AI AND POVERTY REDUCTION IN MOLDOVA: A CONCEPTUAL SIMULATION FRAMEWORK FOR SOCIAL ASSISTANCE

Mihail CIOBANU
PhD student, Scientific Researcher
National Institute for Economic Research,
Academy of Economic Studies of Moldova,
Email: ciobanu.mihail@ase.md

Xülasə. Moldovanın 2023-cü ildə 31,6% yoxsulluq səviyyəsi və 2024-cü ildə adambaşına düşən 7.618 ABŞ dolları ÜDM sosial yardım sisteminin daha ağıllı şəkildə təkmilləşdirilməsinə təcili ehtiyac olduğunu göstərir. Bu məqalə Moldovanın sosial təminat sisteminə süni intellektin - maşın öyrənməsi, proqnozlaşdırıcı analitika və təbii dil emalının - inteqrasiyası üçün konseptual simulyasiya çərçivəsini təqdim edir. Dörd ssenari sosial yardımdan kənarda qalma səhvlərinin 12–22% azalmasını və xərclərin 25%-ə qədər qənaətini proqnozlaşdırır, siyasətçilər və inkişaf tərəfdaşları üçün mühüm siyasət nəticələri təqdim edir.
Açar sözlər: süni intellekt, yoxsulluğun azaldılması, sosial yardım

Abstract. Moldova's 31.6% poverty headcount (2023) and GDP per capita of USD 7,618 (2024) underscore urgent needs for smarter social assistance. This paper presents a conceptual simulation framework for integrating AI - machine learning, predictive analytics, and NLP - into Moldova's welfare system. Four scenarios project 12–22% reductions in exclusion errors and up to 25% cost savings, with policy implications for policymakers and development partners.
Keywords: artificial intelligence, poverty reduction, social assistance

Аннотация. Уровень бедности в Молдове в размере 31,6% в 2023 году и ВВП на душу населения в размере 7 618 долларов США в 2024 году подчеркивают острую необходимость более эффективной системы социальной помощи. В данной статье представлен концептуальный симуляционная структура для интеграции искусственного интеллекта - машинного обучения, предиктивной аналитики и обработки естественного языка - в систему социального обеспечения Молдовы. Четыре сценария прогнозируют снижение ошибок исключения на 12–22% и экономию затрат до 25%, с важными политическими выводами для лиц, принимающих решения, и партнеров по развитию.
Ключевые слова: искусственный интеллект, снижение бедности, социальная помощь

Introduction

The Republic of Moldova stands at a critical juncture in its socioeconomic development trajectory. With a GDP per capita of USD 7,618 in 2024 (World Bank, 2025a) and a national poverty headcount ratio of 31.6% recorded in 2023 - subsequently estimated at 25.7% under the revised 2024 absolute poverty threshold of 2,780 MDL per person per month (Prav-da.Moldova, 2025) - Moldova remains one of the most economically vulnerable countries on the European continent. Poverty disproportionately affects specific population subgroups: indi-viduals with primary education (60%), families with three or more children (49%), residents of southern regions (43%), pensioners (37%), and agricultural workers (31%). As of early 2024,

56.5% of Moldova's population resided in rural areas, where social service access and digital literacy consistently lag urban centers. These structural vulnerabilities are compounded by a social protection system that continues to struggle with inadequate targeting, administrative inefficiency, and persistent exclusion errors.

The country's flagship social assistance program - Ajutor Social - still relies predominantly on rule-based proxy means testing (PMT) mechanisms that fail to capture the full complexity of household poverty dynamics, particularly for households exposed to seasonal migration, energy price shocks, and climate-related agricultural losses. Against this backdrop, the rapid global diffusion of artificial intelligence (AI) technologies presents a potentially transformative opportunity for social assistance modernization. The OECD's landmark 2025 report on AI and the future of social protection documents that governments across member and partner countries are increasingly applying AI to improve the coverage, effectiveness, and efficiency of social programmes, with particular applications in client support, back-office automation, and fraud detection (OECD, 2025).

In July 2024, Moldova's Ministry of Economic Development and Digitalization approved the White Book on AI and Data Governance, explicitly outlining the country's vision for responsible AI deployment in public services. This document, combined with Moldova's Digital Transformation Strategy 2023–2030 and its remarkable leap from the high to the very high E-Government Development Index group in the 2024 UN E-Government Survey, signals a genuine institutional readiness for AI-augmented social policy. Notwithstanding this enabling environment, the wholesale transposition of AI solutions from high-income settings to resource-constrained transitional economies carries well-documented methodological and ethical risks.

AI-enabled welfare systems in India's Telangana state (2024) auto-rejected thousands of food assistance applications due to biometric data mismatches, while Sweden's algorithmic benefits profiling system denied assistance to 10–15% of eligible claimants in error (Digital Convergence Initiative, 2025). A context-sensitive, simulation-based approach is therefore essential for evaluating the prospective impacts of AI adoption before full-scale deployment. This paper fills a gap in the literature by developing a conceptual simulation framework tailored to Moldova's specific institutional environment. Three research questions guide the study: (1) Through what mechanisms can AI improve social assistance targeting and delivery in Moldova? (2) What institutional and infrastructural preconditions must be in place for responsible AI adoption? (3) What do simulated scenarios reveal about the magnitude and distribution of potential welfare gains and risks?

Literature review

The intersection of AI and social protection has attracted rapidly expanding scholarly and policy attention, accelerated by post-pandemic imperatives for welfare system modernization and by the emergence of large language models and generative AI as practical tools for public service delivery. A foundational strand of the literature concerns AI applications in welfare targeting. Aiken (2024), in a comprehensive doctoral dissertation from UC Berkeley, demonstrates that machine learning models trained on mobile phone metadata, satellite imagery, and administrative data substantially outperform traditional PMT instruments in poverty classification accuracy in low-resource settings. The research documents that ML (machine learning) approaches can achieve 15–25% reductions in combined exclusion and inclusion errors relative to conventional survey-based methods.

The OECD (2025) report on AI and the future of social protection in OECD countries provides the most comprehensive and up-to-date synthesis of current AI applications in welfare systems globally. The report finds that AI is already embedded in half of Public Employment Services (PES) across OECD countries for job matching and profiling, and documents success-

ful deployments in fraud detection, document processing, and real-time benefit eligibility determination. Crucially, however, the report notes that governments are proceeding with caution, citing concerns about explainability, data quality, and the risk of automating discrimination (OECD, 2025). Concerns about algorithmic exclusion and bias are substantiated by a growing empirical record of AI welfare failures.

The Digital Convergence Initiative (2025) documents three paradigmatic cases: India's Telangana state (2024), where algorithmic auto-rejection denied food rations to thousands of elderly and climate-displaced households; the Netherlands' SyRI system, which disproportionately targeted immigrant and low-income communities before being struck down by courts as rights-violating; and Australia's Robodebt program, which erroneously issued debt notices totaling USD 900 million to over 500,000 welfare recipients before its collapse under legal challenge. These cases underscore Eubanks' (2018) seminal argument that automated welfare systems disproportionately harm already-marginalized populations when deployed without adequate transparency, accountability, and grievance mechanisms.

On the positive side, NLP-based citizen interfaces have demonstrated meaningful access improvements in diverse contexts. Within the Eastern European context specifically, the UNDP's 2025 Human Development Report for Moldova highlights that since 2005, Moldova's Human Development Index has increased by 11.8%, yet inequality-adjusted HDI stands at only 0.719 in 2023 - reflecting persistent structural barriers to inclusive development (UNDP, 2025). The report explicitly identifies AI governance and inclusive digital policy as critical determinants of whether AI will accelerate or exacerbate Moldova's development trajectory. International donors are responding: in 2025, a joint EU-UNDP three-year, EUR 3 million project was launched specifically to strengthen Moldova's social protection systems through digital innovation, and Italy-UNDP channeled an additional EUR 14 million for complementary social protection capacity building (UNDP, 2025).

The research thus converges on a consistent set of enabling conditions for responsible AI in social protection: high-quality interoperable administrative data, adequate computational infrastructure, algorithmically literate civil servants, transparent governance and grievance frameworks, and participatory design mechanisms. The simulation framework developed in this paper operationalizes these conditions for the Moldovan context.

Methods and data

This study employs a mixed conceptual-simulation methodology, combining systematic literature review with scenario-based modeling. Given the nascent stage of AI deployment in Moldova's social assistance domain and the consequent absence of real-world outcome data, prospective simulation under defined parametric assumptions represents the most rigorous available methodology for impact projection. This approach is consistent with established practices in technology policy evaluation in data-scarce environments (Walker et al., 2003). The systematic literature review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. The simulation framework models four scenario architectures reflecting graduated levels of AI integration. Scenario S0 represents the status quo (no AI integration). Scenario S1 introduces ML-enhanced targeting, replacing the current categorical PMT with gradient-boosted classification models trained on the Moldova Household Budget Survey and linked administrative registers.

Scenario S2 adds an NLP-based citizen service interface in Romanian and Russian, accessible via mobile and web platforms. Scenario S3 implements full integration, adding real-time predictive risk monitoring - an early warning layer that identifies households at risk of poverty onset based on labor market, energy price, and migration data signals. Three outcome dimensions are modeled for each scenario: (i) targeting accuracy, measured by changes in combined inclusion/exclusion error rates; (ii) administrative efficiency, measured by per-

beneficiary processing cost and average application time; and (iii) equity impact, measured by coverage rate changes among the lowest income quintile. Scenario parameters are calibrated using three primary data sources: the Moldova Household Budget Survey 2023 (National Bureau of Statistics, 2024); the World Bank Social Protection and Labor Database 2023–2025. International benchmark data from comparable AI deployments documented in OECD (2025) and

Aiken (2024) are used where Moldova-specific empirical data are unavailable. Sensitivity analyses vary data quality, institutional capacity, and digital literacy parameters across ranges derived from Moldova's 2024 AI readiness profile (Oxford Insights, 2024). The simulation outputs represent probabilistic projections under idealized conditions. All projected ranges reflect 80% confidence intervals derived from Monte Carlo sensitivity analysis across the parameter space described above. Results need to be interpreted as indicative rather than predictive, with the primary analytical value lying in the relative ordering and magnitude of effects across scenarios rather than in the precision of point estimates.

Results and discussions

The simulation results in ***Table 1*** reveal a consistent positive relationship between depth of AI integration and projected welfare outcomes, with important qualifications regarding preconditions and distributional risks. Under S1 (ML-enhanced targeting), projected reduction in combined targeting error rates of 8–12% reflects the substantial information gains achievable by transitioning from Moldova's current rule-based PMT to data-driven classification. In the Moldovan context, ML algorithms are able to exploit non-obvious correlations in household budget survey and administrative data - including patterns of utility consumption, seasonal mobile phone activity, and remittance receipt - that are not captured by categorical eligibility criteria.

Table 1.

Simulation scenario parameters and projected outcomes

Scenario	AI components	Targeting error reduction	Admin. cost saving (5-yr)	Q1 coverage gain
S0 – Baseline	None (status quo PMT)	—	—	—
S1 – Partial	ML-enhanced targeting	8–12%	7–10%	+3.4%
S2 – Moderate	ML + NLP citizen interface	12–16%	14–18%	+6.9%
S3 – Full	ML + NLP + Predictive risk monitoring	16–22%	19–25%	+9.7%

Source: Elaborated based on author's estimates

This aligns with Aiken's (2024) finding of 15–25% error reduction in analogous low-resource settings, and suggests that Moldova's relatively well-developed administrative data infrastructure, including the MPay and MConnect interoperability platforms, provides a stronger baseline than many comparator countries. The moderate integration scenario S2, which adds an NLP-based multilingual citizen interface, projects substantially larger gains: 12–16% targeting error reduction, 14–18% cost savings, and a 6.9 percentage point coverage increase for the bottom quintile.

The amplification effect relative to S1 is primarily attributable to reduced application dropout rates among rural households - consistent with the 18–30% dropout reductions for comparable NLP deployments. Moldova's 98% 4G network coverage and 80% internet penetration rate provide a strong distributional infrastructure for mobile-first service access, though

the rural-urban digital literacy gap (56.5% of the population is rural as of 2024) requires targeted accessibility design. The full integration scenario S3 generates the largest projected welfare gains across all three outcome dimensions. The incremental benefit of adding predictive risk monitoring to existing ML and NLP components reflects the value of proactive household identification in a context of high circular migration, seasonal agricultural employment, and energy price volatility - factors especially acute since Russia's invasion of Ukraine drove energy costs up by 56% for electricity and more than 300% for gas in 2022, with lasting poverty implications documented in the World Bank's 2023 Moldova Poverty Assessment.

The early warning capacity modeled in S3 would enable social workers to reach at-risk households before poverty becomes entrenched, operationalizing the preventive social protection paradigm advocated by UNDP's 2025 Human Development Report for Moldova. Sensitivity analysis reveals that S3 gains are strongly conditional on data quality and institutional capacity. When the data quality parameter is reduced by 30% -approximating scenarios of incomplete civil registration or administrative under-coverage in rural southern regions - projected targeting error reductions fall by approximately one-third. Institutional capacity deficits, proxied by civil servant AI literacy scores from Moldova's 2024 Oxford Insights AI Readiness profile (Technology Sector score: 29.94 out of 100), are the single largest attenuator of projected efficiency gains across all three integration scenarios. This finding is consistent with OECD (2025), which identifies workforce readiness as the primary implementation bottleneck for AI in social protection systems. The equity analysis produces a finding of considerable policy significance. Across all scenarios, projected coverage gains for the bottom quintile exceed those for higher income groups in relative terms, indicating a pro-poor distributional profile for AI-enhanced social assistance.

However, this progressive outcome is contingent on the explicit incorporation of demographic fairness constraints - specifically, parity requirements to prevent the systematic underscoring of Roma communities, elderly single-person households, and rural residents with sparse administrative records. Without such constraints, unconstrained ML models risk replicating historical exclusion patterns, as documented in the Telangana and Netherlands cases (Digital Convergence Initiative, 2025). These findings are directly relevant to Moldova's institutional context. The July 2024 White Book on AI and Data Governance provides an initial policy foundation for algorithmic accountability, but translating its principles into operational safeguards - algorithmic impact assessments, independent audit mechanisms, and citizen grievance pathways - requires further regulatory development.

The joint EU-UNDP EUR 3 million social protection digitalization project launched in 2025, combined with the EUR 14 million Italy-UNDP envelope, represents a significant financing opportunity to embed fairness and accountability requirements into any AI welfare deployment from its inception (UNDP, 2025). Taken together, the results support a phased AI integration roadmap for Moldova: S1 implementation in the short term (2025–2027), coinciding with the ongoing Social Registry modernization; S2 deployment within 2027–2029, leveraging the MWallet and EVOSign digital identity infrastructure; and S3 activation within a 2029–2031 horizon, contingent on the development of an interoperable real-time data exchange layer across CNAS, ANOFM, and the tax authority. Each phase should be preceded by algorithmic impact assessments and accompanied by civil service AI literacy programs aligned with the Digital Transformation Strategy 2023–2030 milestones.

Conclusions

We developed a conceptual simulation framework to assess the potential impacts of AI integration on social assistance targeting and delivery in the Republic of Moldova. Drawing on a systematic review of research and a scenario-based simulation calibrated to Moldova's most current available data, we reach three principal conclusions. First, AI-enhanced social assis-

tance has the potential to generate substantial and progressive welfare gains in Moldova. Simulated scenarios project targeting error reductions of 8–22% and administrative cost savings of 7–25% depending on the depth of integration, with the largest relative gains accruing to the bottom income quintile.

These estimates are broadly consistent with the 2024–2025 international evidence base, including OECD (2025) and Aiken (2024), and are plausible given Moldova's existing digital infrastructure - 98% 4G coverage, MConnect interoperability layer, and the newly enacted AI and Data Governance framework. Second, these gains are not automatic. They are contingent on enabling conditions that Moldova must actively develop: interoperable administrative data systems connecting the social register, civil registry, and tax authority; sustained AI literacy programs for social workers and ministry officials; a legally binding algorithmic accountability framework building on the 2024 White Book; and participatory design mechanisms that include Roma communities, rural households, and other marginalized groups.

Given Moldova's 2024 Oxford Insights AI readiness Technology Sector score of 29.94/100, institutional capacity building represents the most binding constraint and must precede large-scale deployment. Third, the risks documented in international AI welfare deployments, from India's Telangana to Australia's Robodebt, demonstrate that poorly governed AI systems can cause severe and disproportionate harm to the very populations they are intended to serve. Moldova's EU integration trajectory and the active involvement of UNDP, the EU, and bilateral donors provide a favorable governance environment for embedding human rights, transparency, and accountability requirements into AI welfare systems from the outset. This study is subject to limitations inherent in prospective simulation: outputs are sensitive to parameter assumptions and cannot fully capture Moldova's political economy dynamics. Future research should prioritize pilot implementation studies with rigorous quasi-experimental evaluation designs, and extend the framework to incorporate energy poverty and climate-related vulnerability dimensions increasingly salient in Moldova's post-2022 context.

In conclusion, the pathway to smarter, fairer, and more effective poverty reduction in Moldova runs through the careful, accountable, and phased integration of artificial intelligence into the social assistance systems that serve the country's most vulnerable citizens. The institutional foundations are being laid; the evidence reviewed here suggests the opportunity is real, and the risks, manageable, if governance is given equal priority to technology.

Acknowledgments: The article was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union", institutional funding.

REFERENCES:

1. Aiken, E. (2024). Targeting social protection programs with machine learning and digital data [Doctoral dissertation, University of California, Berkeley]. UC Berkeley School of Information. Accessed on 21.02.2026, Accessible at: https://www.ischool.berkeley.edu/research/publications/2024/targeting-social-protection-programs-machine-learning-and-digital-data
2. Digital Convergence Initiative. (2025). AI in social protection: harnessing potential, preventing harm, Accessed on 21.02.2026, Accessible at: https://spdci.org/resource/ai-in-social-protection-harnessing-potential-preventing-harm/
3. Eubanks, V. (2018). Automating inequality: How high-tech tools profile, police, and punish the poor. New York: Picador, St Martin's Press, Accessed on 21.02.2026, Accessible at: https://lthj.qut.edu.au/article/view/1386/845

4. Ministry of Economic Development and Digitalization of Moldova. (2024). White book on AI and data governance of the Republic of Moldova. Government of Moldova, Accessed on 21.02.2026, Accessible at: https://mded.gov.md/cartea-alba-privind-inteligenta-artificiala-si-guvernanta-datelor-primul-document-cadru-de-politici-al-mded/
5. National Bureau of Statistics of Moldova. (2024). Household budget survey 2023: Key indicators. National Bureau of Statistics, Accessed on 21.02.2026, Accessible at: https://statistica.gov.md/en/household-budget-survey-hbs-9925.html
6. OECD. (2025). AI and the future of social protection in OECD countries. OECD Artificial Intelligence Papers, No. 42. OECD Publishing, Accessed on 21.02.2026, Accessible at: https://doi.org/10.1787/7b245f7e-en
7. Oxford Insights. (2024). Government AI Readiness Index 2025. Oxford Insights, Accessed on 21.02.2026, Accessible at: https://oxfordinsights.com/ai-readiness/ai-readiness-index/
8. Pravda.Moldova. (2025). The absolute poverty rate in Moldova reached 25.7% in 2024, an increase of 2.8%, according to Expert-Grup data, Accessed on 21.02.2026, Accessible at: https://md.news-pravda.com/en/world/2025/11/28/82712.html
9. UNDP Moldova. (2025). In the age of AI, Moldova faces key choices to ensure human development progress. United Nations Development Programme, Accessed on 21.02.2026, Accessible at: https://www.undp.org/moldova/press-releases/age-ai-moldova-faces-key-choices-ensure-human-development-progress-says-new-undp-report
10. Walker, W. E., Harremoës, P., Rotmans, J., van der Sluijs, J. P., van Asselt, M. B. A., Janssen, P., & Krayer von Krauss, M. P. (2003). Defining uncertainty: A conceptual basis for uncertainty management in model-based decision support. Integrated Assessment, 4(1), 5–17, Accessed on 21.02.2026, Accessible at: https://doi.org/10.1076/iaij.4.1.5.16466
11. World Bank. (2023). Moldova poverty headcount ratio at national poverty line (% of population): 2023 estimate. Poverty and Inequality Platform, Accessed on 21.02.2026, Accessible at: https://pip.worldbank.org/country-profiles/MDA
12. World Bank. (2025a). GDP per capita (current US$) - Moldova, Accessed on 21.02.2026, Accessible at: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=MD
13. World Bank. (2025b). Moldova Poverty Assessment: Boosting Access to Opportunities and Strengthening Resilience. World Bank. License: CC BY-NC 3.0 IGO. Accessed on 21.02.2026, Accessible at: http://hdl.handle.net/10986/43114