LANSA
Leveraging Agriculture for Nutrition in South Asia

LANSA WORKING PAPER SERIES

Volume 2018 No 24

An analysis of protein consumption in India through plant and animal sources

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February 2018

About this paper

This study is part of the ongoing research programme on Leveraging Agriculture for Nutrition in South Asia (LANSA) funded by UKaid from the Department for International Development, UK. The author would like to thank Dr. R. V. Bhavani, Dr. Brinda Vishwanathan, Dr. Madhura Swaminathan and the LANSA team for their valuable feedback. An earlier version of the paper was presented at the TASS-IFPRI Conference in May 2017 at Delhi and a poster at the Agriculture, Nutrition and Health (ANH) Academy in Kathmandu, Nepal in July 2017. The author is thankful to the participants for their useful comments and suggestions.

About LANSA

Leveraging Agriculture for Nutrition in South Asia (LANSA) is an international research partnership. LANSA is finding out how agriculture and agri-food systems can be better designed to advance nutrition. LANSA is focused on policies, interventions and strategies that can improve the nutritional status of women and children in South Asia. LANSA is funded by UKaid from the UK government. The views expressed do not necessarily reflect the UK Government's official policies. For more information see www.lansasouthasia.org

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Abstract

Cereals are the major source of protein in the Indian diet. In recent years, due to declining preference the consumption of cereals is decreasing in spite of increasing output. Therefore, the country needs to further increase the production and encourage the intake of pulses in order to meet the nutritional requirements of the population, specifically in terms of protein consumption. This paper discusses the trends in pulses and protein consumption over the years. It uses a seemingly unrelated regression estimation (SURE) framework to study the price and income effect on protein from different sources: cereals and pulses (plant sources), milk and milk products (dairy sources), and animal sources such as eggs, fish and meat, and other sources of protein. Further, it focuses on the substitutability and complementarity between the various sources of protein, with emphasis on plant sources such as cereals and pulses. It finds that the expenditure on protein is large and significant. Higher disposable incomes have led to higher demand of animal sources of protein. As the price of cereals decreases, an increase in the consumption of protein from pulses is observed. As the price of pulses increases, the sample shifts to consumption of protein from animal sources and milk and milk products. It becomes important to contain volatility in pulses prices, given that it is a major source of plant protein. States that distribute pulses in the public distribution system (PDS) show higher consumption of protein than other states.

1 Introduction

In any economy, developments in both the production and consumption sectors are important. With careful planning and technological development, it is possible to bring about significant changes in the production sector in a short span of time. The consumption sector, however, is built on well-established social and cultural norms that evolve slowly over time (Hirschman 1985). Further, the study analysed the continuities and discontinuities in consumption in a changing environment and argues that people cling to primitive patterns of consumption as an effective defence against forces of change. Thus, changes occurring in the consumption sector are not as dramatic or visible as those happening in the production sector but are equally important to take into account.

India is home to the highest number of malnourished children under 5 years of age. Thirty-seven per cent of the children were stunted, 21 per cent wasted and 34 per cent were underweight in 2014-15, according to the Fourth Round of the National Health and Family Survey (NFHS-4). Protein-energy malnutrition as well as micronutrient deficiencies can be reduced by increasing the consumption of pulses, which are a rich source of protein, minerals, iron and fibre. Thirty-one per cent of Indians are vegetarian, according to the 2006 The Hindu-CNN-IBN State of the Nation Survey.[1] Thus, a large part of the protein requirement could be met by pulses. Food security stands on the three pillars of availability, access and absorption (nutrition) (UNICEF 2016). Recently, there has been a paradigmatic shift from food availability to household food insecurity, and from energy intake (input measures) to anthropometric measures (output indicators), thereby shifting the focus to proper nutrition (Dev and Sharma 2010).

Consumption patterns have been found to be affected by rising incomes, changing prices, urbanisation, globalisation, demographic shifts, improved transportation and changing consumer

[1] http://www.thehindu.com/todays-paper/article3089973.ece accessed in August 2016

tastes and preferences. Apart from this, there are regional differences. The staple diet in one state is very different from that in another. Given different diets, food expenditure responses to income and price changes vary between different states (Meenakshi 1996). Low-income households spend a greater portion of their budget on staple food products and are generally more responsive to food price and income changes. The magnitude of a household's response to income and price change also differs across food items. For example, in poorer households, greater budget adjustments are made to higher value food items such as dairy and meat, and staple food budgets undergo little change. Rural and urban spending patterns are extremely different. Urbanisation has played a significant role in changing food consumption patterns. Given the different lifestyles of urban and rural residents, as well as increased food availability and higher purchasing power in urban areas, urban and rural diets tend to differ significantly. With higher disposable income among urban residents, the demand for meat, horticultural, and processed products is expected to increase within developing countries (Kumar and Mathur 1996; Kumar and Mittal 2003).

The analysis of consumption patterns in a developing country like India has to take into account several factors. The process of development is accompanied by rising levels of income, leading to increases in real per capita expenditure, changes in institutions and organisations, and, in general, a change in preferences. Change in global prices is another important factor that affects the consumption patterns in any country. The economic reforms undertaken in India during the 1990s, along with a sharp rise in her growth rate, makes this decade a significant one for the country, as it saw India become one of the world's fastest growing economies. The results of changing consumption patterns are important for policy makers because they are concerned with food and nutrition security in a period of significant economic change that is meant to improve the overall well-being of the people.

India became self-sufficient in food because of the Green Revolution in the late 1960s. However, both technological innovation as well as policy support has been biased towards cereals, viz., wheat and rice. Minimum support prices for rice and wheat are highly lucrative. In terms of calories, cereals supply well over 50 per cent of the total calorie intake of the household (Chatterjee et. al. 2007). Cereals are a moderate source of protein as they contain only about 10 per cent protein. However, in the Indian diet, they are the major source of protein (NSSO, 2011-12). In recent years, the consumption of cereals has been declining in spite of increasing output because of changing preferences. In 2004-05, 66.37 per cent and 56.16 per cent of total protein came from cereals in the rural and urban sectors, respectively. This declined to 62.45 per cent and 53.69 per cent, respectively, in 2011-12. Therefore, the country needs to increase consumption and production of pulses in order to meet the nutritional requirements of the population. Using nationally representative data, Maitra et al. (2013) find evidence of a worsening of calorie intake over the periods 1998-99 and 2005-2006.

There have been some studies on calorie intake, such as those authored by Deaton and Dreze (2008), Chatterjee et al. (2007) and Maitra et al. (2013) among others. However, there is a shortage of theses focusing on protein intake. The current study seeks to fill this gap. Cereals and pulses are the major sources of protein from plant sources in the Indian diet. Pulses are nutrient-dense crops and an increased consumption of pulses in the diet is also associated with better nutrition. Encouraging the production and consumption of pulses is in line with the second Sustainable Development Goal (SDG) with the three-fold objective to end hunger, achieve food security and

improved nutrition, and promote sustainable agriculture (FAO 2016).[2,3] State Governments have taken proactive steps to make pulses available at reasonable prices. Distribution of pulses through PDS has been taken up by some states, following the National Food Security Act (NFSA). Ensuring a smooth supply of pulses at affordable prices, however, remains a major challenge.

This paper examines the consumption patterns of various pulses and proteins over the years. It then undertakes a detailed seemingly unrelated regression (SURE) of protein consumption for the 68th round of the National Sample Survey for different occupations, education groups, social castes and monthly per capita expenditure (MPCE) for the five food groups of cereals, pulses, milk and milk products, animal sources[4] and other sources of protein. It tries to explain how the consumption of protein varies with income and prices and how these are conditioned by education, occupation, household size and social group. Further, it focuses on the substitutability and complementarity between various sources of protein with emphasis on the plant sources of protein — cereals and pulses.

2 Consumption patterns of various pulses and sources of protein

On an average, 100 gm of Bengal gram (chana) comprise around 17 gm of protein, 4.6 mg of iron, 186 mg of folic acid, 202 mg of calcium and roughly 360 calories. Red gram (*arhar*) and black gram (*urad*) have a higher proportion of protein (24 gm per 100 gm). According to the Indian Council of Medical Research (ICMR)[5], 40 gm of pulses is the recommended daily intake for a balanced diet of an average sedentary man.

In 1993-94, the total pulse consumption was about 25.3 gm per day in rural India while it was 28.7 gm per day in urban India. The consumption increased in the next five years to 28 gm per day in the rural sector and 33.3 gm per day in the urban. The consumption of pulses showed a decline during the NSSO 61st Round in 2004-05, to 23.67 gm per day in the rural sector and 27.3 gm per day in the urban sector. In 2011-12, during the NSSO 68th Round, about 26.1 gm per day were consumed in the rural sector while it was 30.03 gm per day in the urban sector (**Table 1**). The per capita per day consumption has always been higher in the urban sector as compared to the rural sector, even though a higher proportion of the population consumed pulses in the rural sector.

On looking at the five important pulse crops individually, it is observed that the consumption of red gram, green gram (*moong*), lentil (*masur*), black gram and split Bengal gram has fallen over the time period for both the rural and urban sectors.

[2] http://www.fao.org/pulses-2016/en/ accessed in July 2016
[3] http://www.un.org/sustainabledevelopment/hunger/ accessed in August 2016.
[4] These include eggs, fish and meat.
[5] http://www.icmr.nic.in/

Table 1: Consumption of different pulses and pulses products in rural and urban India

Pulse Type	Year	Per capita (kg) Consumption in 30 Days		Per capita (gm) Consumption in a Day		Percentage of HHS Consumption in a 30-Day Period	
		Rural	Urban	Rural	Urban	Rural	Urban
Red gram	1993-1994	0.24	0.33	8.00	11.00	53.00	68.90
	1999-2000	0.23	0.33	7.67	11.00	52.90	70.80
	2004-2005	0.21	0.30	7.00	10.00	56.80	71.10
	2011-2012	0.21	0.301	7.00	10.03	59.60	74.10
Green gram	1993-1994	0.10	0.13	3.33	4.33	39.20	55.60
	1999-2000	0.10	0.15	3.33	5.00	39.20	55.50
	2004-2005	0.09	0.11	3.00	3.67	43.70	59.40
	2011-2012	0.091	0.117	3.03	3.90	45.60	60.00
Lentil	1993-1994	0.12	0.10	4.00	3.33	36.60	33.60
	1999-2000	0.14	0.13	4.67	4.33	37.10	37.40
	2004-2005	0.11	0.09	3.67	3.00	37.90	37.10
	2011-2012	0.112	0.093	3.73	3.10	41.10	38.00
Black gram	1993-1994	0.10	0.10	3.33	3.33	34.50	39.40
	1999-2000	0.09	0.11	3.00	3.67	30.90	40.00
	2004-2005	0.08	0.09	2.67	3.00	35.40	41.70
	2011-2012	0.084	0.098	2.80	3.27	38.90	44.70
Bengal gram (split)	1993-1994	0.06	0.07	2.00	2.33	24.80	35.90
	1999-2000	0.08	0.09	2.67	3.00	29.50	39.50
	2004-2005	0.06	0.07	2.00	2.33	33.20	44.30
	2011-2012	0.08	0.085	2.63	2.83	39.90	46.60
All pulses & pulse products	1993-1994	0.76	0.86	25.33	28.67	96.70	92.10
	1999-2000	0.84	1.00	28.00	33.33	96.70	94.30
	2004-2005	0.71	0.82	23.67	27.33	97.30	94.40
	2011-2012	0.783	0.901	26.10	30.03	98.10	92.50

Source: NSSO Reports, 50th, 55th, 61st and 68th Rounds

On examining data from the consumer expenditure surveys of the National Sample Survey (NSS), it is seen that the average consumption of pulses increased in rural India between 2004-05 and 2011-12, from 22 gm to 26 gm (**Table 2**). This is less than 70 per cent of the norm of 40 gm per day. Further, there were large differences across expenditure classes. In the lowest decile according to MPCE, the deficit in the consumption of pulses per day was 25 gm in 2004-05 which came down to 22 gm in 2011-12, and only persons in and above the eighth decile consumed more than 70 per cent of the recommended dietary allowance (RDA) for pulses.

Table 2: Decile-wise consumption of pulses and pulses products in rural India per day per capita in gm

	2011-12		2004-05	
MPCE Class	Rural	Deficit in Rural	Rural	Deficit in Rural
MPCE 1	18	-22	15	-25
MPCE 2	21	-19	17	-23
MPCE 3	22	-18	19	-21
MPCE 4	23	-17	20	-20
MPCE 5	24	-16	21	-19
MPCE 6	26	-14	22	-18
MPCE 7	27	-13	23	-17
MPCE 8	29	-11	25	-15
MPCE 9	31	-90	28	-12
MPCE 10	40	0	35	-50
MPCE all	26	-14	22	-18

Source: National Sample Survey, 61st and 68th rounds

For the pulses and pulses products group as a whole, per capita consumption rose by 77-78 gm between 2004-05 and 2011-12: from 705 gm per month to 783 gm in the rural sector and from 824 gm to 901 gm in the urban sector. However, in 2011-12, the minimum requirement of 40 gm per day was not observed in any of the states. Comparing the consumption of pulses between 2004-05 and 2011-12, the highest consumers of pulses and pulses products were Andhra Pradesh, Gujarat, Karnataka, Punjab, Maharashtra, Madhya Pradesh, Tamil Nadu and Uttar Pradesh (**Table 3**). The consumption of pulses was higher in the urban sector as compared to the rural sector. Even though Rajasthan was among the highest producers of pulses, it was not among the highest consumers.

Table 3: Consumption of pulses and pulses products in rural and urban India in 2004-05 and 2011-12 (per capita, per day, in gm)

	2011-12		2004-05	
	Rural	**Urban**	**Rural**	**Urban**
Andhra Pradesh	28.57	31.67	23.40	26.73
Assam	21.57	26.10	20.73	25.80
Bihar	24.80	27.40	23.60	29.47
Chhattisgarh	26.47	32.10	24.70	32.23
Gujarat	28.10	31.77	25.90	31.17
Haryana	25.03	29.87	19.63	23.40
Jharkhand	19.23	27.93	18.20	29.10
Karnataka	30.47	33.93	25.43	29.50
Kerala	23.23	26.17	19.53	21.37
Madhya Pradesh	28.47	30.97	25.53	28.77
Maharashtra	32.50	33.63	29.30	30.43
Odisha	20.33	24.30	16.57	23.43
Punjab	29.93	31.87	27.93	30.07
Rajasthan	18.97	19.77	16.90	16.90
Tamil Nadu	33.10	35.63	25.83	31.73
Uttar Pradesh	28.83	29.60	28.27	27.90
West Bengal	16.27	19.17	13.57	18.33

Source: 61st and 68th Rounds of the National Sample Survey

On looking at protein consumption across sectors, social groups, wealth quantiles and household types, it is found that the highest share of protein in the diet is met by cereals (**Table 4**). The rural sector consumes more cereals than the urban sector while consumption of pulses and animal sources of food such as milk, meat, eggs and fish is higher in the urban area. This is because the urban sector has a more diversified diet than the rural sector. The structural shift in consumption patterns is on account of the diversification effect because of easy access to supply, changed tastes and preferences, and change in relative prices (Radhakrishna and Ravi 1990; 1992).

Kumar and Mathur (1996) find per capita consumption of all non-staples higher in both rural and urban areas in 1987 than in 1977, and higher in urban than rural households. Moreover, rural households had higher growth rates over that period for only livestock products, but not for fruits and vegetables. Kumar (1997) points out that diversification in the food basket due to urbanisation will provide food security and improve the quality of life by adding to the nutritional status and welfare of the population. With diversification, consumers are exposed to a wider choice of foods and shifts in dietary pattern either due to a rise in income or a fall in price. Increasing urbanisation and economic growth reduce per capita demand for cereals and the demand for non-cereal food items goes up. Meenakshi (1996) indicates that shift in the dietary pattern from cereal consumption to more expensive milk, poultry and meat products is a consistent change associated with economic growth the world over. This implies that as the pressure on the direct demand for cereals as food eases, indirect demand will increase, as increasing milk and meat demand exerts in turn a demand for cereals as livestock feed. Meenakshi and Ray (1999) analyse food expenditure, recognising regional differences in prices and preferences. The results reveal large regional differences in expenditure

patterns, implying that nutrient-enhancing programmes must recognise this diversity. According to them, in a developing country, cultural and other non-economic factors are as important as the conventional economic variables in explaining observed differences in food expenditure patterns. The poor are also consuming fewer calories over time, though it is possible that this change reflects the fact that their work involves less physical effort (Meenakshi and Vishwanathan 2003; Jha 2004). According to Ray and Lancaster (2005), a large number of households failed to meet the minimum calorie requirements right through the reform decades. Chatterjee et al. (2007) point out that cereals continue to supply well over 50 per cent of the total calorie intake of the households, highlighting the fact that with all the excitement about India's faster growth performance, she is still a low-income developing country. They also bring out some significant regional differences; for instance, the rural southern region represented by Andhra Pradesh recorded a sharply lower calorie intake than the rural north represented by the Punjab. Murty (2000) breaks down the changes in cereal quantity consumption as changes in income, prices, tastes and preferences and other omitted variables. Demand elasticities are estimated for ten states using pooled series of time series data from the National Sample Survey. The analysis shows wide variation in demand elasticity across states, income groups and sectors.

Scheduled Castes (SC) consume more cereals than Scheduled Tribes (ST) in the urban sector while all groups consume more pulses than ST, Other Castes (OC), being the highest in both urban and rural sectors. also consume higher quantities of animal sources of protein than other groups in both the urban and rural sectors (**Table 4**). The higher quantiles have a higher consumption across all food groups. In the urban sector, the middle quantiles are associated with higher consumption of cereals than other food groups. This is because as income increases, the consumption of other food groups increases and cereal consumption declines, especially in the urban sector. In the rural sector, diets are primarily cereal-based and consumption increases with income. Radhakrishna (2005) also finds that, despite some improvement in the incomes of the poor and decline in relative prices of cereals, cereal consumption per head has not risen. According to him, there has been a taste shift away from cereals and some non-food items have entered the basket of the poor and, within cereals, there has been a substitution of commodities with higher cost per calorie. Some authors (included in Regmi 2001) have argued that shifts in food consumption are not a measure of increased prosperity, rather food preferences have been changing over time.

In the rural sector, households that consume high quantities of cereals, pulses and animal food are primarily the ones self-employed in agriculture and those with a regular wage. In the urban sector, the salaried class and other types consume higher quantities of pulses and animal sources of food while casual labour and self-employed households consume high quantities of cereal. Radhakrishna and Ravi (1992) demonstrate that taste changes were an important factor in explaining the decline in cereal consumption, accounting for nearly 17 per cent of the decrease in cereal intake in rural areas observed between 1972-73 and 1987-88. In urban areas, the corresponding figure is 8 per cent.

Table 4: Per day per consumer unit consumption of protein from plant and animal sources in 2011-12

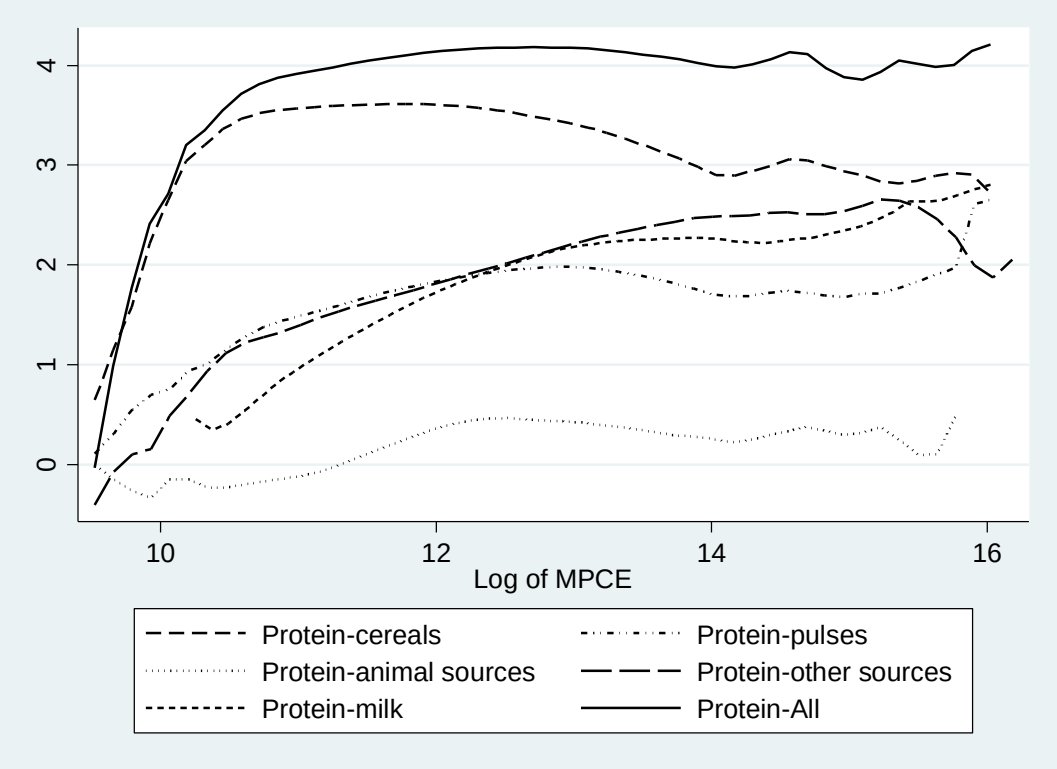
	Cereal (gm)	Pulses (gm)	Milk & Milk Products (gm)	Animal Products (gm)	Others (gm)	Total Proteins (gm)	Number
All	41.00	8.05	8.52	1.68	13.05	72.31	100325
	(15.07)	(5.28)	(9.20)	(2.51)	(19.84)	(30.63)	
Share	56.71	11.13	11.78	2.33	18.05	100.00	
Sector							
Rural	43.34	7.83	8.13	1.60	12.77	73.66	59232
	(14.72)	(5.10)	(9.61)	(2.34)	(17.85)	(29.07)	
Share	58.84	10.63	11.03	2.17	17.33	100.00	
Urban	37.63***	8.37***	9.08***	1.80***	13.45***	70.35***	41093
	(14.92)	(5.51)	(8.53)	(2.73)	(22.39)	(32.65)	
Share	53.48	11.90	12.91	2.57	19.12	100.00	
Social Group: Rural							
Scheduled Tribe	41.71***	6.12***	4.10***	2.08***	15.89***	69.93***	9858
	(14.34)	(4.92)	(6.30)	(2.39)	(20.48)	(29.12)	
Share	59.65	8.75	5.86	2.99	22.72	100.00	
Scheduled Caste	44.36*	7.64***	6.88***	1.23***	12.07	72.20***	10132
	(15.03)	(4.68)	(7.79)	(1.98)	(16.17)	(27.09)	
Share	61.44	10.58	9.53	1.70	16.70	100.00	
Other Backward Classes	43.20***	8.27	8.21***	1.49***	12.02*	73.21***	23405
	(14.96)	(5.01)	(8.7)	(2.29)	(17.17)	(28.1)	
Share	59.02	11.30	11.22	2.04	16.42	100.00	
Other Castes	43.90	8.34	11.29	1.68	12.36	77.57	15828
	(14.28)	(5.36)	(12.20)	(2.54)	(17.89)	(31.16)	
Share	56.59	10.76	14.56	2.17	15.93	100.00	
Social Group: Urban							
Scheduled Tribe	37.34	6.44***	5.06***	2.86***	14.80	66.52***	3577
	(15.13)	(4.66)	(6.01)	(3.14)	(22.71)	(32.13)	
Share	56.14	9.68	7.61	4.30	22.25	100.00	
Scheduled Caste	38.59***	8.11***	7.35***	1.43***	12.01***	67.51***	5505
	(15.16)	(5.04)	(7.38)	(1.91)	(18.27)	(29.20)	
Share	57.19	12.01	10.89	2.12	17.79	100.00	
Other Backward Classes	37.28*	8.61	8.16***	1.81***	11.92***	67.80	15913
	(15.21)	(5.52)	(7.29)	(2.89)	(20.12)	(30.30)	
Share	54.99	12.70	12.04	2.67	17.58	100.00	
Other Castes	37.70	8.65	11.49	1.70	15.16	74.70	16092

	Cereal (gm)	Pulses (gm)	Milk & Milk Products (gm)	Animal Products (gm)	Others (gm)	Total Proteins (gm)	Number
	(14.48)	(5.72)	(9.77)	(2.65)	(25.36)	(35.50)	
Share	50.47	11.58	15.38	2.27	20.30	100.00	
Quantile: Rural							
First	41.24	5.76	3.28	0.68	8.35	59.31	14808
	(12.63)	(3.17)	(4.12)	(0.91)	(10.15)	(18.01)	
Share	69.53	9.71	5.54	1.14	14.08	100.00	
Second	42.96***	7.03***	6.21***	1.19***	10.63***	68.04***	14808
	(13.34)	(3.87)	(6.06)	(1.35)	(13.96)	(21.47)	
Share	63.14	10.33	9.13	1.75	15.62	100.00	
Third	44.21***	8.16***	8.96***	1.70***	12.84***	75.87 ***	14808
	(14.69)	(4.71)	(8.17)	(1.88)	(16.68)	(25.56)	
Share	58.26	10.76	11.81	2.27	16.92	100.00	
Fourth	44.95***	10.36***	14.04***	2.81***	19.23 ***	91.41***	14808
	(17.47)	(6.72)	(13.64)	(3.64)	(25.16)	(37.21)	
Share	49.17	11.38	15.32	3.17	21.04	100.00	
Quantile: Urban							
First	37.03	6.05	3.94	0.84	6.68	54.54	10274
	(12.63)	(3.37)	(3.93)	(1.10)	(9.39)	(17.52)	
Share	67.89	11.10	7.22	1.54	12.25	100.00	
Second	38.19***	7.60***	7.42***	1.49***	9.70 ***	64.42***	10273
	(13.48)	(4.22)	(5.71)	(1.69)	(15.68)	(23.25)	
Share	59.32	11.80	11.49	2.33	15.06	100.00	
Third	38.06***	8.95 ***	10.41***	2.03***	13.95***	73.42***	10273
	(14.43)	(5.15)	(7.68)	(2.40)	(21.51)	(29.63)	
Share	51.84	12.19	14.18	2.76	19.00	100.00	
Fourth	37.23	10.87***	14.57***	2.85***	23.48***	89.02***	10273
	(18.44)	(7.28	(11.10)	(4.22)	(32.38)	(43.55)	
Share	41.82	12.25	16.40	3.26	26.40	100.00	
HH type: Rural							
Self- employed in agriculture	45.96	8.14	10.62	1.37	12.31	78.41	16565
	(14.77)	(5.29)	(12.26)	(2.16)	(17.45)	(30.48)	
Share	58.62	10.38	13.55	1.75	15.70	100.00	
Self- employed in non-agriculture	42.05***	7.46***	6.94***	1.66***	12.20	70.31***	15082
	(13.30)	(4.51)	(7.79)	(2.29)	(16.72)	(26.20)	
Share	59.74	10.67	9.96	2.42	17.35	100.00	

	Cereal (gm)	Pulses (gm)	Milk & Milk Products (gm)	Animal Products (gm)	Others (gm)	Total Proteins (gm)	Number
Regular wage earner	41.04***	8.13	8.61***	2.04***	14.76***	74.59***	10490
	(13.18)	(5.26)	(8.78)	(2.66)	(21.67)	(30.12)	
Share	55.01	10.90	11.80	2.73	19.80	100.00	
Casual labour in agriculture	42.00***	7.44***	4.86***	1.34	11.83*	67.49***	4960
	(14.85)	(4.75)	(5.55)	(2.01)	(15.76)	(25.78)	
Share	62.22	11.02	7.26	1.99	17.48	100.00	
Casual labour in non-agriculture	42.67***	7.05***	5.94***	1.36	11.88*	68.93***	8947
	(14.33)	(4.25)	(7.02)	(1.97)	(15.69)	(24.44)	
Share	61.90	10.24	8.63	1.97	17.23	100.00	
Other	47.36***	9.70***	10.36	2.08***	15.13***	84.64***	3171
	(21.93)	(7.56)	(11.53)	(3.27)	(19.11)	(38.76)	
Share	55.95	11.46	12.23	2.45	17.85	100.00	
HH type: Urban							
Self employed	39.07	8.09	9.38	1.66	12.45	70.64	15286
	(12.78)	(4.74)	(8.32)	(2.51)	(21.47)	(30.01)	
Share	55.30	11.46	13.28	2.34	17.62	100.00	
Salaried class	36.33***	8.65***	9.56**	1.94***	14.76	71.24*	15965
	(14.23)	(5.43)	(8.06)	(2.74)	(24.22)	(33.05)	
Share	51.00	12.13	13.34	2.72	20.72	100.00	
Casual labour	37.17***	7.42***	5.31***	1.60	9.89***	61.41***	5402
	(14.17)	(4.60)	(5.26)	(2.26)	(15.44)	(24.66)	
Share	60.53	12.08	8.63	2.61	16.12	100.00	
Others	37.89***	9.48***	10.99***	2.09 ***	16.56 ***	77.03***	4424
	(22.65)	(8.30)	(12.08)	(3.75)	(24.78)	(44.21)	
Share	49.21	12.31	14.29	2.73	21.51	100.00	

Notes: Milk and milk products include milk, butter, ghee, powdered milk and processed milk. Animal proteins consist of eggs, fish and meat. Standard deviations are in parenthesis. Share represents the percentage share of that particular food group protein in total protein. *** p<0.01, ** p<0.05, * p<0.1 for test of difference in equality.

Figure 1: Log of protein consumption per consumer unit per month from different food groups

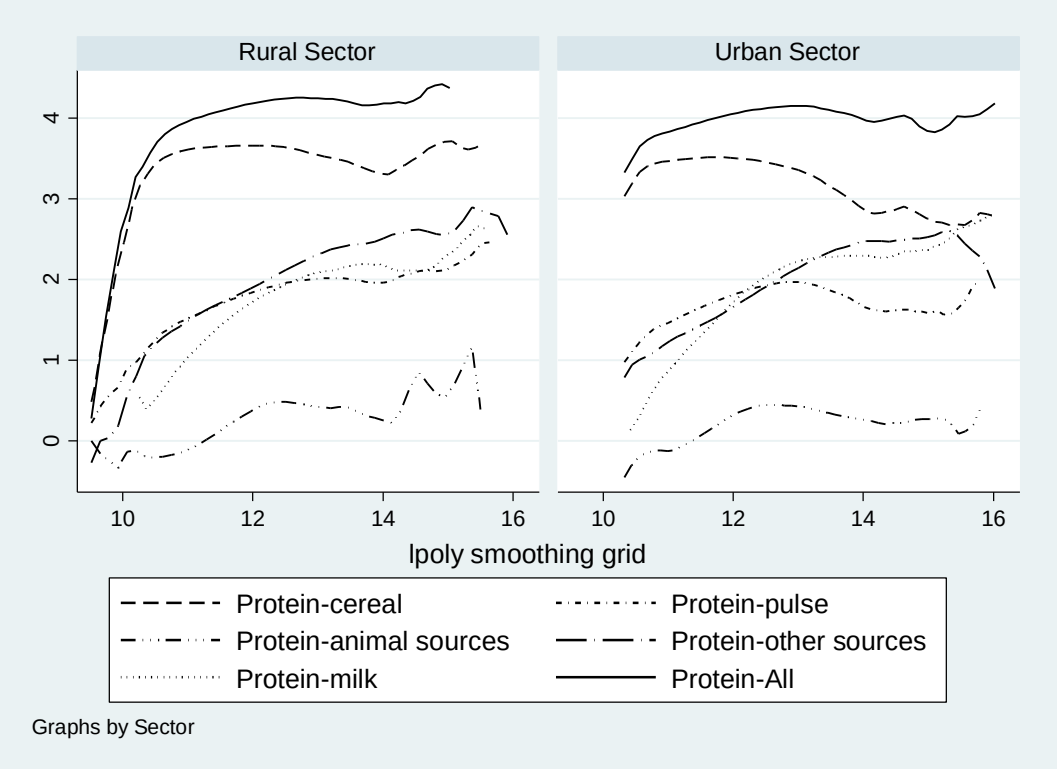


Source: NSSO 68th Round

On plotting the local polynomial graphs for log of protein consumption from various food groups, against log of MPCE, it is seen that cereals remain the single most important source of protein, followed by other sources of protein and milk and milk products for higher income levels (**Figure 1**). For lower income levels, protein consumption is highest through cereals and pulses than all other sources.

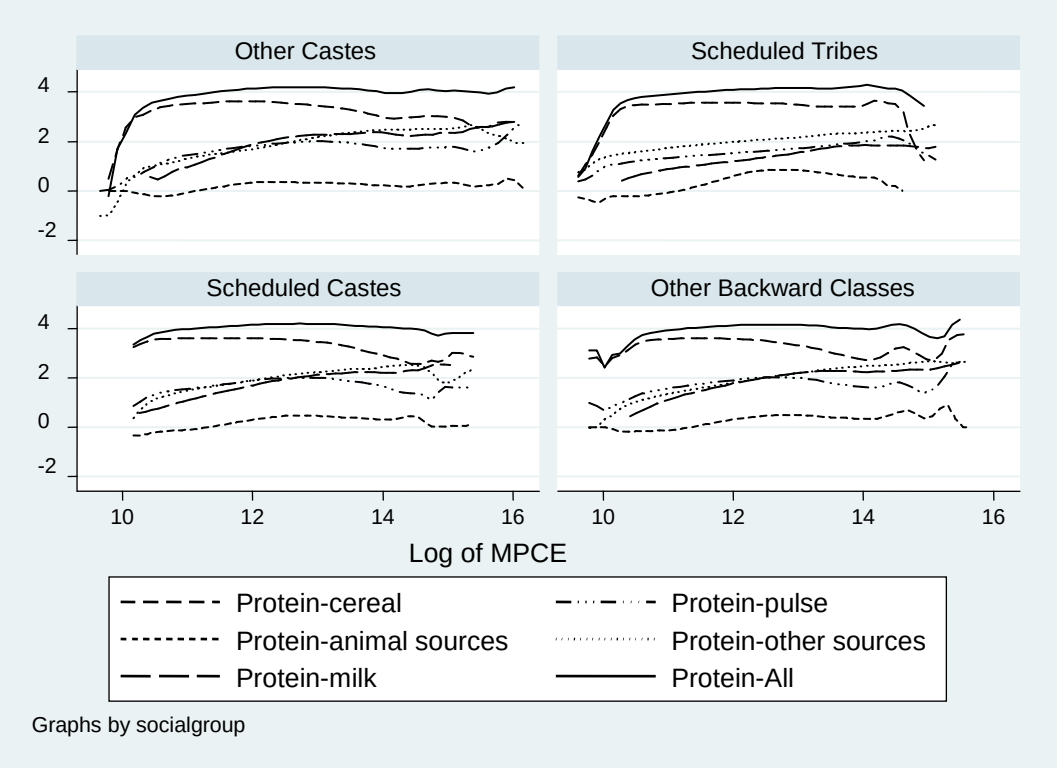
On disaggregating the analysis according to sector, it is observed that the consumption of food groups is higher in the rural sector than in the urban. On analysing protein consumption by social groups, similar patterns are observed at the all-India level (**Figures 2 and 3**).

Figure 2: Log of protein consumption per consumer unit per month from different food groups, by sector



Source: NSSO 68th Round

Figure 3: Log of protein consumption per consumer unit per month from different food groups, by social groups



Source: NSSO 68th Round

3 Data and Methodology

The objective is twofold. First, to examine the factors that affect protein consumption from plant and animal sources in the year 2011-12 across social groups, sectors, wealth quantiles and household occupations. Second, to identify factors that affect protein consumption from different sources of food.

For the first objective, following Gaiha et al. (2010), there is one demand equation for protein consumed for major food groups:

$$\ln Y_i = \alpha + \Sigma\beta_{1k} \ln P_{ik} + \beta_2 \ln MPCE_i + \beta_3 (\ln MPCE_i)^2 + \gamma Z + e_i, \; k=1, 2,,,,,. 7 \quad (1)$$

The dependent variable in equation (1) above is log of per consumer protein consumed by the ith household. The protein consumption in the household is adjusted for the household size and composition by using Gopalan et al.'s equivalent scales (1989)[6]. $\ln P_{ik}$ is the vector of log of food prices computed from the NSS at the district level for seven food groups, i.e., k ranges from 1 to 7.[7] These include cereals, eggs, vegetables, milk, fish, chicken and pulses. $\ln MPCE_i$ is the log of monthly per capita expenditure for ith household. Z is the vector of household characteristics such as household size and ethnic group, which have a significant impact on consumption. Occupation has an impact through income. Education plays a major role in consumption as it helps identify nutritious food. Living environment is important. i.e., whether the individual resides in the urban or rural sector.

For the second objective, there are five equations which describe five protein consumption functions from five different sources, viz., cereals, pulses, milk and milk products, other animal sources (such as egg, fish and meat) and other plant sources (such as fruits and vegetables). In general, cereal and pulses are the major sources of plant protein while eggs, milk and meat are major sources of animal protein. Different equations contain different variables as the price of one particular food group might increase or decrease the demand for another. Therefore, the control is for own price and cross-price effects. The equations may look distinct individually but there is some kind of relationship that exists among them. Such equations can be used to examine the jointness of the distribution of disturbances. It seems reasonable to assume that the error terms associated with the equations may be contemporaneously correlated. The equations are apparently or "seemingly" unrelated regression estimation (SURE) rather than independent relationships (Greene 2008):

$$\ln Y_1 = \alpha + \Sigma\beta_{1k} \text{ In } P_i + \beta_2 \ln MPCE_i + \beta_3 (\ln MPCE_i)^2 + \gamma Z + e_1$$
$$\ln Y_2 = \alpha + \Sigma\beta_{1k} \text{ In } P_i + \beta_2 \ln MPCE_i + \beta_3 (\ln MPCE_i)^2 + \gamma Z + e_2$$
.
.
$$\ln Y_5 = \alpha + \Sigma\beta_{1k} \text{ In } P_i + \beta_2 \ln MPCE_i + \beta_3 (\ln MPCE_i)^2 + \gamma Z + e_5, k = 1, 2 \ldots .7$$

[6] The equivalent scales are attached in the Appendix,**Table A1**`.

[7] In the calculation of district level prices, all observations with zero consumption were removed and an average of the unit prices for households that consumed the particular food group was obtained as a district level average unit price

Here Y_i is the dependent variable, i.e., per consumer unit consumption of protein from five different sources — cereals, pulses, milk and milk products, animal sources and other sources. P_i is a k X 1 vector of prices, own price and cross price for different food groups, viz., cereals, eggs, vegetables, milk, fish, chicken and pulses. $\ln MPCE_i$ is the log of monthly per capita expenditure. As before, Z is the vector which includes demographic factors.

4 Results and Discussion

4.1 Data description

Fifty-nine per cent of the sample data is from the rural sector while 41 per cent belongs to the urban sector (**Table 5**). The majority of the households are headed by male members. The percentage of social groups in the sample is almost proportional to the all-India percentage. In the rural sector, more than 50 per cent of the households are self-employed — 28 per cent in agriculture and 25 per cent in non-agriculture. In the urban sector, 37 per cent are self-employed while 39 per cent are the salaried class. Almost a quarter of the population is non-literate.

Table 5: Descriptive statistics

Variable	Number	Mean	Std. Dev.
Log protein consumption per capita	101652	4.22	0.46
Household size	101651	4.57	2.26
Log of MPCE	101651	12.10	0.63
Log of MPCE squared	101651	146.79	15.41
Log of price of cereals	101651	-4.13	0.21
Log of price of eggs	101414	1.34	0.16
Log of price of vegetables	101651	-3.22	0.60
Log of price of milk	101449	-3.67	0.18
Log of price of meat	101587	-3.55	0.27
Log of price of pulses	101651	-2.87	0.12
Log of per capita protein consumption from milk	87054	1.90	1.02
Log of per capita protein consumption from other sources	101652	2.01	1.13
Log of per capita protein consumption from animal sources	101652	0.42	0.73
Log of per capita protein consumption from pulses	101652	1.88	0.69
Log of per capita protein consumption from cereals	101652	3.61	0.60

Variables	Frequency	Percent
Percentage of Sample		
Sector		
Rural	59674	58.71
Urban	41962	41.29
Social Group: Rural		
Other Caste	16,005	26.82
Scheduled Tribe	9,930	16.64

Variables	Frequency	Percent
Percentage of Sample		
Sector		
Scheduled Case	10,193	17.08
Backward Caste	23,546	39.46
Social Group: Urban		
Other Caste	16,631	39.63
Scheduled Tribe	3,636	8.66
Scheduled Case	5,564	13.26
Backward Caste	16,131	38.44
Access to PDS		
No	12786	12.58
Yes	88866	87.42
Gender: Household Head		
Male	89,989	88.53
Female	11,662	11.47
Education		
Non-literate	23820	23.44
Literate below primary	10914	10.74
Middle school	28726	28.26
Secondary/Senior Secondary	23737	23.35
Graduate	14440	14.21
Household type: Rural		
Self-employed in agriculture	16703	27.99
Self-employed in non-agriculture	15173	25.43
Regular wage earner	10609	17.78
Casual labour in agriculture	4982	8.35
Casual labour in non agriculture	8974	15.04
Other	3225	5.41
Household type: Urban		
Self-employed	15,544	37.05
Salaried class	16,361	39.00
Casual labour	5,429	12.94
Other	4,618	11.01

4.2 Discussion

Following Gaiha e al. (2010), it is observed that the consumption of protein is positively related to the monthly per capita expenditure (MPCE). As MPCE (which is a proxy for income) increases, consumption of protein rises for both urban and rural sectors. The second order of MPCE is negative and significant, implying that expenditure will fall after a point in time. This is true of necessities such as food (**Table 6**).

Price effects capture both own and cross-price effects through substitutions between food commodities. The results confirm significant food price effects — negative for cereals, pulses, milk and vegetables in the rural sector (**Table 6**). The expenditure on protein demand is positive and large. As prices of cereals, pulses, vegetables and milk increase, the consumption of protein shows a decline in the rural sector. In the urban sector, the prices of cereals, vegetables, milk and chicken are negatively associated with protein consumption. However, the price of pulses, eggs and fish are positively related to protein consumption. The positive relationship between some commodity prices and their quantities can possibly be attributed to switching to better quality pulses, eggs and fish. The results are similar to Gaiha et al. (ibid.).

Table 6: Regression results of determinants of consumption of consumer unit of protein

Consumption of Total Proteins	(1)Rural Consumption of Consumer Unit of Protein	(2)Urban Consumption of Consumer Unit of Protein
Log of MPCE	1.17***	0.48***
	(0.07)	(0.09)
Log of MPCE squared	-0.03***	-0.00
	(0.00)	(0.00)
Log prices- cereal	-0.51***	-0.55***
	(0.01)	(0.01)
Log prices- eggs	0.22***	0.16***
	(0.01)	(0.02)
Log prices- vegetables	-0.03***	-0.04***
	(0.00)	(0.00)
Log prices- milk	-0.07***	-0.06***
	(0.01)	(0.02)
Log prices- fish	0.03***	0.09***
	(0.01)	(0.01)
Log prices- chicken	-0.01	-0.03*
	(0.01)	(0.02)
Log prices- pulses	-0.09***	0.10***
	(0.01)	(0.02)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 Detailed results with estimated coefficients for all other explanatory variables is reported in Table A2

The Scheduled Castes in the urban and Backward Classes in the rural sector consume the least protein in all the social groups. In terms of household type, self-employed in agriculture in rural and self-employed in urban areas have a higher consumption of protein than all other types of households. Deaton and Dreze (2008) claim people do not buy nutrients but food commodities. However, if consumers are aware of the nutrient value of foods, demand for protein can be studied (Pitt and Rosenzweig 1985; Gaiha et al. 2010).

In the second part of the analysis, the attention is on the consumption of protein from five different sources: cereals, pulses, milk and milk products, other animal sources and other plant sources in both the urban and rural sectors (**Table 7**). It is seen that overall, protein consumption from all the five sources increases as income or MPCE increases. The second order MPCE is negative.

Table 7: Regression results of determinants of consumption of consumer unit of protein from cereals and pulses for rural and urban India

	(1)Urban Per consumer Protein Consumption from Cereals	(2)Urban Per consumer Protein Consumption from Pulses	(1)Rural Per consumer Protein Consumption from Cereals	(2)Rural Per consumer Protein Consumption from Pulses
Log of MPCE	1.45***	2.55***	1.02***	2.13***
	(0.08)	(0.11)	(0.07)	(0.12)
Log of MPCE squared	-0.05***	-0.09***	-0.03***	-0.07***
	(0.00)	(0.00)	(0.00)	(0.00)
Log prices- cereal	-0.30***	0.02	-0.16***	-0.13***
	(0.02)	(0.03)	(0.01)	(0.02)
Log prices- eggs	0.09***	0.14***	0.15***	-0.03
	(0.03)	(0.04)	(0.02)	(0.03)
Log prices- veg	-0.03***	0.12***	-0.01**	0.07***
	(0.01)	(0.01)	(0.00)	(0.01)
Log prices- milk	-0.09***	0.14***	-0.05***	0.23***
	(0.02)	(0.03)	(0.01)	(0.02)
Log prices- fish	0.03**	-0.06***	-0.00	-0.03***
	(0.01)	(0.02)	(0.01)	(0.01)
Log prices- chicken	0.00	0.26***	-0.08***	0.17***
	(0.02)	(0.03)	(0.01)	(0.02)
Log prices- pulses	-0.12***	-1.15***	0.03	-1.17***
	(0.03)	(0.05)	(0.02)	(0.03)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 Detailed Tables A3 and A4

In both the sectors, the consumption of protein from cereals decreases as price of cereals increases, in accordance with the demand theory. Consumption of protein from cereals increases as price of eggs increases. Consumption of protein from pulses increases as price of pulses decreases. Consumption of protein from pulses shows an increase as price of milk and milk products and price of chicken increases. As price of cereal decreases, an increase in the consumption of protein from pulses is observed. The consumption of protein from animal foods and milk and milk products is positively related to the price of pulses. As price of pulses increases, the sample shifts to consumption of protein from animal sources and milk and milk products. Egg prices are also positively related to consumption of protein from milk and milk products. As the monthly per capita expenditure (MPCE) increases, consumption of protein from various sources increases. The second order of MPCE is negative, suggesting that there is only a certain amount of income that is spent on food in the household budget.

On disaggregating the analysis sector-wise, it is seen that in the urban sector, Scheduled Tribes and Backward Castes consume more protein from cereals and consumption of protein from pulses is least for Scheduled Castes. Least quantities of animal protein and the most quantities of protein from

milk and milk products are consumed by Other Castes. In the rural sector, Scheduled Castes, Scheduled Tribes and Backward Castes consume higher quantities of protein from cereals. Other Castes consume the highest quantities of protein from pulses, and milk and milk products. In both the sectors, households where the household head is more educated consume the highest quantities of protein from milk and milk products. Female-headed households in general show a higher consumption of protein.

In the urban sector, households which are self-employed consume the highest amount of protein from cereals. Households employed in other occupations consume more protein from pulses, and milk and milk products. In the rural sector, self-employed in agriculture consume the highest quantities of protein through cereals, pulses and milk. Households that are self-employed in non-agriculture as well as regular wage earners consume the highest quantities of protein through animal and other sources. . Households having access to PDS show a higher consumption of protein from cereals in both the rural and urban sectors.

State-wise, those that consume the highest amount of protein from cereals include Jammu and Kashmir, Rajasthan, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Jharkhand and Nagaland. States that consume most protein from pulses are Himachal Pradesh, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu. Interestingly, four of these states provide pulses in the Public Distribution System. These are Himachal Pradesh, Andhra Pradesh, Tamil Nadu and quite recently, Karnataka. Punjab, Haryana and Jammu and Kashmir have the highest consumption of protein from milk and milk products. States that consume the highest quantity of protein from animal sources include Himachal Pradesh, Uttarakhand, Uttar Pradesh, Sikkim, Assam, West Bengal, Jharkhand, Kerala and Tamil Nadu.

5 Conclusions

Between 1993-94 and 2011-12, the consumption of pulses per consumer unit including red gram, green gram, lentils and black gram has fallen while the per capita consumption of split Bengal gram shows an increase. However, on the whole there is an increase in the quantity of pulses and pulses products consumed over the same period. This can be largely attributed to increased consumption of processed pulses products such as *besan, sattu* and others. This confirms that consumers have diversified their consumption to include processed food due to globalisation, improved transportation and changing consumer tastes and preferences.

On looking at protein consumption, it is found that the expenditure on protein is large and significant. As income increases, consumption of protein increases for both urban and rural sectors. Higher disposable incomes have led to higher demand of animal sources of protein. There are significant food price effects in the analysis. As pointed out in the earlier discussion, with decrease in the price of cereal, an increase in the consumption of protein from pulses is observed. The consumption of protein from animal foods and milk and milk products is positively related to the price of pulses. As price of pulses increases, the sample shifts to consumption of protein from animal sources and milk and milk products. This is a consistent change associated with economic growth.

Even till 2011-12, all the states were not meeting the minimum requirement of 40 gm of pulses per day. The consumption is higher in the states which distribute pulses in the PDS. It is also observed

that most pulses cannot be substituted in the diet as state-wise tastes and preferences are very important determinants of pulses crops and their inclusion in the diet. For instance, *urad* is more popular in the southern states and Bengal gram in the northern states.

Pulses are often referred to as "poor man's meat" and, together with millets, as "orphan crops". This mindset needs to be changed. Inclusion of pulses to form a balanced diet is crucial. The consumption of all pulses and even less popular pulses such as moth bean and cow pea should be promoted and encouraged. This is important in a country which has a large vegetarian population. Pulses are a nutrient-dense crop and their inclusion in the diet is important to tackle protein-energy malnutrition, especially for vegetarians. Pulses, along with cereals, meet a large part of the protein requirement of an individual. However, the protein derived from pulses is more nutritious and different from the protein in cereals. It is vital that awareness about the benefits and nutritive value of pulses be made known to the masses.

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7 Appendices

Table A1: Equivalent scales as specified in Gopalan et al. (1989)

Age	Male	Female
<1	0.43	0.43
1-3	0.54	0.54
4-6	0.72	0.72
7-9	0.87	0.87
10-12	1.03	0.93
13-15	0.97	0.80
16-19	1.02	0.75
20-39	1.00	0.71
40-49	0.95	0.68
50-59	0.90	0.64
60-69	0.80	0.51
>70	0.70	0.50

Table A2: Regression results of determinants of consumption of consumer unit of protein

	(1)Rural Consumption of Consumer Unit of Protein	(2)Urban Consumption of Consumer Unit of Protein
Log of MPCE	1.17***	0.48***
	(0.07)	(0.09)
Log of MPCE squared	-0.03***	-0.00
	(0.00)	(0.00)
Log prices- cereal	-0.51***	-0.55***
	(0.01)	(0.01)
Log prices- eggs	0.22***	0.16***
	(0.01)	(0.02)
Log prices- vegetables	-0.03***	-0.04***
	(0.00)	(0.00)
Log prices- milk	-0.07***	-0.06***
	(0.01)	(0.02)
Log prices- fish	0.03***	0.09***
	(0.01)	(0.01)
Log prices- chicken	-0.01	-0.03*
	(0.01)	(0.02)
Log prices- pulses	-0.09***	0.10***
	(0.01)	(0.02)
Access to PDS (Control: No access)		
Having access	0.07***	0.46***
	(0.00)	(0.01)
Household Type Rural (Base: Self-employed in agriculture)		
Self-employed in non-agriculture	-0.06***	
	(0.00)	
Regular wage	-0.09***	
	(0.00)	
Casual labour in agriculture	-0.02***	
	(0.01)	
Causal labour in non-agriculture	-0.06***	
	(0.00)	
Other	-0.06***	
	(0.01)	
Household Type Urban (Base: Self-employed)		
Salaried		-0.05***
		(0.01)
Casual labour		0.00
		(0.01)
Other		-0.06***
		(0.01)

	(1)Rural Consumption of Consumer Unit of Protein	(2)Urban Consumption of Consumer Unit of Protein
Social Group (Base: Other Caste)		
Scheduled Caste	-0.03***	-0.08***
	(0.00)	(0.01)
Scheduled Tribe	0.02***	0.02**
	(0.00)	(0.01)
Backward Caste	-0.01**	-0.02***
	(0.00)	(0.01)
Household Size	-0.01***	0.00**
	(0.00)	(0.00)
Education (Base: Illiterate)		
Literate	-0.06***	-0.08***
	(0.01)	(0.01)
Middle School	-0.09***	-0.12***
	(0.00)	(0.01)
Higher Secondary	-0.10***	-0.13***
	(0.00)	(0.01)
Graduate	-0.13***	-0.12***
	(0.01)	(0.01)
Gender-Household head (Control: Male)		
Female	0.05***	0.11***
	(0.01)	(0.01)
Constant	-7.99***	-3.79***
	(0.44)	(0.57)
Observations	53,750	38,728
R-squared	0.29	0.28

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A3: Per consumer consumption of protein from 5 major food groups-Urban

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
Log of MPCE	1.45***	2.55***	3.31***	5.57***	1.34***
	(0.08)	(0.11)	(0.14)	(0.15)	(0.23)
Log of MPCE squared	-0.05***	-0.09***	-0.11***	-0.19***	-0.02**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Log prices-cereal	-0.30***	0.02	-0.16***	-0.25***	-0.31***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.06)
Log prices-eggs	0.09***	0.14***	-0.15***	0.01	0.00
	(0.03)	(0.04)	(0.05)	(0.06)	(0.09)
Log prices- veg	-0.03***	0.12***	-0.06***	0.05***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Log prices-milk	-0.09***	0.14***	-0.09**	-0.20***	0.21***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Log prices- fish	0.03**	-0.06***	-0.10***	0.04*	-0.08**
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Log prices-chicken	0.00	0.26***	-0.17***	-0.35***	0.17***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Log prices-pulses	-0.12***	-1.15***	0.71***	0.24***	-0.47***
	(0.03)	(0.05)	(0.06)	(0.06)	(0.09)
Access to PDS (Control: Not having access)					
Having access	0.18***				
	(0.01)				
Employment (Base: Self-employed)					
Salaried class	-0.03***	-0.01*	-0.01	-0.08***	-0.03**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Casual labour	0.00	-0.03***	0.04***	-0.15***	0.10***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Others	0.02***	0.07***	-0.00	0.12***	0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Social Group (Base: Other Caste)					
Scheduled Caste	0.01	-0.06***	0.14***	-0.19***	0.22***

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Scheduled Tribe	0.04***	0.03***	0.10***	-0.17***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Backward Caste	0.02***	0.00	0.11***	-0.08***	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Household Size	-0.01***	-0.02***	0.01***	-0.00*	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (Base: Illiterate)					
Literate	-0.05***	-0.01	-0.05***	-0.02	0.01
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Middle School	-0.08***	-0.03***	-0.08***	-0.03**	-0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Higher Secondary	-0.09***	-0.04***	-0.14***	0.06***	-0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Graduate	-0.12***	-0.05***	-0.21***	0.17***	-0.14***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Sex of Household Head (Base: Male)					
Female	0.07***	0.08***	-0.01	0.11***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
State (Control: Punjab)					
Jammu and Kashmir	0.17***	-0.30***	0.35***	-0.27***	-0.19***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.06)
Himachal Pradesh	0.07**	0.12***	0.25***	-0.44***	-0.61***
	(0.03)	(0.04)	(0.06)	(0.06)	(0.09)
Chandigarh	-0.02	0.37***	-0.05	-0.29***	-0.71***
	(0.03)	(0.04)	(0.05)	(0.05)	(0.08)
Uttarakhand	0.16***	0.16***	0.13***	-0.38***	-0.25***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)
Haryana	0.02	-0.35***	0.03	-0.22***	0.06
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
Rajasthan	0.13***	-0.52***	0.04	-0.27***	-0.43***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)
Uttar Pradesh	0.09***	0.05**	0.23***	-0.47***	-0.25***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Bihar	0.17***	-0.08***	0.43***	-0.57***	-0.34***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)
Sikkim	-0.28***	-0.39***	0.65***	-0.48***	0.35***
	(0.04)	(0.05)	(0.06)	(0.07)	(0.10)
Arunachal Pradesh	0.11***	-0.26***	1.03***	-1.57***	-0.06
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Nagaland	0.11***	-0.72***	1.30***	-1.39***	0.02
	(0.03)	(0.04)	(0.05)	(0.05)	(0.08)
Manipur	0.07***	-0.83***	0.50***	-1.78***	-0.11
	(0.03)	(0.04)	(0.04)	(0.05)	(0.07)
Mizoram	0.02	-0.33***	0.99***	-1.38***	-0.70***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Tripura	0.03	-0.30***	1.07***	-1.92***	0.45***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Meghalaya	-0.13***	-0.83***	0.99***	-1.61***	-0.36***
	(0.03)	(0.04)	(0.04)	(0.05)	(0.07)
Assam	0.00	-0.20***	0.91***	-1.56***	-0.23***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
West Bengal	-0.00	-0.37***	0.94***	-1.40***	0.07
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Jharkhand	0.12***	-0.03	0.38***	-0.82***	-0.26***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Odisha	0.01	-0.07**	0.39***	-1.26***	0.22***
	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Chhattisgarh	-0.04	0.09***	0.33***	-1.20***	-0.04
	(0.02)	(0.03)	(0.04)	(0.04)	(0.07)
Madhya Pradesh	0.13***	0.10***	0.10***	-0.54***	-0.45***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Gujarat	-0.06***	-0.12***	0.08***	-0.40***	-0.38***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Maharashtra	0.00	0.06***	0.30***	-0.83***	-0.39***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
Andhra Pradesh	-0.06***	0.06***	0.39***	-0.84***	-0.22***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Karnataka	-0.06***	0.07**	0.43***	-0.78***	-0.38***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.06)
Kerala	-0.20***	-0.13***	1.09***	-1.20***	-0.09*
	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
Tamil Nadu	-0.18***	0.03	0.59***	-0.58***	-0.41***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Constant	-8.12***	-17.83***	-23.15***	-37.79***	-12.77***
	(0.54)	(0.74)	(0.91)	(0.99)	(1.51)
Observations	33,936	33,936	33,936	33,936	33,936
R-squared	0.19	0.36	0.37	0.52	0.23

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A4: Per consumer consumption of protein from 5 major food groups-Rural

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
Log of MPCE	1.02***	2.13***	2.00***	4.99***	2.35***
	(0.07)	(0.12)	(0.14)	(0.19)	(0.24)
Log of MPCE squared	-0.03***	-0.07***	-0.06***	-0.17***	-0.06***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Log prices-cereal	-0.16***	-0.13***	-0.16***	-0.04	-0.06
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Log prices-eggs	0.15***	-0.03	-0.18***	0.16***	-0.06
	(0.02)	(0.03)	(0.04)	(0.05)	(0.07)
Log prices-veg	-0.01**	0.07***	-0.05***	0.07***	-0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Log prices-milk	-0.05***	0.23***	-0.16***	-0.09**	0.13***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Log prices-fish	-0.00	-0.03***	-0.05***	-0.00	-0.02
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Log prices-chicken	-0.08***	0.17***	-0.10***	-0.40***	0.25***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Log prices-pulses	0.03	-1.17***	0.48***	0.31***	-0.33***
	(0.02)	(0.03)	(0.04)	(0.05)	(0.07)
Access to PDS (Control: Not having access)					
Having access	0.01**				
	(0.00)				
Employment (Base: Self-employed in agriculture)					
Self employed in non agriculture	-0.05***	-0.04***	0.04***	-0.22***	0.02*
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Regular wage earner	-0.06***	-0.04***	0.03***	-0.21***	0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Casual labour	-0.02***	-0.04***	0.06***	-0.28***	0.14***

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
in agriculture					
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Casual labour in non-agriculture	-0.05***	-0.03***	0.06***	-0.34***	0.09***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
Others	-0.01	0.03***	0.06***	-0.04**	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Social Group (Base: Other Caste)					
Scheduled Caste	0.01**	-0.02**	0.10***	-0.22***	0.35***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Scheduled Tribe	0.02***	-0.02***	0.05***	-0.18***	0.15***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
Backward Caste	0.01***	-0.01**	0.04***	-0.10***	0.10***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Household Size	-0.01***	-0.03***	0.01***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (Base: Illiterate)					
Literate	-0.03***	0.00	-0.05***	-0.01	-0.04**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
Middle School	-0.06***	-0.02***	-0.06***	0.01	-0.06***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Higher Secondary	-0.09***	-0.03***	-0.09***	0.08***	-0.15***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Graduate	-0.13***	-0.05***	-0.13***	0.18***	-0.21***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Sex of Household Head (Base: Male)					
Female	0.05***	0.11***	0.00	0.06***	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
State (Control: Punjab)					

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
Jammu and Kashmir	0.08***	-0.21***	0.54***	-0.29***	-0.50***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Himachal Pradesh	0.19***	0.19***	0.34***	-0.20***	-0.45***
	(0.01)	(0.03)	(0.03)	(0.04)	(0.05)
Chandigarh	-0.15***	0.47***	-0.09	-0.34***	-0.62***
	(0.04)	(0.06)	(0.07)	(0.10)	(0.13)
Uttarakhand	0.22***	0.34***	0.16***	-0.19***	-0.16***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Haryana	-0.01	-0.32***	0.22***	0.06	-0.25***
	(0.02)	(0.03)	(0.04)	(0.05)	(0.06)
Rajasthan	0.28***	-0.39***	0.24***	-0.13***	-0.52***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Uttar Pradesh	0.18***	0.17***	0.37***	-0.46***	-0.19***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
Bihar	0.18***	0.04**	0.58***	-0.61***	-0.18***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
Sikkim	-0.23***	-0.19***	0.56***	-0.49***	0.26***
	(0.02)	(0.03)	(0.04)	(0.05)	(0.06)
Arunachal Pradesh	-0.10***	-0.25***	1.02***	-1.79***	0.04
	(0.02)	(0.03)	(0.03)	(0.05)	(0.06)
Nagaland	-0.02	-0.67***	1.42***	-1.63***	-0.08
	(0.02)	(0.03)	(0.04)	(0.05)	(0.06)
Manipur	0.05***	-0.74***	0.77***	-2.05***	-0.16***
	(0.02)	(0.03)	(0.04)	(0.05)	(0.06)
Mizoram	-0.05***	-0.28***	1.01***	-1.97***	-0.79***
	(0.02)	(0.03)	(0.04)	(0.05)	(0.06)
Tripura	0.03**	-0.30***	1.08***	-1.89***	0.46***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Meghalaya	-0.21***	-0.75***	1.24***	-1.77***	-0.05
	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
Assam	0.00	-0.07***	1.07***	-1.54***	0.03
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
West Bengal	-0.01	-0.23***	0.96***	-1.46***	0.16***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Jharkhand	0.10***	-0.01	0.57***	-1.05***	-0.09*

	(1) Per consumer Protein Consumption from Cereals	(2) Per consumer Protein Consumption from Pulses	(3) Per consumer Protein Consumption from Animal Sources	(4) Per consumer Protein Consumption from Milk and Milk Products	(5) Per consumer Protein Consumption from Other Sources
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Odisha	0.08***	0.07***	0.47***	-1.45***	0.40***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Chhattisgarh	-0.01	0.09***	0.49***	-1.45***	0.12**
	(0.02)	(0.03)	(0.03)	(0.05)	(0.06)
Madhya Pradesh	0.23***	0.26***	0.28***	-0.52***	-0.36***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
Gujarat	-0.11***	0.06***	0.31***	-0.59***	-0.26***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Maharashtra	0.05***	0.24***	0.37***	-1.09***	-0.29***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
Andhra Pradesh	-0.09***	0.15***	0.69***	-0.95***	0.03
	(0.01)	(0.02)	(0.03)	(0.03)	(0.04)
Karnataka	-0.13***	0.20***	0.61***	-0.99***	-0.33***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Kerala	-0.38***	-0.22***	1.27***	-1.47***	0.10**
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Tamil Nadu	-0.23***	0.16***	0.72***	-0.72***	-0.23***
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Constant	-4.74***	-16.08***	-15.81***	-32.27***	-16.93***
	(0.43)	(0.75)	(0.89)	(1.20)	(1.52)
Observations	44,269	44,269	44,269	44,269	44,269
R-squared	0.34	0.40	0.40	0.45	0.19

Standard errors in parentheses* p<0.01, ** p<0.05, * p<0.1**