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SUBSIDISED FOODGRAINS TRANSFER FOR HOUSEHOLD FOOD SECURITY: COMPARISON OF CHANGING CONSUMPTION FROM THE PUBLIC DISTRIBUTION SYSTEM AGAINST OTHER STAPLE-SOURCES IN RURAL INDIA

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Abstract

This study evaluated the effect of subsidised in-kind transfers on household food security by comparing the calorie consumption share between the Public Distribution System, India, and other sources. Using the pseudo-panel of NSSO-CES data from 1993, 2004, and 2009, and the latest 2011 (released in 2014), the study found that the share of home-produced foodgrains was supplanted by PDS. The analysis revealed a negative elasticity of per-capita calorie intake to the decline in PDS subsidies, after controlling for socioeconomic and spatial attributes. Regional interactions with elasticity were statistically significant in regions with greater vulnerability to food insecurity. Strengthening the in-kind subsidised transfer is recommended as a crucial strategy, given the continued decline in the share of home-grown sources.

Keywords: In-Kind Transfer, Food-Price Subsidy, Public Distribution System, Household Food Security, Non-Market Sources, Calorie Intake.

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Introduction

Food security has worsened globally since the COVID-19 pandemic and continuous economic crises (Swinnen & Mcdermott, 2020; UN, 2020; Laborde et al. 2020; Mardones et al., 2020; Workie et al., 2020). Time and again, the use of foodgrain transfer to mitigate food insecurity has been suggested (Barrett; Workie et al. 2020). However, in past studies, there has been mixed evidence on the effectiveness of direct transfer of foodgrains (George & McKay, 2019). Some studies have found the impact negligible (Jensen & Miller, 2010), while others have found a positive impact (Tarozzi, 2005), and there are debates about whether cash transfer rather than foodgrains is more effective (Parikh, 2013; Kozicka et al., 2017, 2019). In this context, this study analyses the effectiveness of the Public Distribution System (PDS) for improving access to calories in rural Indian households controlling for variation in socioeconomic attributes and access to alternative foodgrain sources.

While India's food availability conditions have improved since independence, food access conditions in rural areas have seen challenges due to sharp increases in real food prices (Sasmal, 2015), absence of a risk market-making credit or insurance (Ramaswami 2002; Ramaswami & Balakrishnan, 2002) and shocks such as the lockdown post COVID19 (Pothan et al., 2020). At the same time, consumption from own-grown crops in agrarian households has been on the decline; there is diversification from farm to non-farm occupations (Desmarais, 2007), increasing commoditisation of agriculture (Clapp et al., 2009), and increasing landlessness (Rawal, 2008). The need for a comprehensive policy for food and nutrition security in India is also corroborated by recent evidence of hunger, such as an increase in wasting, underweight, and stunting among children under 5 in several states of India (IIPS, 2020).

PDS has been widely studied with mixed evidence. Some studies observed that the PDS incurred excessive cost, had poor implementation, and had an insignificant impact on nutrition (Swaminathan, 2000; Ramaswami & Balakrishnan 2002; Gulati et al., 2012; Parikh, 2013; Kaushal & Muchomba, 2015). Others found a significant impact of the PDS and recent improvements on its implementation (Jean & Khera, 2013; Sen & Himanshu 2013; Sinha, 2015; Bhattacharya et al., 2017; Kaul, 2018). There is evidence of exclusion owing to biometric failure in the PDS (Dreze et al., 2017; Dreze, 2018).

The PDS underwent significant structural shifts after 2013 with the National Food Security Act (2013). NFSA allocations have two components, viz. (a) the TPDS state allocations, and (b) the tide over allocation, i.e. in the case of a reduction in post-NFSA allocation, a Centrally sponsored matching of allocation up to the pre-reduction average levels. Recent estimates showed that NFSA coverage was lower than mandated coverage by around 112 million (Khera, 2020) and offtake to allocation remained high in the states that primarily consumed rice and low (less than 100 per cent) in states that primarily consumed wheat (Bhattacharya & Ravi, 2022). The link between staple type and consumption coupled with the evidence of high demand observed in times of COVID-19 lockdown in India also imparts significance to a thorough understanding of how India's food access conditions have changed in relation to the foodgrain transfer programme of the PDS.

This study contributes to the literature on the impact of subsidised foodgrain transfer by analysing how access to multiple food sources influences the magnitude of the impact of transfer on a household's nutritional intake.

Data, Metrics, and Methodology

Four large rounds of the Consumption Expenditure Survey of the National Sample Survey Organisation (Government of India), namely the 1993, 2004, 2009 and the latest rounds, i.e. 2011 (released in 2014), are used. The dataset is comprehensive and is the only item-wise consumption data available at the unit level for a large sample size, which can be disaggregated at the regional level.

Methodology for Estimating the PDS Elasticity of Calorie

A bivariate analysis of trends in the share of calorie intake from different sources of food access was performed to gain insights into the changing relevance of these sources. In the multivariate analysis, the elasticity of rural households' per capita average calorie intake to the benefits received from the PDS was estimated. Although the objective is to estimate the comparative significance of the PDS and other sources on household consumption, taking the calorie equivalent of household consumption has the advantage that the percentage share would not be affected by changes in the quantity or value of the items consumed if its calorie contribution is the same. In other words, a calorie equivalent of consumption is potentially more robust than the total monetary value of the consumption basket.

In this study, a multi-variate approach was taken as a bivariate regression would not have provided a consistent estimate. Calorie intake is affected by many factors. Multivariate regression analysis was performed to control for sociodemographic attributes. To control for consumption from homegrown stock or other alternative sources of food, we measured the PDS elasticity of calorie intake by (a) Household type, and (b) Crop-regions. Sources of food access were classified into market and non-market (the PDS and homegrown stock). The reason for the spatial difference in the response of households to PDS can be different regionally, for example, because of the programmatic performance or variation in access to other sources of foodgrain consumption.

Metric of PDS Benefit: Price Ratio

To observe the effect of changing PDS prices relative to market prices, we added the ratio of PDS prices to the market prices.

$$\text{Price Ratio} = \frac{\text{Price of Grain bought from PDS}}{\text{Price of Grain bought from Market}}$$

Where, Price Ratio == 1 if Grain Price from PDS== Grain Price from Market,

Price Ratio > 1 if Grain Price from PDS> Grain Price from Market, and,

Price ratio < 1 if the Grain Price from the PDS< the Grain Price from the Market.

A price ratio <1 signifies a higher subsidy level, given the market price (in terms of price provision and not actual consumption). A price ratio of .8 basically means that PDS prices are 20 per cent lower than the market price. In other words, the higher the price savings from the PDS rates, the lower the price ratio value.

Table 1

Definition and Construction of the Indicators for Analysis

S. No.	Metric	Construction/categories	Remarks
Metric of Household Food Security			
1	Calorie intake per capita per day	Food intake reported in kilograms (kg) was converted to their calorie equivalent, added up across items by households and divided by household size to arrive at the total per-capita calorie intake.	
Other predictor variables:			
2	Share of Calorie from Homegrown Stock	Proportion of the total quantity of food from homegrown stock adding cereals, pulses, edible oils, dairy products, poultry, vegetables, and fruits to the total quantity of food consumed is estimated as our second key predictor.	

Contd...

S. No.	Metric	Construction/categories	Remarks
3	Household Type	It was observed that household's main occupation (agricultural labour, non-agricultural labour, or cultivator) was related to its demand for homegrown stock and the PDS. Therefore, a variable for household type (non-agricultural labour as 0; agricultural labour as 1 and cultivator as 2) was added to the equation. Price ratio was interacted with this variable to get the variation of the impact of the PDS vertically.	
4	Agricultural Systems: Crop Regions	The percentage of calories produced by major crops in each district was computed from APY data. The districts falling within specific ranges of percentage of calories produced combined to form regions. The calorie-share-based crop regions were again divided by the irrigation status of the districts. Regions: Non-food producing regions (0), un-irrigated and irrigated a. rice-producing regions, b. wheat-producing regions, c. coarse grains and pulses-producing regions, d. non-grain producing regions [i.e., vegetables, fruits etc. as major crops], and e. mix of rice, wheat, and other crops regions	
Other control variables: Socio-demographic attributes			
5	District-level Fisher Price Index	Continuous variable	A state-wise price volatility of food in terms of the state-wise coefficient of variation of food items price was added to the equation.
6	Expenditures on education-items	Any expenditure in HH as 1, otherwise 0	Added to control for non-food budget share
7	Household Size	Number of Adult Members in Household	
8	Monthly Per Capita Consumption Expenditure (MPCE)	Monthly expenditure of all consumed items in household divided by household size	
9	Caste-Land-class Dummy	1 ST-Landless (Up to 1 Hectares), 2 ST Small (1 to 4 Hectares), 3 ST Med/Large (4 and above Hectares), 4 SC Landless, 5 SC Small, 6 SC Med/Large, 7 OBC Landless, 8 OBC Small, 9 OBC Med/Large, 10 Other Caste Landless, 11 Other Caste Small, 12 Other Caste Med/ Large	

Source: By author.

The equation for estimating elasticity is expressed as

Log Calorie Intake= α + β_1 Log Price Ratio + β_2 Share of Food from Home + β_3 Log Price Ratio x HH-type + β_4 Price Ratio x Crop Regions + β_5 CV of Food Price Fisher Index + β_6 Household Size + β_7 MPCED + β_8 Expenditure Education + β_9 Fisher Price Index+ β_{10} Land Size-Cast FE (2)

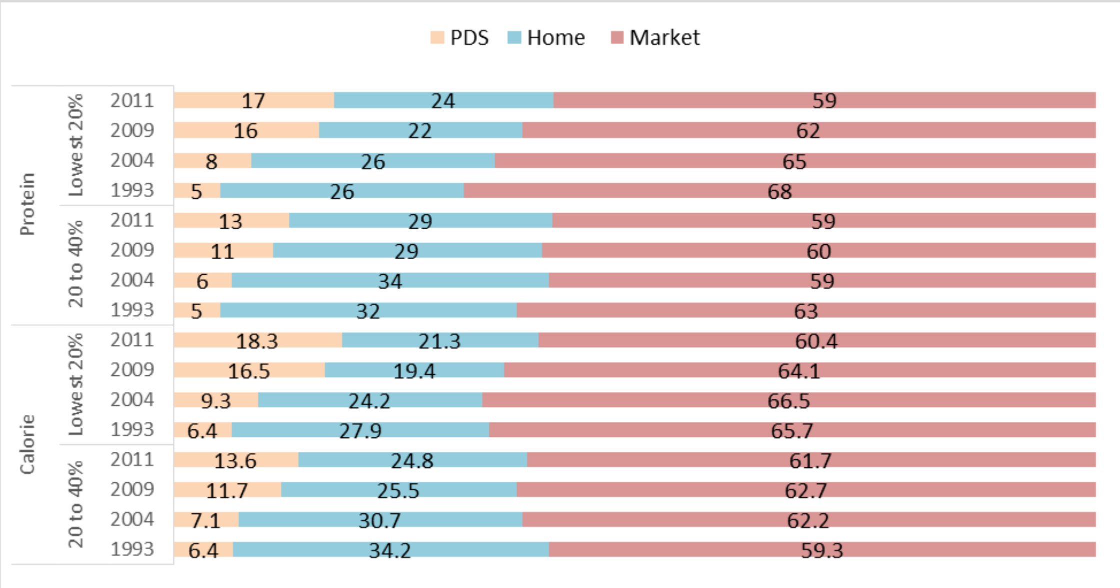
Since the overall calorie intake and share from homegrown stock were affected by the same household-level factors which create intra-region and inter-household inequality in accessing foodgrains, there was a possibility of endogeneity of share from homegrown stock. To avoid possible bias resulting from including the share of homegrown stock variables, a panel regression was conducted by creating a pseudo-panel of four rounds of NSS data and absorbing the impact of vertical variation in access to food. To do this, we added fixed effects of a dummy variable that combined land size class and caste of the households (Table 2). The second key indicator is the price ratio, and with the limitation of secondary data, we assumed it to be exogenous, as socio-demographic and agroecological region dummies were also added to the equation.

Results

The proportion of calorie consumption for each of the three sources - market and non-market (PDS and homegrown stock) - were plotted against years to examine the changing share of these sources in households' total calorie consumption in the bottom 20 per cent and 20–40 per cent MPCE classes (Figure 1). The share of non-market consumption sources increased from 1993 to 2011 for both income groups. In the case of home-grown consumption, there was a decline in the proportions of both the bottom 20 per cent and 20-40 per cent expenditure classes. The percentage of non-market consumption increased from 2009 to 2011 among the bottom 20 per cent of the population because of an increase in the share of the PDS.

Figure 1

Change in % of Consumption by Sources and MPCE Class 1993-2011



Source: By author using NSS CES unit-level data (1993, 2004, 2009 and 2011).

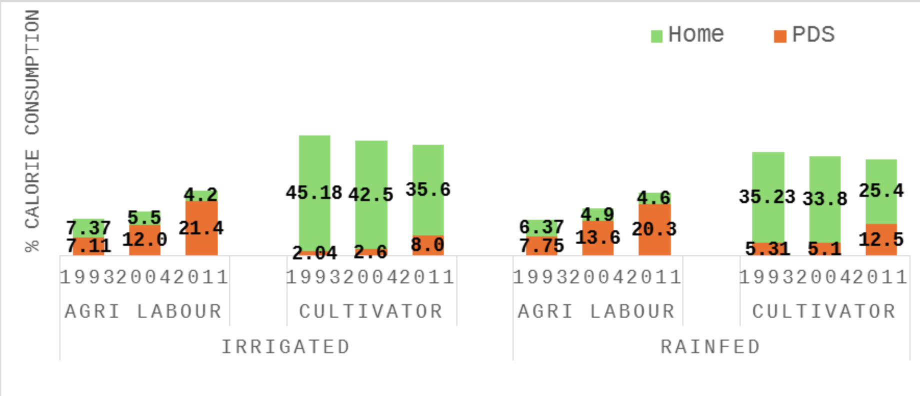
The trends were further disintegrated by three indicators – household type–to observe how the proportionate demand for sources changed vertically and by region (irrigated and un-irrigated), and to understand how the demands change spatially (Figure 2).

The share of PDS vis-à-vis homegrown stock was starkly different between cultivator and agricultural labour households (Figure 2). The proportion of consumption from homegrown stock was higher than that of PDS for cultivator households in all the rounds. Although the proportion of PDS in cultivator households increased in later rounds, the overall consumption from homegrown stock remained much higher than that of PDS (from 1993 to 2011, 35 per cent to 25 per cent in irrigated regions and 45 per cent to 36 per cent in unirrigated regions). The agricultural labour households showed increasing consumption from the PDS (from 1993 to 2011, 7 per cent to 20 per cent in un-irrigated and 7 per cent to 21 per cent in irrigated regions) and low and declining consumption from homegrown stock (from 1993 to 2011, 6 per cent to 5 per cent in un-irrigated and 7 per cent to 4 per cent in irrigated regions). Irrespective of the region's irrigation status, agricultural labour households showed a higher share of PDS and a lower share of homegrown stock in consumption. For the cultivators, unirrigated regions consumed a higher share of the PDS (5 per cent in 1993 and 2004 and 13 per cent in 2011) than their counterparts in the irrigated regions (2 per cent in 1993 and 2004 and 8 per cent in 2011).

The price ratio (PDS to Market) dropped from 0.18 in 1993 to 0.14 in 2009-10, and again returned to 0.18 in 2011. For the poor, this ratio increased from 0.17 in 1993 to 0.20 in 2011 (Figure 3).

Figure 2

% of Calorie Consumption by the Sources and Household Types

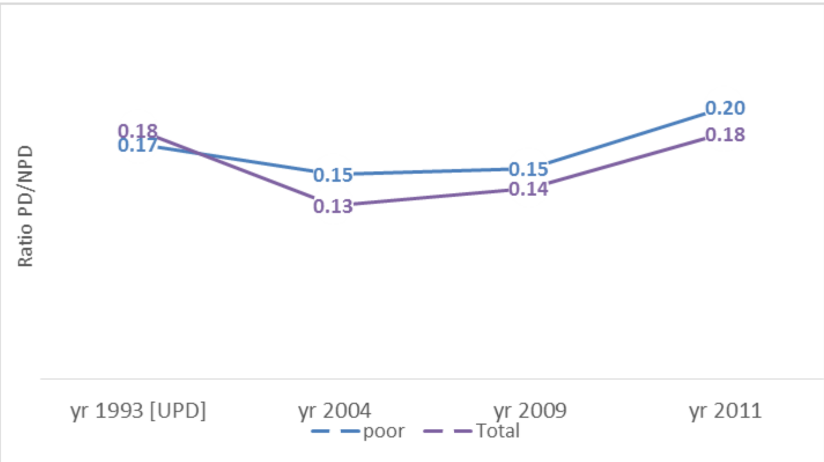


Source: By author using NSS CES unit-level data (1993, 2004, 2009 and 2011).

Note: Only agricultural labourers and cultivator households are included in the graph.

Figure 3

Trends in the Ratio of Grain Prices of PDS and Non-PDS from 1993-2011



Source: Author, using NSS data.

Note:

a. UPD refers to universal PDS.

b. Unit values (value/quantity) are used as a proxy for grain prices. The values and quantities of rice and wheat were added to calculate the single ratio.

c. Poor refers to households below the poverty line (using the Tendulkar Committee's (2009) estimates of the poverty line).

Table 2

Summary Statistics for the Key Indicators 1993/94 to 2011/12

Outcome and Predictor Indicators	Mean/ (Standard Deviation)			
	1993/94	2004/05	2009/10	2011/12
Share of Calorie from Home	32.4	27.7	22.8	22.4
	(35.9)	*(33.1)*	*(29.8)*	*(28.1)*
Calorie Intake PC	2,154	2,045	2,020	2,097
	(773)	*(1,062)*	*(553)*	*(545)*
Price Ratio (PDS to Market)	0.18	0.13	0.14	0.18
	(0.4)	*(0.3)*	*(0.2)*	*(0.3)*
Average MPCE	273.5	579.3	953.1	1,287.3
	(225.8)	*(410.1)*	*(725.3)*	*(962.4)*
HH Size	6.1	6.1	5.8	5.7
	(2.8)	*(2.9)*	*(2.6)*	*(2.5)*
Land Size- Cast Matrix	8	6.6	6.5	6.5
	(4)	*(2.9)*	*(2.9)*	*(2.9)*
N	69190	79260	59113	59686

Source: Author, from NSSO Rounds 50th (1993/94); 61st (2004/05); 66th (2009/10) and 68th (2011/12).

Note: Sampling weights were applied to compute average values.

The key indicator Calorie intake per capita has steadily declined in rural India since 1993, with a marginal increase observed in the 2011 round (Table 2). The share of homegrown sources showed a decline from 32 per cent to 22 per cent.

Table 3 presents the estimated elasticity of calorie intake to the key indicators for the full sample and the truncated sample after dropping 1993 data and Tamil Nadu. In the full sample, the coefficient of the price ratio is small but statistically significant. It can be interpreted from the result that for every 1 per cent increase in the price ratio of PDS and Market, there is a 0.014 per cent reduction in the calorie intake of rural households. Since the increase in price ratio reflects a reduction in price-gap between PDS and Market (therefore, reduction in subsidy from the PDS) it shows that keeping access to land and production as fixed, households lose in terms of calorie intake if PDS subsidy reduces.

A 1 per cent increase in the consumption share of homegrown stock results in a 0.002 per cent increase in calorie intake. Although small, the elasticity was positive and statistically significant as expected. The coefficients of the truncated sample do not contradict any of the results obtained but rather show a much steeper slope for the price ratio indicator. In terms of the other determinants of calorie intake, the elasticity estimates of the regions showed that non-food-growing regions lost calorie intake by 0.053 per cent from a 1 per cent increase in price ratio. Apart from this region, all the other regions showed either a gain from the price-ratio increase or statistically insignificant coefficients. However, a significant and negative coefficient on non-food regions also showed how taking other determinants of household access to food as constant, a decreased subsidy results in decreased welfare for the regions that did not access food production for consumption and mostly depends on the market. Calorie intake showed increasing positive elasticity to consumption expenditure classes. Household size and price volatility showed a negative and significant relationship with calorie intake.

Table 3

Elasticity of the Calorie-to-Price Ratio of the PDS and the Market Consumption to the Key Predictors: 1993 & 2011

Indicators	Details	β[α]	β[£]
Price Ratio PD/Market		-0.014***	-0.025***
Share of calorie from home		0.002***	0.002***
Price Ratio X HH type	Non-agriculture Labour	Reference	
	Agricultural Labour	-0.012***	-0.010**
	Cultivator	0.003	-0.005
Price Ratio X Region	No Food Crop Production	Reference	
	Rainfed Rice Production	-0.027***	-0.017**
	Rainfed Coarse Grains and Pulses	0.015**	0.029***
	Rainfed No Foodgrain Production	0.021***	0.025***
	Rainfed Partly Staple	0.015**	0.027***
	Irrigated Rice Production	0.038***	0.060***
	Irrigated Pulses and Cotton	-0.005	0.055
	Irrigated No foodgrain production	0.001	0.008
	Irrigated Partly Staple	0.005	0.019**
	Rainfed Wheat	-0.011	-0.009
	Irrigated Wheat	0.027***	0.042***
Household Type	Non-agriculture Labour	Reference	
	Agricultural Labour	-0.013**	-0.011
	Cultivator	0.015***	0.002
Regions	No Food Crop Production	Reference	
	Rainfed Rice Production	-0.024***	-0.061***
	Rainfed Coarse Grains and Pulses	0.022***	0.023**
	Rainfed No Foodgrain Production	-0.053***	-0.102***
	Rainfed Partly Staple	0.060***	0.031***
	Irrigated Rice Production	0.078***	0.080***
	Irrigated Pulses and Cotton	0.057	0.108*
	Irrigated No foodgrain production	-0.041***	-0.069***
	Irrigated Partly Staple	-0.01	-0.027**
	Rainfed Wheat	0.068***	0.028*
	Irrigated Wheat	0.097***	0.072***
HH Size		-0.022***	-0.025***
MPCE Class	MPCE Class 1	Reference	
	MPCE Class 2	0.118***	0.119***
	MPCE Class 3	0.192***	0.193***
	MPCE Class 4	0.271***	0.275***
	MPCE Class 5	0.442***	0.429***
Price Volatility		-0.002***	-0.004***
Non-food Expenditure		-0.005***	-0.016***
Caste X Land Size Class Fixed Effects		Added	
Constant		7.480***	7.871***

Source: Author, using NSS CES unit level data (pooled 50th, 61st, 66th and 68th Round).

Note: * p<0.05, ** p<0.01, *** p<0.001; Expenditure on education used as a proxy of overall non-food expenditure

[α] Elasticity of calorie intake to the price ratio from the full sample (R square: 0.375)

[£] Elasticity of calorie intake to the price ratio after dropping 1993 and Tamil Nadu from the sample (R square: 0.356)

Table 4

Calculated Elasticity of the Interaction Terms of the Price-Ratio (PDS to Market Consumption) and Selected Covariates €

Indicators	Details	β^{α}	$\beta^{£}$
Price Ratio X HH type	Non-agriculture Labour	**Reference**	
	Agricultural Labour	-0.026***	-0.035***
	Cultivator	-0.011	-0.030
Price Ratio X Region	No Food Crop Production	**Reference**	
	Rainfed Rice Production	-0.041***	-0.042**
	Rainfed Coarse Grains and Pulses	0.001**	0.004***
	Rainfed No Foodgrain Production	0.007***	0.000***
	Rainfed Partly Staple	0.001**	0.002***
	Irrigated Rice Production	0.024***	0.035***
	Irrigated Pulses and Cotton	-0.019	0.03
	Irrigated No Foodgrain production	-0.013	-0.017
	Irrigated Partly Staple	-0.009	-0.006**
	Rainfed Wheat	-0.025	-0.034
	Irrigated Wheat	0.013	0.017

Source: Authors from NSS CES data; Note: * p<0.05, ** p<0.01, *** p<0.001

€ The coefficient of Price-Ratio added to the coefficients of Price Ratio interactions with HH type and Region.

α Elasticity from the full sample.

£ Elasticity after dropping 1993 and Tamil Nadu from the sample.

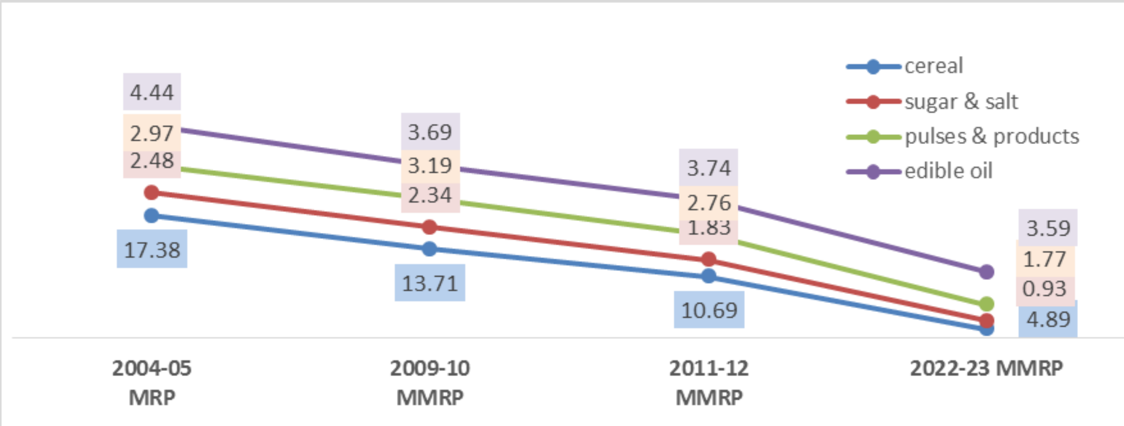
By the interaction of the Price-Ratio indicator with the crop regions, we obtained statistically significant coefficients in six out of the 11 crop regions and price interactions (Table 4). The crop region which showed an expected negative sign of the coefficient was the rainfed rice-producing region. Households lost welfare when the PDS subsidies were reduced. The elasticity of the regions was slightly higher than the overall price-ratio elasticity of rural India. The other regions that produced a mixture of staple crops and cash crops, both rainfed and irrigated, showed a positive elasticity-to-price ratio. For every 1 per cent increase in the ratio, the household calorie intake increased by 0.03 per cent. The irrigated rice-producing regions also showed a positive and statistically significant elasticity of 0.018 per cent. The other regions did not show any statistically significant effects. Interaction of the price-ratio indicator with the household type indicator showed that a 1 per cent increase in the price ratio decreased the calorie intake of agricultural labour households by 0.026 per cent. However, the coefficient for cultivator households was not statistically significant.

Post-NFSA (2013) Evidence: Staple Expenditure Pattern from NSSO 2022-23

There is little evidence of consumption pattern within the households after 2011-12. The aggregate expenditure trends reported in the Household Consumer Expenditure Survey Factsheets (2022-23) (Figure 4) reflect the continued decline of foodgrains in terms of their proportion in the total household consumption expenditure. In fact, 2022-23 is the only year where expenditure on cereals decline below 5 per cent and is less than expenditure on processed food and beverages. These grains were traditionally given in the PDS and are now part of NFSA. It remains to be seen whether the actual calorie share mirror the expenditure pattern. The composition of sources for these items (market or other sources) will be observable only after the full data is accessible.

Figure 4

Percentage of Food Grains Expenditure to MPCE (Rural) 2004-22



Source: Factsheet of NSSO HCES 2022-23, Govt. of India

Note: Graph plots the % of itemised monthly expenditure per capita to monthly total household expenditure per capita as reported in the Factsheet; MRP - Mixed Recall Period (Frequent items asked for 1 month and other items for 12 Months); MMRP – Modified MRP (Frequent (food) Items asked for last 7 days)

Discussion

The impact of foodgrain transfer has been extensively studied; however, there is mixed evidence. In complex rural societies and economies, policy analysis cannot overlook spatiotemporal changes in food security conditions and inter and intra-regional factors that cause inequalities in access to food.

Using NSSO consumption expenditure data, this paper tried to contribute to this debate and analysed the PDS elasticity of household calorie intake in the context of the changes in households' access to other alternative sources of foodgrains – mainly market and household's own production in rural India. Classifying the sources into three categories finds resonance in earlier literature on the PDS (Rahman, 2014). The results indicate a few features of the changing food security conditions in India which are elaborated below.

Access to food changes with changing peasantry: The changes in food security conditions were analysed by plotting the percentage share of the three sources, viz. Market, PDS and Homegrown stock within total calorie consumption against the survey years to examine the changing importance of these sources in the bottom 20 per cent and 20 per cent - 40 per cent expenditure classes. The trend analysis revealed that over the study period, the proportion of rural households' consumption from the PDS increased. This may be partly attributed to the increased efficiency of the PDS (Rahman, 2014; Bhattacharya et al., 2017). But comparing with calories from other sources, the result also indicates a changing food access scenario in the period of analysis.

Household consumption from own production drastically reduced in the period with increasing dependence on purchases from the open market.

The overall decline in access to non-market alternative sources, such as homegrown stock, is greater for households in the low-expenditure quartile. These are the households with little to no land and are at higher vulnerability of precarious livelihood even in the case of a shift to the non-farm sector (Berchoux et al., 2020). The PDS in households in the lower expenditure quartile in this sense functions as insurance against the open market.

The Land Size-Cast Fixed Effects: Due to the potential endogeneity of the indicator on the calorie from homegrown stock, the elasticity analysis included land size-cast fixed effects to estimate the elasticities without bias. It was assumed that absorbing the effect of the joint caste-land-size indicator would control for vertical inequality in the access to foodgrains from home within regions, which is the rigidity of social group-based resource distribution in India. In addition, the caste- and land -based hierarchies and biases that create differential access to produce should be time-invariant over less than two decades (1993-94 to 2011).

The results of first-stage regressions (not reported here) show that landless SC, ST and OBC households lose nearly 15 times the calorie intake compared to other castes with landholding larger than two hectares. The importance of land size in securing households against food price increase has been noted earlier. In times of crisis, large landholders benefit by having a stock of surplus produce, but small and marginal farmers lose as they depend on purchased foodgrains and do not have surplus produce (de Janvry & Sadoulet, 2010). In times of food price surges, as a group, farmers lose welfare because large sections of them are small and marginal farmers (Jha et al., 2009).

In India, social factors, such as the caste of the household, also affect access to productive assets, capital, or labour. Land-operated changes in size and use from season to season, but caste remains fixed and free from being influenced by household decisions. Studies confirm that the marginalised caste groups referred to as Scheduled Caste (SC) and Tribes (ST), are least likely to have land, wage and work equivalent to their upper caste counterparts in every part of India (Attewel & Madheswaran 2007; Newman & Thorat 2007; Bakshi 2008).

The elasticity of calorie intake to PDS subsidy varies by the regional conditions: The overall elasticity estimate from the pooled data was statistically significant for both homegrown stock and the price ratio of PDS and the market. Given the fact that calorie intake is affected by a range of socio-economic factors, even a small but significant coefficient of both homegrown stock and PDS to market price ratio indicates that households in rural India have benefited in terms of calorie intake from both homegrown stock and PDS subsidy.

However, there was a visible spatial variation of calorie-elasticity to PDS subsidy. PDS has been beneficial in increasing household calorie intake in rainfed rice-growing regions. Households in non-staple growing regions do not show a caloric benefit from an increased subsidy. Moreover, irrigated or food-secure regions gained from a decrease in the gap between the PDS and the market price of foodgrains.

Although the current analysis is insufficient to make a conclusive sense of these counterintuitive results, in rainfed regions, the counterintuitive results may be due to changes in local food systems. Studies have found a reduction in calories from coarse cereals from 23 per cent to 6 per cent in rural households between 1983 and 2011, with state variation (DeFries et al., 2018). Similarly, in irrigated regions, greater access to staple production or a negative income effect may lower PDS demand in farmer households. There is also a higher leakage in states that report a lower market PDS price gap (Kishore & Chakrabarti, 2015). However, the results from this paper are insufficient to comment on the exact reasons for the positive coefficients on the PDS/market price ratio. An in-depth study is required to understand these relationships.

The counterintuitive results aside, the overall statistical significance of the price ratio elasticity of calories, is important in the context of rural development. Our analysis began in 1993 and ended in 2011. During this period, the real income and aggregate consumption of households increased but not universally. Between 1987 and 1997, all exports were below international prices, whereas all imports were above domestic prices resulting in inflation (Swaminathan, 2002). This was also a time of agrarian distress with increasing inequality in land ownership (Rawal, 2008), increase in input costs of production (Talule, 2020), and unavailability of any credit or any insurance for farmers (Dev, 2004; Ghosh, 2004). Rural wages did not show any encouraging trend until 2007 (Himanshu & Kundu, 2016). Coupled with the sharp increase in real food prices (Sasmal, 2015) and the absence of any risk market for food (Ramaswami, 2002), rural Indian households have faced worsening food security conditions during this period. Access to homegrown stock also declined over the study period. The results corroborate the role of PDS as insurance against low food security conditions and the absence of insurance in the food market (Gadenne et al., 2021).

Direct transfer of grains as a policy solution to the changing food access situation: Elasticity to PDS-subsidy varies horizontally (between regions) and vertically (between households within regions) along with the varying conditions of access to food. The non-cultivator households benefitted from a lower PDS price compared to the market. Since these households have the lowest access to homegrown stock, it can be inferred from the results that PDS has an important impact on households with less food security. Elasticity was significant in the rainfed staple-growing region, where food security conditions and access to other sources were worse than in irrigated food-abundant crop regions. This has been reflected in the discourse on the preservation of local food systems over commoditised commercial agriculture (Pimbert, 2009).

It was observed that cultivators do not depend on the PDS as much as labour households, and they consume a large proportion of homegrown stock. Similarly, in food-abundant regions, PDS may not benefit most households because they have access to other sources of foodgrains regionally. However, in dry regions without access to staple foods, PDS subsidies play an important role in ensuring food security. Earlier studies have also linked agricultural production and consumer subsidies in foodgrains in India with the result that agrarian lobbies influence producer subsidies (Jos E. Mooij, 1994). So much so, that a process of 'De-Peasantisation' has taken place and food production in India has essentially become synonymous with huge commercial rice-wheat producing systems. The major sufferers have been households that either do not have the capital to shift to this commoditised system of farming, or households that are geographically located in regions where huge rice/wheat farming is economically unviable.

This study hints at the numbing effect of foodgrain production on the calorie impact of PDS. Where production is scarce, such as in dry rice-producing areas, PDS has a significant impact on household calorie intake. In well-irrigated regions, the proportion of consumption from the PDS was like that of dry regions, but the impact on calorie intake was not significant. Our results reaffirm the importance of social protection programmes for improving nutritional outcomes in India (Raghunathan et al., 2017), not only for landless households but also for the overall rural population.

Limitations

This study has some limitations. Since the PDS has changed over the years and varies across states, interpreting the results from the pooled data of the four rounds of the NSS had to be performed with caution. Also, the analysis only included households that reported the consumption of any food item from the PDS in the previous 30 days. The results were drawn from pseudo-panel data. A methodologically rigorous empirical strategy with other national and sub-national social protection schemes and an instrumental variable was not adopted, because the NSSO provides a limited number of relevant indicators. We assume that the market and PDS prices are exogenous, which some studies have challenged. A full analysis of all mechanisms separating the income effect from the consumption effect is beyond the scope of this study.

Despite these limitations, the study uses rigorous methodology to arrive at the results and probes them with existing literature. To check the robustness of the elasticity estimates, regressions were conducted after dropping 1993 data and Tamil Nadu samples from the pooled data. The largest deviation from the Central PDS was the state of Tamil Nadu, with universal PDS, higher per capita entitlement, lower issue-price than the Central scheme, high density of PDS shops and political significance of the PDS (Venkatasubramanian, 2006; Anuradha, 2017). The truncated data did not significantly change the results. Also, NSSO is an official and reliable consumption data with disaggregation and scale to conduct an in-depth analysis.

Conclusion

This study provides two main recommendations for food policies. Given the context of reducing access to homegrown stock and PDS as a supplement for the same, subsidised foodgrain transfer is suggested as a crucial strategy to ensure calorie intake levels of households. At the same time, region-specific variations in dependence on the PDS should be considered while deciding the subsidy and entitlements.

Given the trend of increasing consumption of the PDS in the analysis period, it can be concluded that as the landlessness increases, other sources of foodgrain go down, agriculture shifts to non-foodgrain and overall food security conditions worsen, more households would turn to the PDS for foodgrain.

Whether the decline in expenditure on food in the latest consumption survey reflects the same remains to be seen. But this study emphasises that in the changing food access scenario, the PDS is a significant source. The effect of the PDS in the future should be assessed in relation to the food-systems and food-access conditions of the regions.

Notes:

1. Fisher Price Index was constructed using Tendulkar Committee (Planning Commission, 2009) method by district in the NSSO data (using weighted NSSO sample size for population), state-level Coefficient of Variation were then computed to construct the Price Volatility indicator.
2. To test the endogeneity of the constructed variable, a Hausman test was conducted with land class-caste as an instrumental variable. The results of first stage regression are in Supplemental Table 1.
3. A Hausman test was conducted to confirm whether difference between FE and RE estimates is 0 or whether random or fixed effects should be used. The results are reported in the Supplemental Table 2. (Only the FE estimates were consistent).

Supplemental Table 1

Results of First Stage Regressions.[€]

Indicators	Details	β^{α}	$\beta^{£}$
Residuals			***-0.001****
Price Ratio PD/Market		3.150***	-0.027***
Share of calorie from home			0.003***
Price Ratio X	No Food Crop Production	Reference	
	Rainfed Rice Production	-1.337**	-0.033***
	Rainfed Coarse Grains and Pulses	-1.624***	0.013**
	Rainfed No Food grain Production	-2.621***	0.018***
	Rainfed Partly Staple	1.427**	0.016**
	Irrigated Rice Production	0.823	0.039***
	Irrigated Pulses and Cotton	-2.16	-0.02
	Irrigated No foodgrain production	-2.097***	0.005
	Irrigated Partly Staple	-1.516***	0.007
	Rainfed Wheat	0.16	-0.014
	Irrigated Wheat	0.342	0.030***
Caste X Land Size Class	ST Landless	-13.733***	
	ST Small	2.493*	
	ST Med/Large	4.331**	
	SC Landless	-19.831***	
	SC Small	1.125	
	SC Med/Large	3.025	
	OBC Landless	-17.684***	
	OBC Small	-1.42	
	OBC Med/Large	-0.412	
	OC Landless	-14.853***	
	OC Small	2.067	
	OC Med/Large	8.284***	
Regions	No Food Crop Production	Reference	
	Rainfed Rice Production	4.287***	-0.043***
	Rainfed Coarse Grains and Pulses	-1.831***	0.015*
	Rainfed No Food grain Production	-5.806***	-0.057***
	Rainfed Partly Staple	7.302***	0.062***
	Irrigated Rice Production	4.927***	0.079***
	Irrigated Pulses and Cotton	0.346	0.028
	Irrigated No foodgrain production	-6.921***	-0.040***
	Irrigated Partly Staple	-2.402***	-0.009
	Rainfed Wheat	7.426***	0.077***
	Irrigated Wheat	4.452***	0.115***
HH Size		1.507***	-0.024***
MPCE Class	MPCE Class 1	Reference	
	MPCE Class 2	2.126***	0.121***
	MPCE Class 3	3.561***	0.196***
	MPCE Class 4	3.754***	0.275***
	MPCE Class 5	4.152***	0.442***
Price Volatility		0.212***	-0.001***
Non-food Expenditure		-0.217***	-0.010***
Constant		19.659***	7.585***

* p<0.05, ** p<0.01, *** p<0.001; € Consumption share from home-grown food was regressed on all the included exogenous variables and the land-class and caste variable. The residual of the regression was included in the calorie demand equation along with the endogenous and other exogenous variables; α Estimating the residual term from regressing all exogenous variables, instrument on the endogenous variable; £ Regressing all exogenous variables and the residual term.

Supplemental Table 2

Results of Hausman Test

Indicators	Details	β[α]	β[£]
Price Ratio PD/Market		-0.011**	-0.024***
Share of calorie from home		0.002***	0.002***
Price Ratio X	No Food Crop Production	Reference	
	Rainfed Rice Production	-0.030***	-0.031***
	Rainfed Coarse Grains and Pulses	0.012*	0.011*
	Rainfed No Food grain Production	0.019***	0.017***
	Rainfed Partly Staple	0.012*	0.016**
	Irrigated Rice Production	0.034***	0.040***
	Irrigated Pulses and Cotton	-0.006	-0.022
	Irrigated No foodgrain production	0.002	0.004
	Irrigated Partly Staple	0.003	0.006
	Rainfed Wheat	-0.012	-0.015
	Irrigated Wheat	0.026***	0.031***
Caste X Land Size Class	ST Landless	-0.066***	-0.054***
	ST Small	-0.062***	-0.057***
	ST Med/Large	-0.063***	-0.052**
	SC Landless	-0.035**	-0.029*
	SC Small	-0.019	-0.016
	SC Med/Large	0.003	0.006
	OBC Landless	-0.055***	-0.033**
	OBC Small	-0.050***	-0.027*
	OBC Med/Large	-0.038*	-0.012
	OC Landless	-0.025*	-0.033**
	OC Small	0.021	0.004
	OC Med/Large	0.043**	0.024
Regions	No Food Crop Production	Reference	
	Rainfed Rice Production	-0.030***	-0.031***
	Rainfed Coarse Grains and Pulses	0.019**	0.01
	Rainfed No Food grain Production	-0.052***	-0.063***
	Rainfed Partly Staple	0.057***	0.064***
	Irrigated Rice Production	0.076***	0.080***
	Irrigated Pulses and Cotton	0.051	0.04
	Irrigated No foodgrain production	-0.035***	-0.048***
	Irrigated Partly Staple	-0.01	-0.014*
	Rainfed Wheat	0.065***	0.079***
	Irrigated Wheat	0.096***	0.112***
HH Size		-0.021***	-0.023***
MPCE Class	MPCE Class 1	Reference	
	MPCE Class 2	0.128***	0.121***
	MPCE Class 3	0.208***	0.197***
	MPCE Class 4	0.295***	0.277***
	MPCE Class 5	0.478***	0.443***
Price Volatility		-0.003***	-0.001***
Non-food Expenditure		-0.016***	-0.011***
Constant		7.666***	7.625***
$\chi 2$		1281.3***	

* p<0.05, ** p<0.01, *** p<0.001; [¥] Source: By author from NSS CES pooled unit level data (50th, 61st, 66th and 68th Round); [α] Fixed effect estimators; [£] Random effect estimators.

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