is a clear potential to reduce waste and promote recycling, the immediate and visible effects on the environment may be partial. Thus, participants do not exaggerate the benefits, but recognize that the implementation of the DRS is only one component of a broader strategy to protect the environment. Previous data on the importance of operational and economic aspects (such as the clarity of the operating mechanism, the way to return the guarantee, the repayment conditions and the economic benefits) align with the answers regarding environmental improvement.

Figure 3

The distribution of responses regarding respondents' perception of the impact of the DRS on the environment



Source: Developed by the authors based on the survey

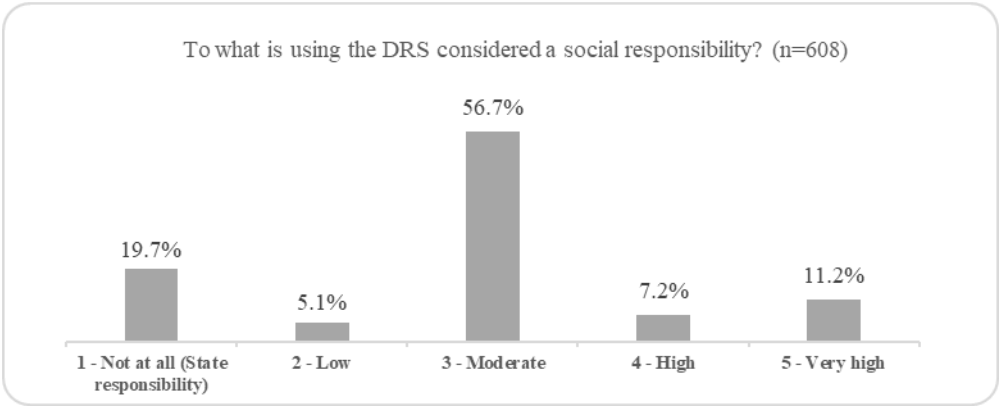
This suggests that respondents, while appreciating the environmental contribution of the DRS, view it in the broader context of a system that must also be financially and operationally efficient. In essence, the moderate perception of environmental benefits complements a holistic assessment, in which the environmental impact is considered important, but not sufficient to radically transform the situation without complementary interventions. Approximately 9.5% of respondents are very skeptical about the environmental effects of the DRS. This small segment may reflect a lack of confidence in the implementation of the system or previous negative experiences with similar environmental policies. From a research perspective, this skepticism highlights the need for more effective communication and monitoring and impact evaluation measures, so that the benefits of the DRS can be clearly and concretely demonstrated.

It has already been demonstrated that DRS is also a social responsibility, therefore it is necessary to analyze not only economic and operational factors, but also to understand the ecological and responsible behavior of the entire society. Thus, DRS not only optimize recycling flows, but also mobilize consumers to actively engage in environmental protection, transforming the act of recycling into a social responsibility (Broniewicz *et al*. 2023). Circular economy strategies,

including DRS, create a bridge between economic benefits and social values, contributing to the consolidation of a culture of sustainability by involving the community in waste management processes (Laubinger *et al*. 2022). Institutional reports, such as those of the European Commission (2021), confirm that the integration of social aspects into environmental policy is essential for the long-term effectiveness of returnable packaging systems. These documents emphasize that, in order to have a real impact on the environment, DRS must be perceived not only as an economic instrument, but also as a mechanism of responsibility for the entire society (European Commission 2021). That is why in the conditions of the Republic of Moldova, where not even a pilot project has been implemented, nor is this topic widely discussed in the media, this approach is absolutely necessary for authorities, companies and citizens, an approach that will emphasize the common effort and that each act of returning packaging contributes to a collective good.

Figure 4

The distribution of responses on the perceived social responsibility of using the DRS



Source: Developed by the authors based on the survey.

When asked to what extent respondents consider that participation in the DRS is a social responsibility, we observed the following distribution of responses (*Figure 4*). Such attitudes reflect the level of public awareness and information regarding the social and environmental impact of the DRS. Respondents (approx. 58%) who perceive a moderate social responsibility recognize that their involvement contributes to improving the environment, but consider that this contribution is only part of a broader set of measures necessary to achieve the objectives of the circular economy. On the other hand, the 20% who do not associate participation in the DRS with a social responsibility may be influenced by a predominantly economic perception or by the lack of complete information regarding the social benefits of the system. In contrast, the 11% segment that

considers the DRS to be a very high social responsibility indicates a high level of sensitivity towards the environmental and social impact of recycling, highlighting the potential for mobilizing groups with consolidated environmental values.

To complete the behavioral analysis, respondents were also asked about anticipated barriers to DRS participation. Beyond understanding environmental perceptions and civic motivations, it is essential to examine the practical and psychological barriers that respondents anticipate encountering when using the DRS. Perceived barriers represent a critical dimension of behavioral intention, as they reflect individuals' sense of control over their ability to successfully participate in the system. When asked to identify the primary difficulties they expect in using the DRS, respondents revealed a multifaceted set of concerns spanning multiple domains.

The most frequently cited anticipated difficulty was additional costs or complications in deposit recovery (71.4% of respondents), suggesting widespread concern about the reliability and transparency of refund mechanisms. This was followed by lack of information (49.3%) – reinforcing earlier findings about informational priorities – and inadequate infrastructure (47.9%). Nearly half of respondents (45.4%) expressed concern about hidden costs or difficulties in guarantee recovery, while time required for return (42.3%) and queues at collection points (39.0%) were also substantial concerns. Process complexity (36.5%) and schedule incompatibility between collection points and users' free time (32.7%) completed the landscape of perceived obstacles.

Notably, only 18.4% of respondents indicated uncertainty ("do not know") when asked about anticipated difficulties, suggesting that most participants had formed concrete expectations (whether based on media coverage, discussions with others, or analogous experiences with similar systems) about challenges they might face.

To examine the combined influence of these factors on participation intentions, a multivariate regression analysis was conducted (*Table no. 4*).

Table no. 4

Regression Analysis of Determinants of DRS Participation Intentions

Variable	Coefficient	Std. Error	t-ratio	p-value
const	0,808840	0,0845673	9,564	2,82e-020 ***
Level_Information	0,115985	0,0114457	10,13	2,15e-022 ***
Impact_environment	0,646671	0,0367031	17,62	2,24e-056 ***
Perceived_Difficulty	−0,00910346	0,00358108	−2,542	0,0113 **

R – Unadjusted R-squared: 0,681230
R – Adjusted R-squared: 0,679646
F (3, 604) 430,2603
P – value(F) 1,8e-149
Source: Elaborated by authors base on the survey data
*Note: *** Indicates statistical significance at the level of 0,1% (p < 0,001)*

These empirical findings provide the foundation for examining the theoretical and practical implications of citizen engagement with DRS implementation.

DISCUSSIONS

The findings reveal important patterns requiring interpretation. According to the theory of planned behavior (Ajzen 1991), when individuals perceive numerous obstacles, regardless of their specific nature, their perceived behavioral control diminishes, potentially reducing engagement even when attitudes and social norms are favorable. The cumulative effect of these diverse barriers can create a significant psychological impediment to action, regardless of how positively individuals evaluate the system's environmental or social benefits.

Overall, the results support the authors' hypothesis that the environmental benefits of the DRS are acknowledged by respondents, though they are perceived as moderate. This balanced perception suggests that, to fully realize the system's environmental potential, its implementation should be accompanied by comprehensive public awareness campaigns and additional measures that reinforce the system's efficiency and accessibility.

In addition to the ecological benefits, it is essential to integrate the concept of social responsibility. Participation in the DRS is not only a way to protect the environment, but also an opportunity to mobilize the entire community in a common effort for sustainable development. Thus, promoting DRS as an act of social responsibility can increase citizen involvement, transforming the recycling process into a collective commitment that brings benefits at both the environmental and social levels.

Recent studies highlight that when citizens are informed not only about the environmental benefits but also about their social role in promoting a circular economy, there is a significant increase in the intention to participate (Pisano and Lubel 2015). Furthermore, research conducted in the context of return systems in the Baltic States has demonstrated that community involvement and the perception of social responsibility can contribute to the successful implementation of these systems.

We propose to develop a more comprehensive behavioral model that examines the combined influence of awareness of the refund value, understanding of system functionality, and perception of environmental benefits on the willingness to participate in the DRS (research hypothesis).

This extended approach allows for a deeper exploration of how both cognitive and affective factors interact to shape consumer behavior intentions within the framework of the circular economy. By integrating these dimensions, the model provides a more robust foundation for designing targeted communication strategies and policy interventions that effectively mobilize public engagement.

This integrated model, which combines the general level of information (including all dimensions of knowledge about the DRS), perceived environmental impact, and perceived difficulty, demonstrates strong explanatory power ($R^2 = 0.681$, Adjusted $R^2 = 0.680$). This increase in explanatory power highlights the fundamental role of perceived ecological impact in motivating participation in the DRS.

As shown in *Table no. 4*, the results indicate that the perceived environmental impact ($\beta = 0.647$, $p < 0.001$) has a strong and highly significant positive effect on the intention to participate, serving as a more powerful predictor than the general level of information ($\beta = 0.116$, $p < 0.001$). Perceived difficulty demonstrates a statistically significant negative effect ($\beta = -0.009$, $p = 0.011$), confirming that anticipated barriers reduce participation intentions. This suggests that, while awareness of the practical aspects of the DRS is important, environmental and circular economy awareness plays a decisive role in motivating citizens to engage with the system, though this motivation can be constrained by perceived obstacles.

These regression findings raise an intriguing question about the relationship between stated information preferences and underlying motivational drivers. The apparent discrepancy between the moderate interest in additional information about environmental benefits (only 49% according to *Figure 3*) and the strong impact of environmental perception on participation intention ($\beta = 0.647$ according to *Table no. 4*) can be explained by several complementary factors. First, this contrast reflects the fundamental distinction between the perceived need for additional information and already internalized values. Environmental values already integrated into the individual's value system do not require additional information to influence behavior, acting as strong intrinsic motivators (Zorpas 2024), Second, respondents seem to prioritize practical and operational information (functioning mechanism, return of guarantee) from the perspective of immediate informational needs, while environmental values act as a deeper frame of reference for their decisions. This phenomenon is consistent with the hierarchical model of attitudes described by Konstantoglou *et al.* (2023), where fundamental values have a stronger influence than explicitly expressed information needs. Third, it is possible that respondents consider that they already have sufficient general information about the environmental benefits of recycling, transferring this knowledge to the DRS. Thus, they no longer feel the need for additional specific information, although environmental values continue to strongly influence their willingness to participate.

The distinction between the declared information needs and the influence of internalized values highlights the importance of a comprehensive approach in communication strategies for implementing the DRS, one that addresses both practical considerations and strengthens ecological values already present among the public.

This finding adds an important layer of interpretation to previous results, showing that effective communication strategies should not focus solely on the operational aspects of the DRS, but also emphasize its positive environmental impact and contribution to the circular economy. While respondents may initially appear more interested in practical elements (such as how the system works or how the refund is processed), the perception of ecological benefits emerges as a strong motivational factor. Additionally, communication campaigns must address the practical and psychological barriers that reduce perceived behavioral control, as evidenced by the significant negative effect of perceived difficulty on participation intentions.

The results obtained confirm our hypothesis, demonstrating that the level of information about the benefits of DRS for the circular economy, reflected mainly by the perception of environmental impact, significantly and positively influences the intention to participate. The inclusion of perceived difficulty in the model further validates the Theory of Planned Behavior framework, showing that positive attitudes must be accompanied by perceived feasibility for intentions to form. This conclusion is consistent with previous studies (Iorga *et al.* 2025; Broniewicz 2023; Kollmuss 2002), which highlighted the importance of awareness of ecological benefits in stimulating pro-environmental behaviors.

In conclusion, to maximize the participation rate in the DRS, it is essential to implement comprehensive information campaigns, addressing both the practical aspects of the system and highlighting its positive impact on the environment and its contribution to the development of the circular economy. These campaigns should also proactively address the barriers identified by respondents – particularly concerns about cost recovery (71%), lack of information (49%), and inadequate infrastructure (48%) – to enhance perceived behavioral control and reduce obstacles to participation. These educational efforts can transform the moderate perception of environmental benefits into a strong motivational factor, thus contributing to the success of the DRS implementation in the Republic of Moldova.

CONCLUSIONS

These findings support the idea that active public participation cannot be achieved without a coherent and well-targeted communication strategy that highlights both the ecological advantages of the system and its economic and social benefits.

The empirical analysis highlighted that respondents from the Republic of Moldova attach high importance to the operational and financial aspects of the system, while the perception of environmental benefits is moderate. Also, the positive correlation between information and perception of social responsibility indicates that messages that combine the ecological and civic dimensions can strengthen long-term engagement.

The extended model tested in the study, which integrates the general level of information (including knowledge of the guarantee value and system functioning), perception of environmental impact, and perceived difficulty, demonstrated strong explanatory power ($R^2 = 0.681$, Adjusted $R^2 = 0.680$). This result highlights the fact that the motivation for participation in the DRS is not determined exclusively by knowledge of the technical aspects, but also by already internalized ecological values.

The perception of ecological impact had a significantly stronger effect ($\beta = 0.647$, $p < 0.001$) than general information ($\beta = 0.116$, $p < 0.001$), while perceived difficulty demonstrated a significant negative effect ($\beta = -0.009$, $p = 0.011$), confirming that anticipated barriers constrain participation intentions. This shows that although the public requires information about the functioning of the system, the valuation of environmental benefits is the most decisive motivational driver, though this motivation can be diminished by perceived obstacles. This difference between declared information needs and the influence of internalized values highlights the importance of a dual approach in communication strategies: one that responds to concrete information needs, but also strengthens the attachment to sustainability values already existing among the population.

This finding adds an important interpretative dimension to previous results, showing that effective communication strategies should not be limited to the operational aspects of the system, but should also emphasize the positive impact on the environment and the contribution to the development of the circular economy. Although respondents seem more interested, at first glance, in the practical elements, ecological benefits emerge as an essential motivational factor.

So, the success of DRS in the Republic of Moldova does not depend exclusively on the logistical infrastructure or the institutional framework, but to a large extent on how the public is informed, involved and motivated.

STUDY LIMITATIONS AND FUTURE DIRECTIONS

This study has several limitations that are worth mentioning. First, the use of a self-report questionnaire may be influenced by subjectivity and social bias. Second, the data collected reflect perceptions at a specific point in time, without capturing the evolution of consumer attitudes over time.

In the future, longitudinal research could highlight the dynamics of changes in environmental behaviors depending on the intensification of information campaigns. Also, comparative studies between urban and rural regions or between different social categories could contribute to the refinement of communication policies regarding the implementation of DRS.

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AI Use Statement

The authors declare that Artificial Intelligence tools were used solely as supportive instruments during the preparation of the manuscript, specifically for language refinement and grammatical editing. AI tools were not used to generate original scientific content, formulate research questions or hypotheses, conduct data analysis, or interpret the results.

REFERENCES

AFAR. 2020. "Norway Recycles 97 Percent of Its Plastic Bottles." AFAR, May 14, 2020. https://www.afar.com/magazine/norway-recycles-97-percent-of-its-plastic-bottles.

Ajzen, Icek. 1991. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50 (2): 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Bamberg, Sebastian, and Guido Möser. 2007. "Twenty Years after Hines, Hungerford, and Tomera: A New Meta-Analysis of Psycho-Social Determinants of Pro-Environmental Behaviour." *Journal of Environmental Psychology* 27 (1): 14–25. https://doi.org/10.1016/ j.jenvp.2006.12.002.

Broniewicz, Elżbieta, Anders Larsson, Wojciech Piontek, and Ewa Sidorczuk-Pietraszko. 2023. "Economic Effects of Introducing a Deposit-Return System for Packaging in Poland." *Economics and Environment* 86 (3): 169–185. https://doi.org/10.34659/eis.2023.86.3.718; https://www.researchgate.net/publication/376780235_Economic_effects_of_introducing_a_deposit-return_system_for_packaging_in_Poland.

Cohen, Jacob. 1988. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates.

DeVellis, Robert F. 2017. *Scale Development: Theory and Applications*. 4th ed. Thousand Oaks, CA: Sage Publications.

Environmental Agency. 2023. *Analytical Note Based on Data Reported by Enterprises through the SIA MD System*. Chișinău: Environmental Agency. https://am.gov.md/sites/default/files/document/attachments/GESTIONAREA%20DE%C8%98EURILOR%20%C3%8EN%20REPUBLICA%20MOLDOVA%20%C3%8EN%20ANUL%202023.pdf.

Environmental Agency. 2024. *Report on the Implementation of the Extended Producer Responsibility Principle in 2023*. Chișinău: Environmental Agency. https://am.gov.md/sites/default/files/document/attachments/Raport%20Narativ_REP_2023.pdf.

European Commission. 2021. *Circular Economy Action Plan: For a Cleaner and More Competitive Europe*. Brussels: EU Publications Office. https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en.

Government of the Republic of Moldova. 2024. *Environmental Strategy for 2024–2030*. Government Decision No. 409/2024. https://www.legis.md/cautare/getResults?doc_id=144295&lang=ro.

Iorga, Maria, Alexandru Semenescu, Daniela Marcu and Bogdan Florea. 2025. "The Efficiency of the Deposit-Return System in Romania: A Statistical and Comparative Analysis." *Proceedings of the International Conference on Business Excellence* 19: 5412–5426. https://doi.org/10.2478/picbe-2025-0413.

Kollmuss, Anja, and Julian Agyeman. 2002. “Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to Pro-Environmental Behavior?” *Environmental Education Research* 8 (3): 239–260. https://doi.org/10.1080/13504620220145401.

Konstantoglou, Apostolos, Thomas Fotiadis, Dimitrios Folinas, Athanasios Falaras, and Konstantinos Rotsios. 2023. “Accessing Consumer Perceptions of the Effectiveness of the Deposit Refund System.” *Sustainability* 15 (12): 9429. https://doi.org/10.3390/su15129429.

Lakhan, Conor. 2024. “Evaluating the Effectiveness, Costs, and Challenges of Deposit Return Systems for Beverage Containers: A Meta-Analysis.” *World Journal of Advanced Engineering Technology and Sciences* 13: 112–131. https://doi.org/10.30574/wjaets.2024.13.1.0397.; https://www.researchgate.net/publication/384080826_Evaluating_the_effectiveness_costs_and_challenges_of_deposit_return_systems_for_beverage_containers_A_meta-analysis

Laubinger, Frithjof, Andrew Brown, Peter Börkey, and Myriam Dubois. 2022. “Deposit-Refund Systems and the Interplay with Additional Mandatory Extended Producer Responsibility Policies.” OECD Environment Working Paper No. 208. Paris: OECD Publishing. https://doi.org/10.1787/c92a063b-en; https://www.oecd.org/en/publications/deposit-refund-systems-and-the-interplay-with-additional-mandatory-extended-producer-responsibility-policies_a80f4b26-en.html

Losa, Riccardo. 2025. “Public Policies on Circular Economy: A Systematic Review.” *Ecological Economics* 228: 108452. https://doi.org/10.1016/j.ecolecon.2024.108452; https://www.sciencedirect.com/science/article/pii/S0921800924003495

Martinho, Graça, Ana Alves, Paula Santos and Mónica Ramos, 2024. “Social Evaluation of a Deposit and Refund System Pilot Project for Polyethylene Terephthalate Packaging.” *Environmental Challenges* 15: 100894. https://doi.org/10.1016/j.envc.2024.100894; https://www.sciencedirect.com/science/article/pii/S266701002400060X

Milošević, Isidora, Zorana Stanković, Sorin Anton and Anđelka Stojanović. 2025. “Empowering Consumers through Circular Economy: Benefits and Challenges.” *Economy4All* 1 (27): [page numbers]. https://doi.org/10.47743/ECO4ALL.2025.1.27; https://www.researchgate.net/publication/398370373_EMPOWERING_CONSUMERS_THROUGH_CIRCULAR_ECONOMY_BENEFITS_AND_CHALLENGES

Morrissey, Anthony J., and Jim Browne. 2004. “Waste Management Models and Their Application to Sustainable Waste Management.” *Waste Management* 24 (3): 297–308. https://doi.org/10.1016/j.wasman.2003.09.005.

Norman, Geoff. 2010. “Likert Scales, Levels of Measurement and the ‘Laws’ of Statistics.” *Advances in Health Sciences Education* 15 (5): 625–632. https://doi.org/10.1007/s10459-010-9222-y.

Perciun, Rodica. 2023. *“Economia circulară și recuperarea deșeurilor din plastic prin reciclare în Moldova./ Circular economy and recovery of plastic waste through recycling in Moldova.”* Economic growth in the conditions of globalization: conference proceedings: International Scientific-Practical Conference, XVIIth edition, october 12–13, 2023, Chisinau. Chisinau: SEP ASEM, 2023, vol. I, pp. 19–36. ISBN 978-9975-167-20-8 (PDF). https://doi.org/10.36004/nier.cecg.2023.17.1

Picuno, Carmine, Spyridoula Gerassimidou, Weimu You, Olwenn Martin, Eleni Iacovidou. 2025. “The Potential of Deposit Refund Systems in Closing the Plastic Beverage Bottle Loop: A Review.” *Resources, Conservation and Recycling* 212: 107962. https://doi.org/10.1016/j.resconrec.2024.107962; https://www.sciencedirect.com/science/article/pii/ S0921344924005536

Pisano, Ignacio, and Mark Lubel. 2015. “Environmental Behavior in Cross-National Perspective: A Multilevel Analysis of 30 Countries.” *Environment and Behavior* 47 (10): 1067–1090. https://doi.org/10.1177/0013916515600494; https://journals.sagepub.com/doi/10.1177/0013916515600494

Plastic Action Centre. 2020. “Denmark – Deposit Return.” Plastic Action Centre. Accessed [26.01.26]. https://plasticactioncentre.ca/directory/denmark-deposit-return/.

RELOOP. 2021. “Factsheet: Deposit Return Systems Reduce Litter.” RELOOP Platform. https://www.reloopplatform.org/wp-content/uploads/2021/01/DRS-Factsheet-Litter-long-29Jan2021.pdf.

Xingjun, Ru, Haibo Qin, Shanyong Wang. 2019. "Young People's Behaviour Intentions towards Reducing PM2.5 in China: Extending the Theory of Planned Behaviour." *Resources, Conservation and Recycling* 141: 99–108. https://doi.org/10.1016/j.resconrec.2018.10.019.

STATBASE. 2025. "Population Ages 18 and above in the Republic of Moldova." STATBASE. Accessed January 27, 2025. https://statbase.org/data/mda-population-age-18-and-above/.

Sullivan, Gail M., and Anthony R. Artino Jr. 2013. "Analyzing and Interpreting Data from Likert-Type Scales." *Journal of Graduate Medical Education* 5 (4): 541–542. https://doi.org/10.4300/JGME-5-4-18.

Timofei, Olga, Victoria Iordachi, and Rodica Perciun. 2024. "Consumer Behavior towards Recycled Clothing." *Cogito* 16 (3): 119–140.

TOMRA. 2021. "New Way to Return Containers Set to Change Consumer Recycling Behavior in Germany, Denmark and Netherlands." TOMRA, [23.10.2025]. https://www.tomra.com/ reverse-vending/media-center/news/2021/germany-denmark-netherlands-news.

TOMRA. 2023. "Germany's Deposit Return System Achieves 98% Return Rate." TOMRA. https://www.tomra.com/reverse-vending/media-center/feature-articles/germany-deposit-return-scheme.

Zheleva, Valentina, and Markov, Nikolay. 2024. "Socio-Economic Challenges in the Transition to a Low-Carbon Economy at Regional Level in Bulgaria." *Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development"* 24 (2): 975–982. https://www.researchgate.net/publication/382697805_SOCIO-ECONOMIC_CHALLENGES_IN_THE_TRANSITION_TO_A_LOW-_CARBON_ECONOMY_AT_REGIONAL_LEVEL_IN_BULGARIA

Zorpas, Antonis A. 2024. "Promoting Circular Economy: The Transformative Impact of Deposit Refund Systems." *Waste Management & Research* (12):1093-1095. https://doi.org/10.1177/0734242X241296617

Eficacitatea Sistemelor de Returnare a Depozitelor (SRD) ca instrumente de promovare a economiei circulare depinde în mare măsură de gradul de participare a publicului. Acest studiu investighează impactul conştientizării consumatorilor cu privire la beneficiile de mediu şi economice ale SDR asupra intenţiei lor de participare, concentrându-se pe contextul Republicii Moldova. Pe baza datelor obţinute dintr-un chestionar structurat administrat la 608 respondenţi, studiul testează empiric ipoteza efectelor statistice semnificative ale conştientizării valorii rambursării, înţelegerii funcţionării sistemului şi beneficiilor de mediu percepute asupra disponibilităţii de participare la Sistemul de Returnare a Depozitelor (SRD). Analiza statistică, efectuată prin regresie liniară multiplă, confirmă efectele semnificative asupra intenţiilor de participare ale nivelului de informare, percepţiei asupra mediului şi barierelor percepute. Cu toate acestea, rezultatele arată, de asemenea, că participanţii acordă prioritate clarităţii operaţionale şi aspectelor economice în detrimentul motivaţiilor de mediu. Această discrepanţă sugerează că, deşi consumatorii recunosc valoarea ecologică a SRD, comportamentul lor este determinat mai mult de consideraţii pragmatice. Constatările subliniază importanţa unor strategii educaţionale şi de comunicare cuprinzătoare care să prezinte atât impactul asupra mediului, cât şi beneficiile practice. Studiul contribuie la literatura comportamentală privind gestionarea durabilă a deşeurilor şi oferă recomandări practice pentru factorii de decizie care doresc să îmbunătăţească implicarea publicului în implementarea SRD la nivel naţional.

***Cuvinte-cheie**: Sistemul de Returnare a Depozitelor (SRD); economie circulară; motivaţia de mediu; implicarea; conştientizare publică; Republica Moldova; gestionarea deşeurilor.*

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