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Assessing the Role of AI in Improving Transparency, Targeting, and Responsiveness of India's Public Distribution System for Hunger Reduction

Dr. Nidhi Sarraf*

Assistant Professor (Economics), Central University of Jammu, J&K.

*Corresponding Author: nidhi.edu@cuajammu.ac.in

Abstract

The Public Distribution System (PDS) is one of India's most important welfare mechanisms for protecting poor and vulnerable households from hunger and food insecurity. Despite its wide reach, the system continues to face serious challenges such as leakages, incorrect identification of beneficiaries, uneven distribution, delays, and lack of transparency in delivery. These problems reduce the overall effectiveness of the PDS and limit its role in ensuring food access for all. In this context, Artificial Intelligence (AI) is emerging as a promising tool to improve the functioning of welfare systems through better data use, faster decision-making, and more efficient service delivery. This chapter discusses how AI can contribute to making the PDS more transparent, better targeted, and more responsive to people's needs. AI can support the identification of genuine beneficiaries, track food grain movement, detect irregularities, forecast demand, and strengthen monitoring and grievance handling. Such improvements can help reduce corruption, minimize errors, and ensure that food support reaches the right people at the right time. However, the use of AI also raises concerns about digital exclusion, privacy, data quality, and fairness. The chapter argues that AI should not replace human responsibility but should be used carefully as a supportive tool within an inclusive and accountable governance framework. A balanced use of technology can strengthen the PDS and contribute meaningfully to hunger reduction in India.

Keywords: Artificial Intelligence, Public Distribution System, Food Security, Hunger Reduction, Transparency, Targeting, Responsiveness, Welfare Governance, India, Inclusive Delivery.

Introduction

The Public Distribution System in India is among the largest state-run food distribution programme in the world. It plays an important role in improving food access by supplying subsidized food items and essential commodities to eligible families under the National Food Security Act (NFSA). Over time, it has become a

major component of India's social welfare system, particularly for low-income and vulnerable sections of society. Despite its importance, the system has been criticized for problems such as food grain diversion, fake or duplicate beneficiaries, targeting errors, corruption, delays, and weak grievance handling. These governance failures have repeatedly limited the system's contribution to food security and hunger reduction. The study on the PDS shows that its importance is undeniable, but its effectiveness depends heavily on transparency, accuracy in targeting, and the administrative ability to respond to people's needs in a timely manner (George & McKay, 2019; Masiero, 2015).

According to the Department of Food and Public Distribution (n.d.), the Public Distribution System has undergone major digital reforms in recent years. These include digitization of ration-card records, Aadhaar seeding, electronic point-of-sale machine at fair price shops, digital stock and allocation monitoring, and portability reforms under One Nation One Ration Card scheme. These changes have moved the PDS from a largely paper-based administrative system toward a digital platform capable of producing real-time transaction data and broader administrative visibility. Official dashboards now provide statewise information on ration cards, beneficiaries, allocation, portability operations, and e-PoS-linked distribution. This shift matters because digital infrastructure creates the foundation on which more advanced systems, including AI-enabled monitoring and decision support, can be built.

Artificial intelligence, in this context, should be understood broadly. It does not refer only to robots or complex autonomous machines. In public administration, AI includes predictive analytics, anomaly detection, pattern recognition, demand forecasting, automated classification, grievance analysis, and decision support systems that help governments process large datasets and act more effectively. Recent work in public-governance scholarship argues that AI's significance lies not in technology itself, but in how it is embedded in administrative systems, institutional accountability, and citizen-facing service delivery. For India's Public Distribution System, this means the real question is whether AI can improve the quality of governance in ways that strengthen food access and reduce hunger (Zuiderwijk et al., 2021).

This study suggests that artificial intelligence can strengthen India's Public Distribution System in three closely connected areas: transparency, beneficiary targeting, and responsiveness. AI can improve transparency by making irregularities easier to detect, improve targeting by reducing duplication and strengthening beneficiary identification, and improve responsiveness by helping administrators anticipate demand and react more quickly to disruptions. However, these gains are not automatic. AI systems depend on accurate data, adequate infrastructure, administrative capacity, public trust, and strong grievance mechanisms. If these conditions are weak, AI may reproduce exclusion or create new forms of opacity.

Therefore, Artificial intelligence should be understood as a supportive tool for governance, not as a complete solution to hunger. (Kumar et al., 2021; Zuiderwijk et al., 2021).

The Public Distribution System and the Problem of Hunger Reduction

The PDS was designed to make essential food grains accessible at subsidized prices, especially for poorer households. Under the NFSA, eligible households receive entitlements that are intended to protect them from severe food-price pressures and basic food deprivation. The broader policy logic is that hunger cannot be addressed only through aggregate food production; it also requires institutional systems that ensure food reaches vulnerable populations at affordable rates. In this sense, the PDS is not merely a logistical mechanism but a form of social protection embedded in food security policy (George & McKay, 2019).

Even so, food security and hunger reduction are more complex than the distribution of grains alone. Hunger is shaped by income, employment, price fluctuations, health, sanitation, gender inequality, and dietary quality. A household may receive subsidized grain and still experience nutritional deprivation. This means the PDS should not be seen as a complete answer to hunger, but rather as one of the most important institutional tools available to reduce food stress among low-income groups. The literature therefore treats the PDS as necessary but insufficient: it can reduce vulnerability, but its outcomes depend on how fairly and efficiently it is run (George & McKay, 2019).

Historically, the greatest problem with the PDS has been implementation failure. Earlier scholarship documented substantial leakages, meaning that food grains intended for beneficiaries were diverted before reaching them. These leakages took place through transport losses, stock diversion, retail-level corruption, or manipulation of beneficiary records. Such failures had two major consequences. First, they reduced the welfare impact of public spending. Second, they weakened trust in the system itself. In a food security program, delivery failure has a direct human consequence: households that are formally eligible may still face food stress because entitlements do not reach them in practice (Ahluwalia, 1993).

The recognition of these failures generated pressure for reform, especially through digitization. Scholars examining state-level reforms found that digital record systems, electronic monitoring, and computerization improved traceability and administrative oversight. Masiero's study of Kerala is especially important because it showed that e-governance did not simply automate an existing system; it changed the way food distribution became visible and governable to the state. This insight is central to later discussions of AI. If digitalization creates new administrative visibility, AI may deepen that visibility by making the resulting data more actionable (Masiero, 2015).

Governance Challenges in Public Distribution System

The PDS faces several challenges that affect its proper functioning. These include errors in identifying deserving households, leakage and diversion of food grains, insufficient storage facilities, poor viability of Fair Price Shops, and the supply of low-quality food grains. As a result, the efficiency of the system is reduced.

▪ **Identification of Households Beneficiaries**

Mahamalik and Sahu (2011) highlighted major targeting errors in the Public Distribution System. According to their findings, only 32.2 percent of ration cards reached poor households, whereas 67.8 percent were given to non-poor households. They also found that a large share of BPL and AAY cards was issued to families that were not poor. The study shows that the scheme has major difficulties in identifying the people who actually deserve the benefits.

▪ **Leakages**

Leakages is one of the major challenges facing the Public Distribution System and seriously affect its proper working. Leakage means the gap between the amount of food grains taken by the state and the amount actually received by the beneficiaries (Gulati & Saini, 2015).

It can happen for several reasons:

- Ghost cards
- Shadow ownership
- Diversion by Fair Price Shop owners

The study also found that leakage levels differ across states. States such as Assam, Himachal Pradesh, and Madhya Pradesh had high levels of leakage, with more than 30 percent lost through ghost cards. On the other hand, Andhra Pradesh, Kerala, Haryana, and Tamil Nadu had lower leakages, with less than 10 percent. (Ghabru et al., 2016).

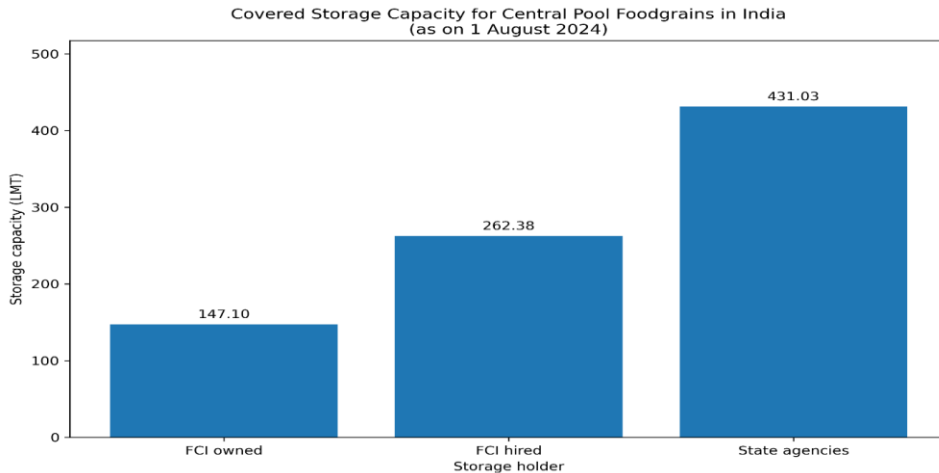
▪ **Food Subsidy**

According to PRS Legislative Research reports, 2025, food subsidy remains the largest component of spending in the Department of Food and Public Distribution. The subsidy burden remains substantial due to continued procurement at minimum support prices, high operational costs, and the supply of free food grains to eligible households.

▪ **Storage Capacity**

According to reports by PRS and the Comptroller and Auditor General (CAG), storage remains an important weakness in food-grain management. As of 1 August 2024, FCI had 147.10 LMT of its own covered storage, but it also relied on 262.38 LMT of hired storage. This shows that FCI depends heavily on rented storage space.

In comparison, state agencies had 431.03 LMT of covered storage. PRS and CAG reports further indicate that FCI's owned storage capacity changed very little between 2018 and 2022, while spending on hired storage increased. This suggests that the shortage of permanent storage creates both operational difficulties and higher costs.



Source: Department of Food and Public Distribution

■ **Non-Viability of FPS**

Fair Price Shops are a crucial link in the Public Distribution System, and their economic viability directly affects service delivery. However, the low financial returns available to many FPS dealers have long weakened their functioning and, in some cases, encouraged malpractice. Recent evidence indicates that this issue remains unresolved. A Parliamentary Committee observed that dealer margins are still low and called for their revision to ensure sustained viability. (PRS Legislative Research, 2025)

From Digitalization to Artificial Intelligence in the PDS

The Department of Food and Public Distribution reports that digital rationcard databases make beneficiary records easier to update and audit. Aadhaar seeding has been used to reduce duplication and strengthen identity linkage. e-PoS machine create transaction-level records at fair price shops. ONORC allows beneficiaries to access their entitlement from different locations, which is especially important for migrant workers. Together, these reforms have made the PDS more data-intensive and more interoperable across administrative spaces.

However, digitalization and AI are not the same. Digitalization refers to converting records and transactions into electronic form. AI refers to using those data for pattern detection, prediction, decision support, or automated flagging of anomalies. In a large welfare system like the PDS, this distinction matters. A digitized system can generate information, but an AI-enabled system can help interpret it at

scale. For example, a digital dashboard may show transaction records, while an AI-based system can identify which records look suspicious, where supply anomalies are emerging, or which localities may soon experience stress in demand. This is why AI is increasingly discussed not as a separate futuristic idea, but as a next-step governance technology layered onto existing digital infrastructures (Zuiderwijk et al., 2021).

The Indian experience is especially relevant because research has already identified AI as a plausible but difficult technology for the PDS. Kumar et al. (2021) showed that the adaptation of AI in India's PDS is hindered by several challenges such as lack of trust in technology, poor knowledge of AI, and political challenges. These barriers are significant because AI in the public sector needs more than just technical tools to work effectively.

It suggests that the question is not simply whether AI could improve the PDS, but whether institutional and social conditions are strong enough for such improvements to work in practice.

AI and Transparency in Food Distribution

Transparency is one of the most frequently cited goals of PDS reform. In practical terms, transparency means that beneficiary lists, allocation records, stock flows, authentication processes, and retail disbursements should be visible, auditable, and resistant to manipulation. In a transparent system, it becomes harder for food grains to disappear, for fake entries to persist, or for frontline discretion to distort entitlements without trace. Transparency is therefore not only a managerial value but also a democratic one, because it strengthens accountability in welfare delivery (Masiero, 2015).

AI can strengthen transparency by moving from static record-keeping to dynamic monitoring. First, anomaly-detection tools can identify unusual transaction patterns. If a fair price shop shows abnormal disbursement timing, improbable beneficiary repetition, or inventory behavior inconsistent with normal demand, an AI system can flag it for administrative review. Second, AI can support cross-verification among datasets, making it easier to detect mismatches between allocation, authentication, and actual disbursement. Third, predictive monitoring can help officials identify where leakage or irregularities are more likely to occur, allowing more targeted oversight. These functions do not replace public officials, but they can increase the efficiency and reach of administrative scrutiny (Kumar et al., 2021).

Transparency, however, is not identical to technical visibility. A system may become more visible to administrators while becoming more difficult for citizens to understand or contest. Public-governance scholarship on AI warns that technological decision systems can create new forms of opacity if the logic of decision-making is not explainable or if people affected by automated flagging have no accessible way

to challenge errors. In the PDS context, this is a serious issue. If AI is used to flag accounts, prioritize investigations, or influence access-related decisions, transparency must also include explainability, auditability, and redress for beneficiaries (Zuiderwijk et al., 2021).

This means that AI-driven transparency should be designed as public accountability, not merely as internal surveillance. Its success depends on whether it reduces corruption and irregularity while preserving fairness and accessibility. AI should help reveal hidden failures in the system, but it should not create a system that becomes more inscrutable to the very citizens it is supposed to serve.

AI and Better Targeting of Beneficiaries

Targeting is a central issue in welfare policy because the success of any entitlement program depends on whether the right beneficiaries are correctly identified and served. In the PDS, targeting failures take two forms: inclusion errors, where non-eligible persons are included, and exclusion errors, where eligible persons are left out. Historically, both problems have affected the effectiveness of India's PDS. Outdated ration-card lists, duplication, local manipulation, and migration-related access barriers have all reduced the accuracy of beneficiary coverage (Ahluwalia, 1993; George & McKay, 2019).

Digital reforms have already attempted to improve targeting through database cleaning, Aadhaar linkage, and portability architecture. ONORC is especially important because it responds to a long-standing weakness of location-bound welfare systems: migrants often lose access to benefits when they move. Portability allows entitlements to move with people rather than remain tied to one shop or one district. In welfare terms, this is a major targeting improvement because it recognizes actual social vulnerability instead of assuming static residence patterns (Department of Food and Public Distribution, n.d.).

AI can deepen this improvement by making beneficiary management more adaptive. Pattern recognition systems can help detect duplication that is not immediately obvious through simple matching. Predictive tools can identify local demand shifts, helping administrators see where migration, economic stress, or underutilization may be changing the actual pattern of need. AI can also support risk-based administrative review, allowing officials to focus on locations or records where exclusion or duplication is more likely. In principle, this makes targeting more dynamic and evidence-driven rather than dependent only on periodic list revisions (Kumar et al., 2021).

Broader foodsecurity research supports the relevance of this approach.

Foini et al. (2023) showed that machine-learning systems can forecast food insecurity indicators using time-series and contextual data, which can help decision-makers anticipate worsening conditions. Although this work is not about India's PDS

specifically, it demonstrates that AI can be used to identify emerging vulnerability rather than reacting only after distress becomes visible. Applied carefully, similar methods could support anticipatory governance in the PDS, where demand, stress, or irregularity patterns inform earlier and better targeting decisions. Still, targeting through AI raises ethical concerns. If administrative databases are incomplete or inaccurate, AI can reproduce those errors at greater scale. If households are classified or flagged by opaque systems, the burden may unfairly shift onto vulnerable people to prove eligibility. Therefore, better targeting must not be defined only in technical terms. It must also include fairness, procedural accountability, and accessible appeal mechanisms.

AI and Responsiveness in the PDS

Responsiveness refers to the system's capacity to act in a timely, reliable, and adaptive manner. In the PDS, this includes regular grain availability, quick resolution of service failures, flexibility during migration, and the ability to cope with emergencies such as price shocks, local shortages, or public crises. A welfare system that is formally efficient but slow to adapt is likely to fail those who need it most.

India's recent digital reforms already support some dimensions of responsiveness. Real-time or near-real-time records allow administrators to observe transaction flows more quickly than in earlier paper-based systems. Portability through ONORC reduces the delay and denial associated with migration. During the COVID-19 period, digital and interoperable systems gained even greater policy importance because they helped governments think about continuity of delivery under stress. Research on digitalization of the PDS during the pandemic suggests that crises accelerated the push toward more integrated and data-dependent systems of welfare management (Kumar et al., 2022).

AI can extend this logic by enabling forecasting and proactive intervention. Demand-forecasting tools can help anticipate where stock shortages may emerge. Grievance analytics can reveal repeating service failures across locations. Pattern recognition can identify fair price shops whose transaction behaviour suggests malfunction, underperformance, or irregularity. Crossdistrict comparisons can help detect where utilization is falling unexpectedly, which may signal access barriers. These forms of intelligence are valuable because they allow officials to intervene earlier rather than waiting for failures to become severe (Kumar et al., 2021; Foini et al., 2023).

The significance of responsiveness lies in its relationship to hunger. Food insecurity can intensify quickly when employment is disrupted, prices rise, or migration interrupts access to entitlements. A responsive PDS can buffer those shocks. If AI helps the system anticipate and respond more quickly, it strengthens the

PDS as a mechanism of food security. However, responsiveness must also include human support. A technically fast system that offers no help when authentication fails, data are wrong, or access is interrupted is not truly responsive from the citizen's point of view.

Hunger Reduction: Potential and Limits of AI-Enabled PDS Reform

The central promise of AI in the PDS is not that it will eliminate hunger by itself, but that it can strengthen a major institutional pathway through which the state supports food access. If AI reduces leakage, improves targeting, and helps administrators respond faster to disruptions, then more eligible households may receive food support more reliably. This can lower food stress and strengthen the anti-hunger role of the PDS. In that sense, AI contributes indirectly but meaningfully to hunger reduction.

At the same time, hunger is not caused only by administrative inefficiency. It is shaped by poverty, unemployment, regional inequality, household composition, nutrition quality, public health, and social exclusion. Therefore, even a highly efficient PDS cannot solve hunger alone. The most realistic claim is that AI can improve the governance quality of a major food-security system, thereby increasing its effectiveness as one part of a wider social protection framework (George & McKay, 2019).

This distinction is important for research and policy. It prevents exaggerated technological claims while still recognizing genuine institutional value. AI may not end hunger, but it may help reduce preventable failures in food distribution that worsen hunger for vulnerable households.

Challenges and Ethical Concerns

The literature strongly cautions against technological optimism without institutional realism. Kumar et al. (2021) found that barriers to AI adoption in India's PDS include lack of trust in technology, low AI literacy, and political issues. These barriers matter because public-sector AI requires more than technical possibility. It requires organizational competence, clear governance rules, and social legitimacy. Without these, AI may remain underused, misused, or distrusted.

Another concern is exclusion. Digital welfare systems may fail when connectivity is poor, devices malfunction, biometric authentication fails, or records are inconsistent. AI layered onto such systems can intensify the consequences of bad data or weak infrastructure. Public-governance research therefore emphasizes the importance of explainability, accountability, and human oversight in AI-enabled administration. For the PDS, this means technology should support decision-making, not replace accessible grievance redress and rights-based correction procedures (Zuiderwijk et al., 2021).

Responsible use of Artificial Intelligence in the PDS should therefore include updated and reliable data, transparent operating rules, periodic audits, inclusive design, accessible complaint systems, and human review of automated decisions. AI should enhance welfare governance, not reduce citizens to opaque data points.

Conclusion

India's Public Distribution System has moved into a new stage of digital governance, and this creates a meaningful foundation for AI-enabled reform. AI has the potential to strengthen transparency through anomaly detection and deeper monitoring, improve targeting through more adaptive beneficiary management, and enhance responsiveness through forecasting and quicker administrative intervention. These are important governance improvements because they increase the likelihood that subsidized food reaches eligible households more reliably and efficiently.

Yet AI is not a substitute for welfare policy. Its contribution depends on institutional trust, infrastructure, good-quality data, accountability, and protection against exclusion. In the Indian context, the most convincing role for AI is as a tool for strengthening the governance performance of the PDS, thereby supporting hunger reduction through better delivery of existing entitlements. Properly designed and responsibly implemented, AI can help move the PDS beyond simple digitization toward a more transparent, targeted, and responsive system of public food distribution.

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