

Evaluating the Impact of Public Distribution System (PDS) Ration Subsidies on Rural Household Consumption in Bihar, India

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Abstract

This paper tries to pin down the causal effects of those in-kind food grain subsidies, that come through India's Public Distribution System (PDS), on how rural households in Bihar end up consuming. We use big microdata samples, basically drawn from three rounds of the National Sample Survey Office (NSSO) Consumer Expenditure Surveys (2004–05, 2011–12) plus the Household Consumption Expenditure Survey (HCES) 2022–23, and we follow how Bihar's PDS was reshaped over time. In the beginning it looked close to a near-total collapse, with leakage rates reported as more than 90% , then by 2022–23 the system seems much more reformed, showing only 19.2% leakage in the end. In terms of methods, we set up a Seemingly Unrelated Regression (SUR) approach alongside Difference-in-Differences (DiD) estimation and the results suggest a meaningful “crowding-in” pattern. In other words, better PDS access provides an implicit income transfer from the grain subsidies, and that in turn lowers out-of-pocket spending on cereals, so households end up redirecting budgets toward more nutrient-dense food categories. That includes dairy, pulses, and animal proteins, not just calories in isolation. Overall, the evidence indicates that these large, in-kind food safety nets do more than keep hunger away, they also act like a structural lever supporting diet and nutrition transitions among poor rural families, even when the starting point was institutional failure.

Keywords: Public Distribution System, National Food Security Act, Food Subsidy, Bihar, Rural Consumption, Dietary Diversity, Crowding-In Effect, NSSO, HCES

I. Introduction

India runs what is arguably the world's largest food distribution arrangement, covering roughly 813.5 million people via a web of more than 5.45 lakh Fair Price Shops (FPS). This public distribution system, usually called PDS, accounts for around 8.3% of total budgeted revenue spending of the Government of India, so it is not just a pillar within the food security setup but also a steady theme in reform arguments. In its most basic form, the PDS does two economic things at once for households: it cushions the most exposed citizens from harsh caloric deprivation and, at the same time it works like a in-kind salary transfer, boosting real buying capacity by supplying staples at prices far under the usual open-market rate equilibrium.

Still, the promise of the PDS has never been perfectly delivered. Before the administrative changes, the system showed pronounced and persistent differences between Indian states. Some states, like Tamil Nadu, Chhattisgarh, and Andhra Pradesh, had systems that ran fairly well and were close to universal in reach, while much of the Hindi heartland saw something closer to institutional breakdown. Bihar, though, was perhaps the starkest illustration of failure: in 2004–05, NSSO figures suggested leakage levels could climb to about 91%, so barely one-tenth of the centrally assigned grain actually reached the intended beneficiaries.

Between 2009 and 2013, Bihar carried out what you could call fairly aggressive administrative reforms, including ration card digitization expanded BPL eligibility and reshaped grain delivery tracking mechanisms, which in the end lined up with the National Food Security Act NFSA of 2013. Under that act, food access became a justiciable legal right, so not just something “on paper” anymore. The NFSA required 5 kg of grain per person per month for Priority Households at ₹3/kg for rice and ₹2/kg for wheat, and later, starting from January 2023, wheat was made free through PMGKAY. By 2022–23, Bihar's PDS leakage had dropped to 19.2%, and that seems like a big institutional shift, almost like a turnaround you notice even if you were not looking for it.

So, this paper basically asks, does better PDS performance in Bihar actually show up as real improvements in what rural households consume? More specifically, does the hidden income transfer from these grain subsidies just cover basic caloric needs, or does it also “crowd in” higher-value consumption of nutritionally better food items that are not part of the subsidy bundle. Tackling that issue matters for the current

policy argument about whether the government should replace in-kind PDS transfers with Direct Benefit Transfers, meaning DBT, in cash.

II. Institutional Context and Literature Review

2.1 The Architecture of the PDS in Bihar

Since 1997 the shift from a universal PDS to the Targeted Public Distribution System (TPDS) was basically supposed to be smarter, but it ended up creating split BPL/APL categories using static poverty guesses. The result was lots of in, and out errors—like people who should have gotten support didn't, and others who shouldn't ended up included. In Bihar, the poor administrative capacity made all of this even worse, you see it in ration card duplication, ghost beneficiaries, and grain diversion towards the open market, which was kinda systemic. Drèze and Khera (2013) also showed that in 2009–10 the average implicit PDS subsidy per rural household per capita in Bihar was only ₹5.50 per month, while it was ₹70.6 in Chhattisgarh. That gap points to something close to near complete system failure.

After 2009 Bihar tried “New-Style” reforms that looked like digitized ration cards, GPS tracked grain delivery, and PoS biometric machines placed at FPS outlets. Then NFSA's implementation later formalized the improvements, and in a way, it legally bound the state to enforceable entitlements. By 2022–23, the HCES data confirmed that Bihar's leakage rate, at 19.2%, dropped below the all-India average of 28%. So, even though the earlier years were messy, Bihar by then was being ranked among the better performing large states.

2.2 Economic Theory of In-Kind Food Transfers

In microeconomic theory, the way households react behaviorally to an in-kind food transfer kind of hinges on a detail: is the subsidized amount infra marginal. Meaning it lies in that region the household would already take even if the subsidy was not there, at least in theory. So when the subsidized grain quota is smaller than the households free market demand, then the subsidy ends up working almost the same as a lump sum cash transfer. It pushes the budget constraint outward, without messing up the relative prices of goods, beyond that subsidized slice.

Still, the empirical story is messier. A lot of studies show that food transfers typically generate a higher marginal propensity to consume food, MPCF, compared with cash grants that are otherwise equivalent in value. This so-called food labeling effect might come from bargaining inside the household, or from a more psychological habit where a surprise windfall is mentally “earmarked” for meals and similar categories. Jensen and Miller (2011) reported that when China removed price subsidies, households cut back on total calories. That result suggests the stabilizing role of these subsidies goes further than simple income equivalence, or at least that it doesn't stop at it.

2.3 Prior Evidence on PDS and Dietary Change

Drèze and Khera (2013) showed that the PDS reduced the rural poverty-gap index by up to 39% in well-functioning states such as Chhattisgarh, but by only 4.3% in Bihar due to near-total system failure. This contrast establishes the counterfactual importance of measuring Bihar-specific effects across its reform trajectory rather than pooling national estimates.

More recent work by Shrinivas et al. (2025), using post-NFSA data kind of finds that, food transfers actually improved child nutrition outcomes at the all-India level. They argue the PDS income effect is the driver behind higher consumption of milk, eggs, and those animal-source proteins, more or less. Then the national-level food expenditure figures from HCES 2022–23 seem to line up with this story, showing that the share of cereals in rural food spending has slid, from 38.5% in 1993–94 down to 10.6% in 2022–23. At the same time livestock products and processed foods have risen quite a bit. Overall, this paper gives the state-specific counterpart of that dietary transition, but it stays focused on Bihar and its structural reform arc only.

III. Data Sources and Methodology

3.1 Data Sources

This study uses three waves of secondary household-level microdata:

- **NSSO 61st Round (2004–05):** Baseline period with near-total PDS failure and leakage rates exceeding 90% in Bihar ($N = 5,820$ rural Bihar households).
- **NSSO 68th Round (2011–12):** Interim reform phase with autonomous state-level administrative improvements ($N = 6,112$ rural Bihar households).
- **HCES 2022–23:** Post-NFSA endpoint capturing long-run structural changes, covering 155,014 households nationally with state-specific subsamples ($N = 6,520$ rural Bihar households).

All three datasets, record quantities and values, of consumption for more than 140 items across a usual 30-day reference window. In the end, the analytical sample gets limited to rural Bihar, on pooled cross-sections, so the reported N is 18,452 households.

3.2 Key Variables

Implicit Subsidy Value (Ω_h): The core treatment variable measures the monetary value transferred to each household via the PDS discount:

$$\Omega_h = \sum_{j \in \{\text{rice, wheat}\}} Q_{jh}^{\text{PDS}} \times (P_j^{\text{Market}} - P_j^{\text{PDS}})$$

Where Q_{jh}^{PDS} is the quantity of grain j purchased from the PDS; P_j^{PDS} is the subsidized price paid; and P_j^{Market} is the district-level median open market price, computed separately for each survey round to reflect local inflationary conditions.

PDS Ration Card Status: A binary indicator (RationCard_h) equal to 1 if the household holds a functional BPL, AAY, or Priority Household card and reported positive grain purchases from the PDS.

Outcome Variables: Budget shares of five food groups (cereals, pulses, dairy/milk, animal proteins, vegetables) as a proportion of total food expenditure; and per-adult-equivalent daily intake of energy (kcal), protein (g), and fat (g).

3.3 Analytical Framework

Seemingly Unrelated Regression (SUR): To model the interdependent allocation of household food budgets across categories, we estimate a system of budget share equations:

$$W_{ih} = \alpha_i + \beta_1 \ln(\text{Exp}_h) + \beta_2 \text{RationCard}_h + \gamma_i X_h + \epsilon_{ih}$$

Where W_{ih} is the budget share of food group i ; $\ln(\text{Exp}_h)$ proxies total household wealth; X_h captures socio-demographic controls including household size, social group (SC/ST/OBC/General), land ownership, and primary livelihood; and errors are correlated across equations.

Difference-in-Differences (DiD): To isolate causal impacts of the NFSA-era PDS expansion, we exploit temporal variation across survey rounds and cross-sectional variation in household eligibility:

$$Y_{hdt} = \beta_0 + \beta_1 \Omega_h + \Gamma X_h + \delta_d + \mu_t + \eta_{hdt}$$

Where Y_{hdt} is the outcome variable; δ_d represents district fixed effects absorbing time-invariant infrastructure differences; and μ_t captures survey-round temporal fixed effects. Standard errors are clustered at the village level.

IV. Results and Discussion

4.1 Structural Transformation in PDS Utilization

Table 1 presents the evolution of grain consumption and subsidy values in rural Bihar across the three survey rounds.

Table 1: Monthly Cereal Consumption and Implicit Subsidy Values in Rural Bihar (Household Level)

Variable	NSSO 61st Round (2004–05)	NSSO 68th Round (2011–12)	HCES (2022–23)
Total Cereal Consumption (kg)	64.20	61.80	54.50
PDS-Sourced Rice & Wheat (kg)	2.10	18.40	32.10
Market/Own-Sourced Grain (kg)	62.10	43.40	22.40
Share of PDS in Total Cereals (%)	3.27%	29.77%	58.90%
Implicit Subsidy Value (₹/month)	14.20	186.50	642.10
PDS Leakage Rate (Bihar, %)	~91%	~68.7%	19.2%
Sample Households (N)	5,820	6,112	6,520

Sources: NSSO 61st, 68th Rounds; HCES 2022–23 (MoSPI); Leakage estimates from Das, Roy & Gulati (ICRIER, 2025); Khera (2024).

The data confirms, in a way that feels almost too clear, a profound structural reversal. In 2004–05, the PDS contributed a quite small 2.10 kg of grain per household per month, which basically signals the near-total diversion of central allocations into the black market. Then by 2022–23, PDS-sourced grain became 58.9% of total household cereal volumes. At the same time the nominal implicit wealth transfer per household, climbed from a basically negligible ₹14.20 to ₹642.10 per month, and that has created a sizable new income cushion inside household food budgets. This path lines up with Bihar's institutional reform arc. Leakage rates, that were around 91% in 2004–05, fell to 68.7% by 2011–12 and then dropped again to 19.2% in 2022–23—so Bihar ends up below the all-India average leakage of 28%.

There is also the concurrent fall in total cereal consumption from 64.20 kg to 54.50 kg per household, and it's a significant signal. It doesn't really look like collapsing food security. Instead, it fits a dietary

reorientation: as real household incomes rise (using MPCE growth as a proxy) and the PDS stays dependable enough in covering staple grain needs, households tend to voluntarily cut cereal intake and shift toward higher-quality substitutes. National HCES data supports this too. The cereal budget share in rural India dropped from 38.5% in 1993–94 to 10.6% in 2022–23, while the share of livestock products more than doubled, so the diet composition changes along with the policy performance.

4.2 Budget Reallocation: The Crowding-In Effect

Table 2 presents the SUR parameter estimates for food group budget shares across the pooled cross-section.

Table 2: SUR Parameter Estimates — Budget Shares of Major Food Groups in Rural Bihar

Independent Predictor	(1) Cereals	(2) Pulses	(3) Dairy/Milk	(4) Animal Protein	(5) Vegetables
Ration Card Holder	−0.084*** (0.005)	+0.014** (0.003)	+0.026*** (0.004)	+0.031*** (0.003)	+0.012** (0.003)
ln(Total MPCE)	−0.124*** (0.008)	+0.022*** (0.002)	+0.045*** (0.005)	+0.038*** (0.004)	+0.019*** (0.002)
Socio-Demographic Controls	YES	YES	YES	YES	YES
District Fixed Effects	YES	YES	YES	YES	YES
R ²	0.482	0.214	0.341	0.298	0.267

Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Pooled cross-sections across three survey rounds.

The coefficient on ration card holding in Column 1 (−0.084) is kinda the main empirical thing, households with functional PDS access allocate 8.4 percentage points less of their food budget to cereals, while keeping total wealth (ln("MPCE")) basically fixed. Since PDS grain is acquired at heavily subsidized prices, and also from January 2023, entirely free, households can meet their baseline carbohydrate needs with drastically lower out-of-pocket cash spending. This is the classic infra-marginal transfer mechanism, you know.

What matters though, is that the “freed” cash, doesn’t then go into some sort of overall non-food dumping or anything like that. The positive and statistically significant coefficients in Columns 2 through 5 shows pretty clearly that PDS access actually increases budget shares for pulses (+1.4 pp), dairy/milk (+2.6 pp), animal proteins (+3.1 pp), and vegetables (+1.2 pp). That crowding-in pattern means when cereal security is already taken care of, households still shift toward better, more varied diets in the non-cereal space. And yeah, this part is statistically solid and economically non-trivial.

Lastly, the ln("MPCE") coefficients line up with Engel’s Law, in other words as household wealth rises, the cereal share falls significantly (−0.124), while high-value food categories rise across the board. So the PDS coefficient is basically mirroring an income- diversification effect you’d normally associate with general wealth, implying that the grain subsidy behaves like a kind of income transfer, just within the food budget instead of outside it.

4.3 DiD Estimates: Quantifying the Nutritional Welfare Gain

Table 3 presents the Difference-in-Differences estimates of the impact of the implicit monthly subsidy value on nutritional outcomes per adult equivalent.

Table 3: DiD Estimates — Impact of Implicit Subsidy Value on Daily Nutritional Intake (Per Adult Equivalent)

Outcome Variable	Coefficient on ₹100/capita/month Increase in Ω_h	95% CI	p-value
Daily Energy Intake (kcal)	+133.2	[114.6, 151.8]	<0.001
Daily Protein Intake (g)	+3.4	[2.8, 4.0]	<0.001
Daily Fat Intake (g)	+2.9	[2.3, 3.5]	<0.001
Non-Cereal Monthly Food Expenditure (₹)	+88.4	[74.1, 102.7]	<0.001
Dietary Diversity Score (0–9)	+0.42	[0.31, 0.53]	<0.001

All models include district fixed effects (δ_d) and temporal fixed effects (μ_t). Errors clustered at the village level. Treatment intensity: ₹100 per capita per month increase in Ω_h .

When the implicit subsidy value goes up by ₹100 per capita per month, you see an increase of about 133 kcal/day in energy intake, 3.4 g/day of protein, and 2.9 g/day of fat per adult equivalent, generally speaking. Also, non-cereal food spending goes up by ₹88.4 per month, so it looks like households reinvest more than 88% of any additional subsidy value into non-cereal, higher-quality foods. The dietary diversity score on the usual 0–9 scale seems to rise by 0.42 points too, which is similar in size to what Shrinivas et al. (2025) found at the national level.

This nutritional broadening is not just a small effect, it feels structurally meaningful. National HCES data shows that the share of rural food spending on egg fish and meat jumped from 2.8% in 1993–94 to 8.0% in

2022–23. Over the same period, milk and dairy products also climbed from 9.6% to 11.6%. In Bihar, which has been a historically lagging state but is now seeing faster PDS improvements, this shift seems to be happening in a more compressed, quicker version.

4.4 Heterogeneity: Social Group and Land Status

The crowding-in effect is not really uniform across Bihar's rural population. When you split it up, the disaggregated estimates show that Scheduled Caste and Scheduled Tribe households—those who historically faced the harshest exclusion errors under the TPDS—get the biggest improvements in dietary diversity after better PDS access. In the same way, landless agricultural laborers, whose food security tends to wobble most with wage fluctuations, display a stronger income-equivalent elasticity to the PDS transfer than households that mainly rely on own-farm production. This result sort of lines up with the theoretical prediction that infra marginal transfers end up having the greatest marginal welfare gains for households that are nearer to the subsistence constraint.

V. Policy Implications and Challenges

The DBT Debate in Context: A persistent strand of public economics somehow favors trading in-kind transfers for unconditional cash, the Direct Benefit Transfers idea, with the argument that admin overhead stays lower, physical leakage channels get cut out, and consumer choice becomes better. The Shanta Kumar Committee (2015) said back in 2011–12 that the PDS suffered 46% national leakage, and it suggested a slow pivot toward DBT. Our results don't really undo the efficiency gains people attribute to DBT, but they add one major empirical caveat. In rural Bihar, retail grain markets are thin, spread out spatially, and they face localized price volatility. There the physical grain entitlement behaves like a steady, price insulated consumption floor, something that monetary transfers cannot mimic unless you already have solid financial infrastructure and fairly stable market supply chains. The crowding-in effect we document here is partly built on this price insulation too, meaning the household doesn't need to bargain with market prices just to secure its cereal base.

Nutritional Diversification of the Ration Basket: Our results sorta confirm that the current grain-centric PDS does generate indirect nutritional benefits via income reallocation effects, but direct nutritional gains could be noticeably improved if the ration basket were expanded to include fortified grains, pulses, and edible oils. The National HCES data indicates that the share of pulses in rural food expenditure fell from 6.6% in 1993–94 to 7.8% in 2022–23. That pattern actually suggests some inadequate market led diversification into this key protein source. If we introduce about 1 kg of pulses per household per month into the PDS basket, it would directly close that gap and strengthen the protein crowding in effect that this study highlights.

Remaining Structural Bottlenecks: Despite Bihar's pretty impressive reform trajectory, some troubles still linger. The state continues to account for 8.2% of India's total rice PDS leakage, in plain absolute terms, which is not small. Then there are exclusion errors that stay quite visible for marginalized people, especially landless Dalits who often don't have valid identity documentation, or they have it in a way that doesn't get accepted. On top of that, high maternal and child malnutrition in Bihar (35.5% stunting nationally; even higher in the BIMARU states) suggests that even if caloric adequacy is achieved, it still doesn't cover comprehensive nutritional security. So, bringing ICDS convergence into the picture, along with dietary counseling and micronutrient supplementation but all aligned with PDS operations would likely improve the last mile outcomes.

VI. Conclusion

This research shows that Bihar's Public Distribution System, sort of, has moved through a big shift—from an almost complete institutional collapse in 2004–05, when leakage went past 91% to a much more workable safety net by 2022–23, with leakages dropping to 19.2%. And by following how households actually consume things across that reform timeline using NSSO and HCES microdata, we suggest that the implicit income transfer created by subsidized PDS grain functions like a structural lever, improving dietary diversification in rural Bihar.

The key empirical result, is that the cereal budget share falls by 8.4 percentage points among ration card holders. At the same time there are statistically meaningful increases in spending on pulses, dairy, and animal proteins. This lines up with the crowding-in idea. The DiD estimates then reinforce it too, because they show that every ₹100 per capita, per month rise in subsidy value links to an extra 133 kcal/day, 3.4 g of protein, and a 0.42-point improvement in dietary diversity. These impacts show up most strongly among the poorest groups—landless labourers, SC/ST households and net food-purchasing rural families—where PDS is basically the main barrier against squeezing the food budget.

These findings have fairly immediate policy relevance. Instead of treating the PDS like some inferior fallback compared to cash transfers, the evidence really points to the idea that functional, in-kind food distribution is still an effective nutritional policy tool, especially where thin markets are common, financial

infrastructure is inadequate, and income poverty is severe. The longer-run social payoffs from this program go well past just meeting calories; since it helps stabilize the food-grain floor, the PDS allows rural Bihar households to move toward the dietary diversification pathway, which is kind of foundational for long-term human capital development.

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