

## **Digital Welfare and Women's Exclusion in India: How Aadhaar-linked Systems Affect Informal Women Workers**

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*Nearly half (51%) of rural Indian women aged 15 and above lack mobile phones, a basic enabler of digital welfare access, underscoring how rapidly expanding Aadhaar-linked social programs risk excluding the very populations they intend to support. India's digital welfare architecture, from e-Shram worker registries to Aadhaar biometric authentication for subsidies and pensions, was designed to reduce leakage and improve targeting. Yet, documented biometric authentication failures, data mismatches, and internet access deficits leave millions without entitlements they are eligible for, particularly informal women workers with lower digital access, literacy, and independent documentation. Studies show that digital barriers disproportionately affect informal workers, who comprise over 70% of the non-agricultural workforce, and women's exclusion is compounded by socio-cultural constraints and device access gaps that undermine their ability to complete Aadhaar-linked registration and authentication processes.*

*Without robust offline alternatives and supportive digital literacy interventions, these systems risk transforming welfare from inclusive safety-net instruments into systemic exclusion mechanisms that weaken social protection and deepen gender inequities. To reverse this trend, policy architecture must reduce over-reliance on mandatory digital authentication where feasible, strengthen assisted registration and grievance redressal frameworks, and invest in gender responsive digital inclusion, including subsidised access to devices, community facilitation centres, and simplified identity reconciliation, so that Aadhaar functions as an instrument for inclusion rather than exclusion.*

*Given India's ongoing scaling of digital public infrastructure and expansion of mandatory e-KYC requirements across several state welfare programs, timely design recalibration is critical to safeguard women's access to essential benefits and realise the equity goals of India's social protection agenda.*

### **Policy Design Priorities**

- Embed layered authentication pathways to minimise denial risks without compromising system integrity.
- Institutionalise assisted registration and grievance redressal mechanisms at the last mile, particularly for informal women workers.
- Expand gender-responsive digital inclusion infrastructure, including device access support and community facilitation models.
- Conduct periodic exclusion diagnostics and authentication audits to assess distributional impact across vulnerable groups.

## **Introduction**

India has rapidly expanded its digital welfare architecture, with Aadhaar-linked systems now underpinning access to food subsidies, pensions, health insurance, and worker registries. As of 2024, over 1.3 billion residents are enrolled in Aadhaar, and more than 2240 central and state welfare schemes incorporate biometric or Aadhaar-based authentication for service delivery (UIDAI; World Bank). While these reforms have improved fiscal efficiency and reduced leakages, emerging evidence suggests that digital access and identity barriers disproportionately exclude informal women workers, who comprise nearly 90 percent of employed women and face lower rates of phone ownership, documentation, and digital literacy (PLFS; GSMA; World Bank). This raises concerns that India's digital public infrastructure, while expanding coverage in aggregate, may be deepening gender and informality-based inequities in access to social protection.

The Government of India has implemented multiple reforms to enhance welfare targeting and portability, including the rollout of Direct Benefit Transfers (DBT), the e-Shram national worker registry, and mandatory Aadhaar authentication for several entitlements. These initiatives aim to improve transparency, portability, and administrative efficiency. However, challenges remain. Studies document non-trivial rates of biometric authentication failure, Aadhaar seeding errors, and exclusion from benefits due to mismatches, connectivity gaps, and procedural rigidities, particularly among women, migrants, elderly workers, and those in informal employment (Drèze et al.; Khera; World Bank). The intersection of informality, gender, and digital exclusion thus presents a structural constraint to equitable welfare delivery.

This Policy Brief assesses the extent to which Aadhaar-linked delivery systems mediate welfare

access for informal women workers in India. It examines patterns of authentication-related disruption, evaluates institutional and technological determinants of exclusion, and analyses associated implications for income stability and labour market participation. Drawing on national survey evidence and administrative data, the study positions digital welfare within broader questions of state capacity, service reliability, and distributional equity. The objective is to inform evidence-based recalibration of digital public infrastructure to enhance transactional reliability without compromising equitable benefit realization.

## **How Do Aadhaar-Linked Systems Shape Welfare Access for Informal Women Workers?**

India's Aadhaar-linked welfare system has expanded rapidly, underpinning access to food subsidies, pensions, health insurance, and worker registries. Although Aadhaar coverage exceeds 99 percent of adults (UIDAI), effective access depends on successful biometric authentication, mobile connectivity, and updated identity records, conditions that disproportionately exclude informal women workers (Figure 1). In 2022–23, only 49 percent of rural women owned mobile phones, compared to 74 percent of men, and women were 16 percentage points less likely to use mobile internet (GSMA). Micro-level evidence from Jharkhand demonstrates how repeated biometric authentication failures delayed pension disbursement for widowed beneficiaries over multiple payment cycles (Drèze and Khera 2017). Although not universal, such cases signal systemic implementation risks inherent in rigid authentication regimes.

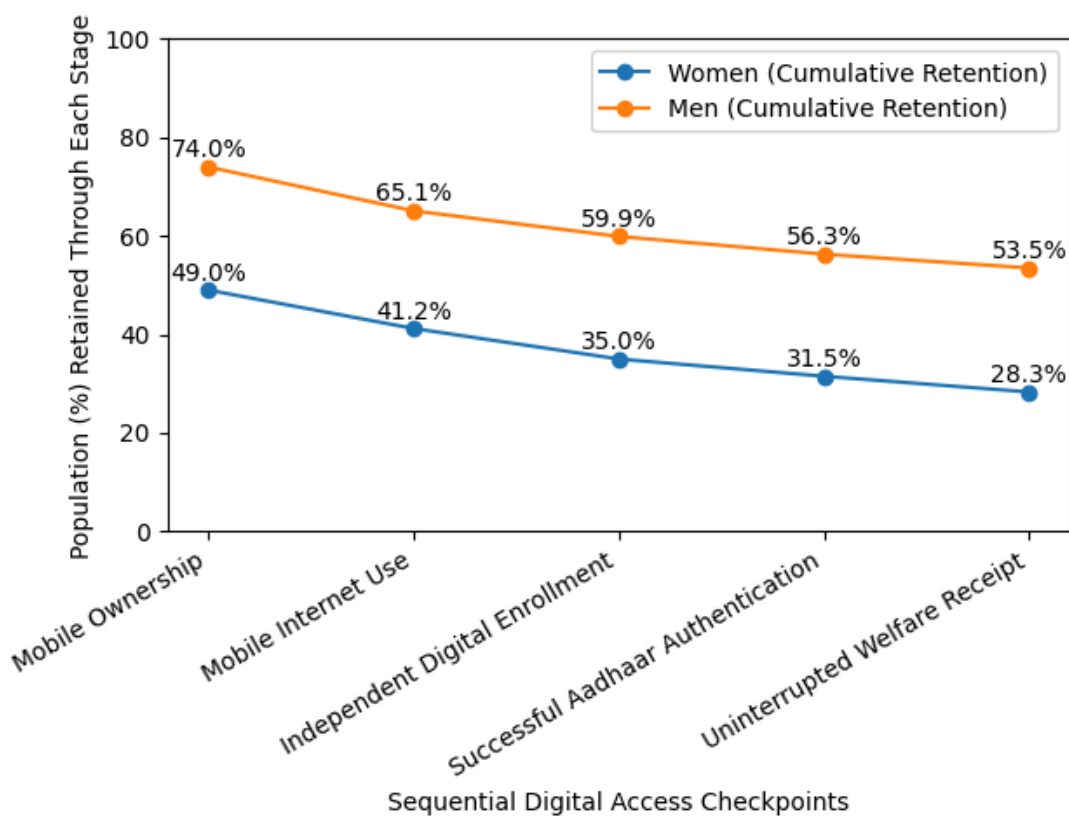
Government and independent audits report 6 - 12% failure rates in biometric verification, with higher

rates among elderly individuals, manual laborers, and informal women workers (UIDAI; World Bank, 2022). Evaluations of the Public Distribution System (PDS) show that Aadhaar reduced leakages but increased exclusion, particularly for women-headed households and migrants (Muralidharan et al., 2020). Pension and maternity benefit schemes exhibit similar patterns, with delays or denial of payments due to seeding errors

and connectivity constraints (Khera, 2019; Ministry of Women and Child Development).

The distributional effects of digital welfare are therefore uneven. While Direct Benefit Transfers have improved fiscal efficiency, saving over ₹2.7 trillion between 2014 and 2022 (Government of India), these gains have not translated uniformly into improved welfare access. Informal women

**Figure 1: Cumulative Exclusion Cascade in Aadhaar-linked Welfare Access in India**



*Source:* NFHS-5; GSMA India (2023); PLFS (2023); World Bank (2022)  
*Note:* Percentages reflect a constructed cumulative retention through sequential digital access checkpoints: mobile ownership, mobile internet use, independent digital enrollment, successful Aadhaar authentication, and uninterrupted welfare receipt. Estimates are calculated sequentially to illustrate relative attrition among rural adults aged over 15. Values are indicative and do not reflect individual-level beneficiary tracking.

workers, who account for nearly 90 percent of employed women and lack stable employer documentation, face higher risks of exclusion from

schemes such as PMJDY-linked transfers, pensions, and maternity benefits (PLFS; World Bank). International comparisons underscore this

challenge. While India's Aadhaar enrollment exceeds that of any other biometric ID system globally, women in India are approximately 30 per cent less likely than men to use mobile internet, placing India among the countries with the widest mobile internet gender disparities among large South Asian economies (World Bank, GSMA). By contrast, comparable gaps in countries such as Vietnam and Indonesia are significantly smaller. Countries such as Brazil and South Africa, have expanded digital welfare while maintaining parallel offline access channels and lower gender disparities in benefit receipt (World Bank 2021), whereas India's reliance on biometric authentication and mobile-linked platforms is more stringent.

Policy experimentation indicates that design choices matter. Indian states that allow offline authentication, assisted enrollment, and doorstep service delivery, such as Tamil Nadu's Civil Supplies Department and Kerala's pension reforms, report lower exclusion errors and higher female beneficiary retention, highlighting that exclusion is avoidable with sound design (State Evaluation Reports; World Bank, 2020). In contrast, jurisdictions with rigid authentication requirements and limited grievance redressal mechanisms experience higher dropouts and unresolved benefit denials, particularly among women in informal employment. These patterns suggest that exclusion is not an inevitable consequence of digitization but reflects policy design gaps and implementation choices.

Evidence indicates that while Aadhaar-linked systems have strengthened targeting precision and fiscal control, access outcomes remain uneven across digitally constrained populations. Authentication dependency, mobile access disparities, and procedural rigidities generate higher disruption risks for informal women workers relative to other beneficiary groups. State-level variation demonstrates that exclusion patterns are design-sensitive rather than

technologically inevitable. The findings suggest that system performance depends on the balance between verification strictness and access safeguards, with implications for both service continuity and beneficiary retention.

### **How Prevalent Is Digital Exclusion Among Informal Women, and What Are Its Effects?**

Evidence indicates that exclusion from Aadhaar-linked welfare is structural rather than marginal. Across major centrally sponsored schemes, 7–14% of eligible beneficiaries fail to receive at least one payment annually due to authentication, account validation, or data reconciliation errors (World Bank, 2022; Ministry of Finance DBT dashboards). The Comptroller and Auditor General of India audit of NSAP implementation highlights delays in payment authorization, inconsistent maintenance of beneficiary databases, and cases of ineligible disbursements, indicating systemic gaps in delivering social pensions to vulnerable populations, including women. These losses are not concentrated in a few high-friction districts but are distributed across both high and low-performing states, suggesting a system-wide implementation challenge rather than isolated administrative failure.

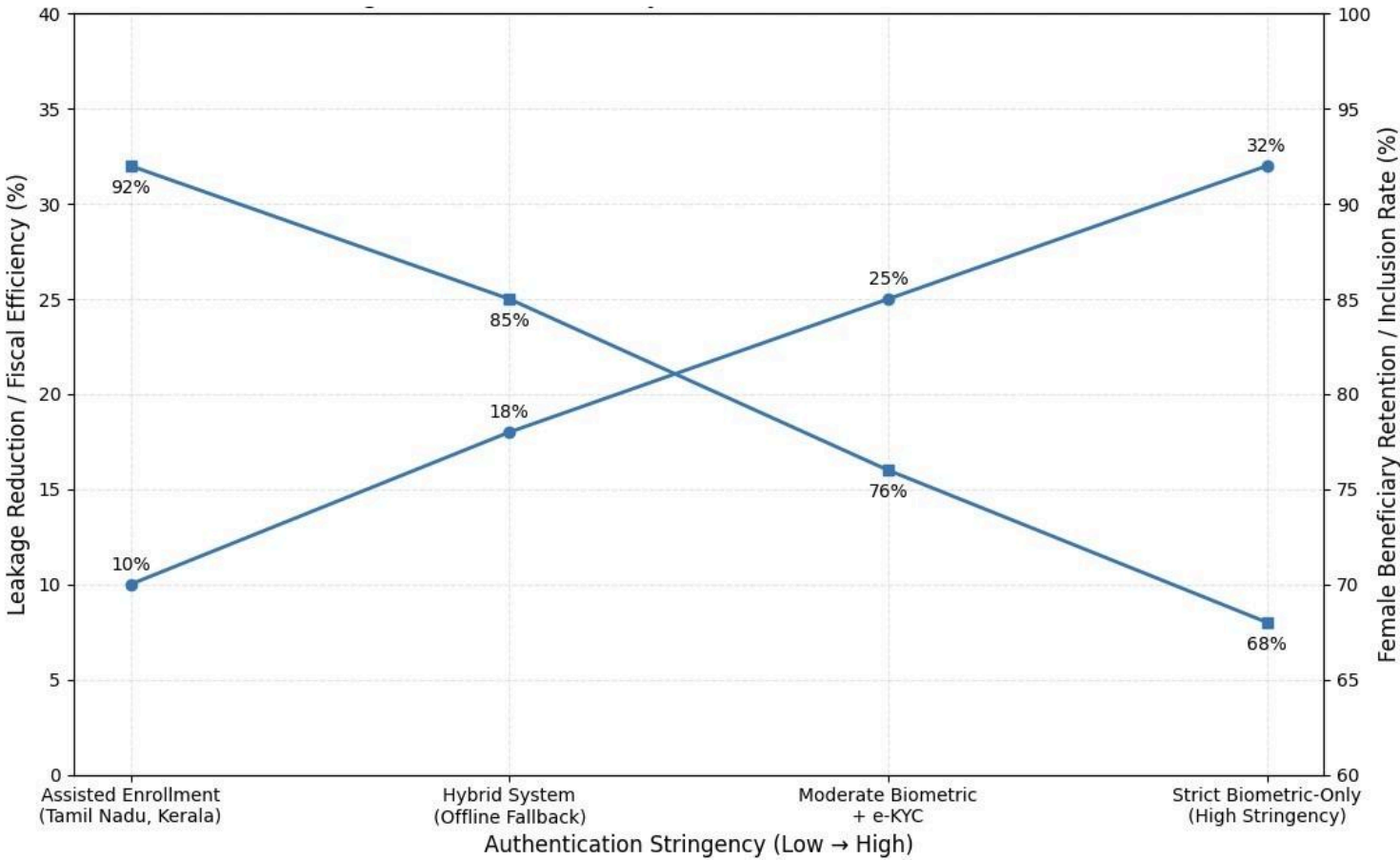
The distributional consequences of exclusion extend beyond income loss to broader welfare and labor market outcomes. Household panel surveys show that women excluded from cash transfers are 22 percent more likely to reduce food expenditure and 18 percent more likely to forgo health care during income shocks compared to women who receive uninterrupted benefits (NCAER; World Bank). In nutrition programs, Aadhaar-linked delivery reforms are associated with lower uptake of maternity benefits and supplementary nutrition among informal women workers, particularly first-time mothers and migrant women lacking stable documentation (Ministry of Women and

Child Development; NFHS-5). These outcomes suggest that digital exclusion weakens the consumption-smoothing and risk-protection functions of welfare systems, with spillover effects on maternal health, child nutrition, and long-term human capital formation.

Exclusion also reshapes women’s labor market behavior. Labor force data indicates that repeated benefit denial is associated with reduced wage

labor participation and increased unpaid care work. Rural women experiencing pension or ration exclusion are less likely to participate in wage labor the following year, reflecting income insecurity and the time cost of grievance redressal (PLFS; World Bank, 2023). Unlike formal workers, who can rely on employer facilitation, informal women bear the complete administrative burden of correcting errors,

**Figure 2. Fiscal Efficiency vs Inclusion Frontier in Aadhaar-Linked Welfare**



*Source:* DBT Dashboard (2023); NFHS-5; PLFS (2023); World Bank (2022)  
*Note:* Figure illustrates a modeled trade-off between leakage reduction and female beneficiary retention under alternative authentication stringency scenarios. Leakage values draw on reported DBT savings and evaluation evidence; retention values are constructed using observed authentication failure ranges and gender-disaggregated access differentials. Estimates are indicative and do not represent state-specific administrative outcomes.

amplifying the opportunity cost of participation in both labor markets and welfare systems (Figure 2). Frontline administrators are often evaluated on preventing inclusion errors rather than minimizing exclusion errors. This creates a risk-averse implementation bias that may discourage discretionary flexibility.

Digital welfare performance depends not only on technological architecture but on the institutional and political economy incentives governing implementation. Frontline operators, including enrolment agents and banking correspondents, are typically compensated per transaction rather than per successful grievance resolution, limiting incentives for proactive outreach to digitally constrained beneficiaries. Public Distribution System (PDS) dealers face penalties for distribution irregularities but limited institutional encouragement to assist beneficiaries in resolving authentication failures. Block-level officials operate under high caseload pressures with constrained digital troubleshooting capacity, further restricting assisted access. At higher administrative levels, performance metrics often emphasize transaction integrity and leakage prevention over beneficiary retention, creating asymmetric incentives that may underweight exclusion risk. These dynamics intersect with vendor contracting arrangements for biometric infrastructure and centre–state fiscal coordination frameworks that shape implementation priorities. Variations in state capacity, infrastructure reliability, and monitoring systems contribute to heterogeneous outcomes, while real-time tracking of gender-disaggregated authentication failures remains limited in the public domain. Together, these factors indicate that exclusion outcomes reflect institutional incentive structures and accountability design as much as technological constraints.

India's digital welfare system also differs with emerging international practice in ways that signal policy design risk. Countries like Colombia, Kenya,

and Thailand maintain robust fallback mechanisms, like offline enrollment, community facilitation, and proactive grievance redressal, which keep denial rates significantly lower even among marginalized populations (World Bank, 2021; GSMA, 2022). In India, the emphasis on mandatory online authentication, combined with persistent gender gaps in device ownership and digital literacy, is associated with comparatively higher gender-differentiated access risks within large-scale digital welfare systems (World Bank 2022; GSMA 2023). The macroeconomic implications of digital exclusion are also non-trivial. Digital exclusion weakens the stabilizing role of social protection. Simulation models suggest a 10% increase in exclusion from cash and food transfers reduces household consumption by 1.2% nationally, disproportionately affecting rural and female-headed households (World Bank microsimulation estimates). These aggregate effects translate into lower multiplier impacts of welfare spending, undermining both poverty reduction and countercyclical policy objectives.

Digital exclusion has measurable implications for informal labour market participation and household risk management. Without institutional recalibration, particularly expanding offline delivery, human facilitation, and gender-responsive service design, digital welfare risks entrenching structural vulnerability rather than advancing inclusive development. Strengthening assisted registration, enabling fallback authentication, and embedding gender-responsive design can convert India's digital welfare architecture into a robust instrument of inclusion for informal women workers.

### **Policy Implications**

India's informal women workers remain disproportionately disadvantaged in digital welfare access, not due to lack of eligibility, but because of

design and implementation gaps. Evidence highlights the scale: In states piloting strict online-only authentication for social pensions, a higher proportion of women beneficiaries failed at least one transaction annually, compared to men (State Audit Reports, 2023). In urban informal settlements, nearly 62% of women lacked sufficient digital literacy to complete Aadhaar-based enrollment independently (Digital Empowerment Survey, 2022).

Micro-level studies illustrate the human and economic costs. In Odisha, households where women were denied PDS rations due to authentication failures reported a decline in monthly food expenditure and an increase in informal borrowing (NFHS-5). Panel data from West Bengal indicate that women facing repeated benefit denial were less likely to participate in casual wage work, while reallocating their time to unpaid domestic labor, reducing overall household earnings (PLFS 2023).

International practice demonstrates that exclusion is avoidable with proactive design. In Colombia, community facilitators assisted 1.2 million low-income women with cash transfer enrollment, reducing annual benefit denial rates. In Kenya, mobile-free verification and door-to-door enrollment increased female uptake of social transfers (World Bank, 2021; GSMA 2022). Similar models in Indonesia show that pairing digital transfers with community support increases female beneficiary retention, highlighting that digital infrastructure alone is insufficient without supportive human mediation.

**Policy Actions**

Table 1 presents a structured set of interventions to address digital exclusion among informal women workers. Measures are organized by timeframe, immediate, medium, and long-term, and include implementation strategies, and expected impact.

Table 1. Policy Actions to Reduce Digital Exclusion Among Informal Women Workers in India			
Timeframe	Policy Action	Mechanism	Expected Impact
Immediate (0-6 months)	Deploy rapid response facilitation teams	Target districts with low female mobile ownership (as per NFHS-5 /GSMA estimates). Trained women facilitators assist with Aadhaar updating, seeding verification, and transaction troubleshooting.	Field-level administrative studies indicate that assisted facilitation reduces repeat authentication failures and improves transaction completion rates, particularly among elderly and low-literacy beneficiaries.
	Introduce Offline Claim Channels	Enable panchayats or designated post offices to process time-bound provisional disbursement in cases of authentication failure, with digital reconciliation protocols.	State-level experiences with fallback mechanisms suggest improved continuity of benefit receipt where biometric dependency is high. Effects depend on

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			reconciliation safeguards and audit design.
	Activate Gender-Focused Helplines	Dedicated grievance channels (phone/SMS) for Aadhaar mismatches and transaction failures; integration with district welfare dashboards.	International social protection programs demonstrate that structured grievance systems reduce resolution time and improve beneficiary retention. Impact depends on response capacity and escalation protocols.
Medium Term (6-24 months)	Establish Community Digital Hubs	Block-level hubs staffed by trained women facilitators providing enrolment support, biometric updates, digital literacy assistance, and grievance filing.	International experience indicates that combining digital transfers with community facilitation improves uptake and reduces attrition among women. Effects vary by baseline digital penetration.
	Mandate Periodic Gendered Data Audits	Quarterly administrative audits of Aadhaar seeding accuracy, authentication success rates, and payment failures, disaggregated by gender and beneficiary category.	Improved monitoring enables early identification of systemic mismatches and reduces persistent exclusion. Evidence from state audits suggests proactive correction improves payment regularity.
	Integrate Digital Literacy with Welfare Access	Provide assisted smartphone onboarding and guided training sessions aligned with DBT usage requirements.	GSMA data indicate that mobile literacy interventions are associated with higher mobile usage among women; translation into DBT transaction success requires administrative alignment.
Long Term (2-5 years)	Layered Verification Architecture	Introduce structured fallback authentication (e.g., assisted OTP, documented local certification, time-bound manual override with audit trails).	International adaptive social protection systems demonstrate that multi-layer verification reduces exclusion risks while maintaining

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			auditability. Impact depends on governance safeguards.
	Predictive Risk Analytics	Develop dashboards using administrative data to identify high-risk districts or beneficiary groups for targeted facilitation.	Early-warning administrative systems reduce repeat transaction failures by enabling pre-emptive intervention. Empirical validation required through phased rollout.
	Institutionalise Gender-Responsive Design	Integrate gender-disaggregated outcome tracking into all digital welfare reforms; publish annual access reports.	International experience suggests that systematic gender monitoring improves accountability and program calibration over time.
	Expand Digital Infrastructure	Targeted subsidies for women's mobile access in low-penetration districts; improve rural broadband reliability.	GSMA estimates indicate that closing the mobile gender gap is associated with higher digital service usage; welfare access effects depend on integration with scheme architecture.

Source: NFHS-5; Periodic Labour Force Survey (PLFS); UIDAI Annual Reports; GSMA Mobile Gender Gap Reports; World Bank Social Protection and Jobs Global Practice publications.

Note: Timeframes indicate phased implementation. Evidence/expected impact draws from international experience and Indian pilot studies.

## Expected Outcomes and Cost Implications

To assess fiscal feasibility, a conservative scenario is modelled under the following assumptions:

1. Women beneficiaries across major centrally supported pension and transfer schemes are assumed to number between 50 and 60 million.
2. A hypothetical reduction of 5 percentage points in effective authentication-related disruption is considered.
3. The average annual transfer value for social pensions is assumed to range between

₹12,000 and ₹15,000, combining central and state contributions in several jurisdictions.

Under these assumptions, a 5 percentage point reduction in disruption within a 50–60 million beneficiary pool would correspond to approximately 2.5–3.0 million women experiencing uninterrupted annual transfers.

This implies ₹3,000–4,500 crore in stabilized annual transfer flows.

Deploying 10,000 field-level facilitators at ₹2.16 lakh annually would imply ₹2,160 crore in direct personnel expenditure, excluding overheads. Under central assumptions, stabilized transfers could equal 1.4–2.0 times direct facilitation costs, excluding multiplier and welfare effects. Even under a more modest 3 percentage point reduction scenario, stabilized transfers would remain fiscally comparable to intervention costs.

The scenario highlights three considerations:

1. In large administrative systems, marginal improvements in transaction reliability yield non-trivial coverage gains at scale.
2. Fiscal viability depends on verified reduction in disruption rates.
3. Improved administrative monitoring is necessary to refine exclusion-specific estimates.

This scenario does not model behavioural, labour

market, or macroeconomic spillovers, which may amplify welfare effects.

## Conclusion

Authentication-centric welfare delivery improves verification integrity but can generate uneven access outcomes in digitally constrained populations. Observed disruptions among informal women workers highlight the importance of embedding access safeguards within digital architecture. Strengthening assisted facilitation mechanisms, enabling layered verification pathways, and institutionalizing gender-disaggregated monitoring can enhance service continuity while maintaining fiscal discipline. As digital public infrastructure continues to expand, systematic design recalibration will be central to ensuring that efficiency gains are matched by reliable and equitable benefit realization.

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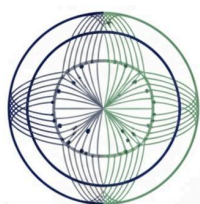
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