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Contents

Food grain Deficiency in India: Magnitude, Determinants and Policy Prescriptions

PARAMITA BHATTACHARYA AND SIDDHARTHA MITRA

Food security, which is one of the basic requirements of livelihood, is generally measured in terms of calorie intake. A major source of calories is carbohydrates, which is mainly obtained from food grains. This paper analyzes the level of food grain deficiency in India and across states. Through panel regression analysis, the study further analyzes the causal relationship between food grain deficiency and some of its determinants, viz., Public Distribution System (PDS), share of home-produced food grains in total consumption of food grains, food diversification and monthly per capita consumption expenditure (MPCE). The entire analysis uses National Sample Survey's unit-level data for two time periods: 1999–2000 and 2009–10.

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1. Introduction

Food security, one of the most important determinants of household welfare, is defined as a situation when all people at all times have access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002, p. 12). Literature suggests that the per capita calorie intake in India, both nationally and across states, has been declining over time (Suryanarayana, 2009, p. 9). This is an issue of great concern as it can have serious nutritional consequences. The major source of calories is carbohydrates, which are mainly obtained from food grains. Moreover, in the case of India where low income households far outnumber others, food grains constitute the cheapest and therefore the predominant broad source of calories. Therefore, this paper focuses mainly on food grain security issues.

Presently, India's aggregate production of food grains is adequate for food grain security; after procurement and public distribution we still have buffer stocks which exceed the minimum buffer stock norms. In spite of this there are millions of food insecure and undernourished people in the country. It indicates that achievement of food grain security at the national level has not percolated down to the level of individual households and has not resulted in nutritional security. Previous studies have shown that economic growth, a rise in per capita income, urbanization, changing tastes and preferences, market integration, etc., are important factors influencing per capita cereal consumption. They further indicate that mechanization of agriculture, improvements in infrastructure and medical facilities also contribute to a decline in energy requirement and thus reduced cereal consumption (Radhakrishna and Ravi, 1992, p. 322; Rao, 2000, p. 202). Like India, China has also observed a decline in cereal consumption in recent times which has been mainly attributed to a dietary shift (Du et al., 2002, p. 169).

The consumption of food grains is affected by various factors. First, income poverty and food insecurity (or food grain insecurity) are linked concepts which propagate a vicious circle of poverty. The propagation of such a circle can be stopped by making the income poor food secure by adopting suitable mechanisms such as the Public Distribution System (PDS) in India or Food Stamps in Jamaica and Sri Lanka. Second, monthly per capita consumption expenditure (MPCE) is assumed to play a pivotal role in influencing food grain deficiency: for low levels of such expenditure; consumption of food grains should increase with a rise in such expenditure. Third, food diversification is also considered to play an important role in influencing food grain deficiency, because with an increase in income, the pattern of diet also changes from a basic cereal-based to a non-cereal-based diet (Dev, 2012, p. 3). Fourth, home-grown food grains have traditionally been an important source of calories (Basu et al., 2013, p. 8). Hence, home-produced food grains also have an important role to play in total food grain consumption and influencing food grain deficiency.

With this backdrop, this study analyzes the level of food grain deficiency in India and across states, in both rural and urban areas. It further analyzes the effect of various factors on food grain deficiency, viz., PDS, food diversification, share of home-produced food grains in total consumption of food grains and MPCE. The entire study has been carried out across 'all classes' taken together, and for the 'Below Poverty Line (BPL) class' separately. The BPL class has been analyzed separately to capture the severity of the problem in the poorest strata of the society. The study overviews two time periods: 1999–2000 and 2009–10.

Section 2 of this paper briefly outlines the data and methodology. Section 3 analyzes the levels and patterns of food grain deficiency in India and across states. Section 4 analyzes the causal relationship between food grain deficiency and its major determinants. We end with a discussion and conclusion in Section 5.

2. Data and Methodology

Our study overviews two time periods: 1999–2000 and 2009–10. Data for these two periods have been taken from two quinquennial consumer expenditure surveys of the National Sample Survey Organization (NSSO), 55th (1999–2000) and 66th (2009–10) rounds.

To measure food grain deficiency, Foster, Greer and Thorbecke's measure of income poverty (1984) has been adopted. This measure is additively decomposable into poverty in different population sub-classes. Here we consider $X = (x_1, x_2, \ldots\ldots\ldots\ldots, x_n)$ as the vector of household food grain consumption levels and z as the predetermined food grain deficiency line (for consumption of food grains). Therefore, food grain shortfall of i^{th} household = $f_i = \max(z-x_i, 0)$, i.e., only positive shortfalls are taken into account as such, while negative shortfalls are considered to be zero. Given that n is the total number of households,

$$\textbf{Food grain Deficiency = FD} = \frac{1}{nz^m} \cdot \sum_{i=1}^{n} f_i^m$$

Here, m is a measure of sensitivity of food grain deficiency. Three deficiency measures are calculated based on three values of m (0, 1 and 2).

Head Count Index of Deficiency (P0) $\underline{m=0}$

It simply measures the proportion of population that is food grain deficient. The greatest virtues of this index is that it is simple to construct and easy to understand. However, this measure is unaffected by the extent to which individual food grain consumption falls below the desired norm, i.e., it fails to capture the intensity of food grain deficiency. Moreover, it is possible to reduce this measure by a large amount by targeting benefits to people just below the food grain deficiency line, even though the magnitude of such aggregate benefits might be small. Thus, use of this measure may give an unduly bright picture of alleviation of food grain deficiency. Hence we use our second measure: the poverty gap index which we refer to as food grain deficiency gap index (P1).

Food grain Deficiency Gap (P1) $\underline{m=1}$

P1 captures the intensity of food grain deficiency since it measures the shortfall of the representative person from the food grain deficiency line. This measure has the drawback that it does not give importance to the number of people who are food grain deficient. For this reason, it is important to use both P1 and P0 jointly to evaluate the extent of food grain deficiency.

Sen (1976, p. 219) formulated two axioms that a poverty measure should satisfy: montonicity axiom and transfer axiom. Monotonicity axiom states that given other things, a reduction in the income of a poor household must increase the poverty measure, while the transfer axiom states that given other things, a pure transfer of

income from a poor household to any other household that is richer must increase the poverty measure. While the poverty gap (here food grain deficiency gap) measure satisfies the monotonicity axiom, it fails to satisfy the transfer axiom. Hence, we use the measure of 'square poverty gap' which satisfies both monotonicity and transfer axioms to formulate an analogous measure, hereafter referred to as 'square food grain deficiency gap'.

Square Food grain Deficiency Gap **(P2)** $\underline{m = 2}$

To construct a measure of poverty that takes into account inequality among the poor, some researchers use the squared poverty gap index. This is simply a weighted sum of poverty gaps, where the weights are the poverty gaps themselves. Hence, by squaring the food grain deficiency gaps, the square food grain deficiency gap implicitly puts more weight on observations that are more distant from the food grain deficiency line, and hence measures the severity of food grain deficiency rather than just its intensity. In discussing poverty, therefore, it is important to use all three measures.

According to National Advisory Council's recommendation (NAC, 2011, p. 14), the per capita consumption of food grain per month should be 7 kg. Therefore, 7 kg of monthly consumption of food grains is taken as the food grain deficiency line. Given that food consumption varies by sex, age and activity level, we compute food grain shortfall in a household as average shortfall per consumer unit in the household. A normal male person doing sedentary work and belonging to the age group 20–39 is considered to be the numeraire, i.e., the embodiment of one consumer unit. A person of given sex, age and activity level is converted into an appropriate number of consumer units based on calorie requirement (NSS Report on Nutritional Intake, 1999–2000, pp. B1–B5) relative to the calorie requirement of the numeraire. Given that 7 kg per month is considered to be the threshold for per capita food grain deficiency, the current age structure and gender composition of the population implies a threshold per consumer unit of 8.6 kg of food grain per month. For the computation of food grain deficiency for BPL consumers we have used state-specific poverty lines given by the Planning Commission to identify income poor consumers.

The role of PDS is examined by measuring effective subsidy provided by PDS (Dreze and Khera, 2013, p. 57), which is measured as:

$$\textbf{Effective Subsidy} = ES = Q_i(p-q)$$

where,

Q_i is the quantity of subsidized commodity being provided to i^{th} household, p is the market price and q is the PDS issue price.

Our purpose here is to see what role PDS has played to combat food grain deficiency. Here effective subsidy levels have been measured for 'all classes' taken together and the 'BPL class' separately for both 55^{th} and 66^{th} rounds. An issue of concern here is the variable market price 'p', since the value of 'p' is different for different varieties of wheat and specially rice. Since better quality rice and wheat is generally consumed by the higher income class, so their effective subsidy levels might get overstated. In order to take care of this problem we have used the market price that applies for purchases by the BPL class for the 'all class' category as well.

The effect of food diversity is captured using food diversity index (FDI), which is also known as Simpsons Index (Drescher et al., 2007, p. 648).

$$\textbf{FDI} = 1 - \sum s_i^2$$

where,

s_i = *Share of product i in the total amount of food consumed*

The index is bounded between 0 and 1-1/n, whose limit value approximates 1 if the number of foods (n) increases. FDI = 0 indicates that an individual consumes only 1 food product. Here we have considered nine broad categories of food products based on the Manual on Dietary Guidelines for Indians (National Institute of Nutrition, 2011). The nine broad categories are cereals, pulses, fats & dry fruits, milk products, non-vegetarian food, vegetables, fruits, sugar and salt. Given that n = 9, therefore, the index is bounded between 0 and $1-\frac{1}{9}=\frac{8}{9}=0.9$. The FDI is computed at the household level.

To capture the effect of the abovementioned components on food grain deficiency, we resort to state-level panel regression analysis. The panel consists of two time periods: 1999–2000 and 2009–10. The regression equation can be written in the following manner:

$$FD_{jt} = \alpha + \beta\, ES_{jt} + \gamma\, SHP_{jt} + \eta\, FDI_{jt} + \lambda MPCE_{jt} + \mu MPCE^2_{jt} + \varepsilon_{jt}$$

where,

subscript j and t stand for states and time, respectively.

Here FD_{jt} refers to the head count index of food grain deficiency. The value of any variable at the level of the state is found by taking the average of household values of the variable. Panel linear regression analysis has been done separately for both rural and urban areas. The analysis has been done separately for 'all classes' taken together and for the 'BPL class'. SHP captures the impact of share of home-produced food grains in total consumption of food grains, while MPCE assesses the impact of monthly per capita consumption expenditure. The hypothesized relationship between MPCE and food grain deficiency allows for a U-shape in the graph depicting that relationship. This takes into account Engel's law, according to which the proportion of total expenditure on food declines with the magnitude of such expenditure; thus, there is every possibility of marginal impact of an increase in total expenditure on food grain consumption becoming negative beyond a threshold level, especially as an increase in total expenditure is associated with food grains being substituted by other food items. Thus, both MPCE and $MPCE^2$ have been included as explanatory variables in the regression.

3. Levels and Patterns of Food grain Deficiency

By estimating food grain deficiency at the all-India level we find that in 1999–2000, approximately 7 per cent of the population was food grain deficient, and of the total food grain deficient population 34.5 per cent belonged to rural India while 65.5 per cent belonged to urban India. In 2009–10, the food grain deficient population rose to 8.5 per cent, of which 36 per cent belonged to rural areas and 64 per cent belonged to urban areas. It is evident that food grain consumption has reduced more in rural areas than in urban areas. But still food grain deficiency in urban areas is higher than that in rural areas. Also, mean consumption level in rural areas is higher than that in urban areas. Another interesting observation is that the food grain deficient population belongs largely to the very low and very high expenditure classes: for the very low expenditure classes, food grain deficiency, as defined, is an indication of food insecurity, while among the very high expenditure classes, it may be taken as an indication of substitution of food grains by other food items in the food basket (fruits, vegetables, animal protein, etc.). In rural areas the head count index from 1999–2000 to 2009–10 has increased from 3.8 per cent to 5.2 per cent, while in urban areas it has increased from 12.38 per cent to 13.89 per cent. Table 1 and Table 2 present the food grain deficiency at the all-India level and across states for 'all classes' taken together and for the 'BPL class', respectively for both 55th and 66th rounds.

For 'all classes' taken together, we find that food grain deficiency in terms of P0 measure has increased most significantly in Himachal Pradesh, Kerala, rural Madhya Pradesh, urban Orissa, rural Rajasthan and urban West Bengal. Out of all these cases, the picture for urban Orissa and West Bengal is gloomy, as increase in food grain deficiency is concentrated in the lower expenditure classes. In the other cases the increase is spread across all expenditure classes. It is also important to mention that food grain deficiency has declined in rural Assam, urban Haryana, rural Jammu & Kashmir, Karnataka, urban Tamil Nadu and urban Uttar Pradesh. The change in food grain deficiency from 55th round to 66th round in terms of P0 measure is shown in Figure 1.

In general, food grain deficiency is found to be high in the states of Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu, well above the mean food grain deficiency levels. It is interesting to find that affluent states have a higher index of food grain deficiency in the rural as well as urban areas than less affluent ones. There might be two reasons for this phenomenon — a larger proportion of the population in such a state belongs to higher income classes and consumes a diversified food basket associated with low amounts of food grain; given a substantial presence of higher income classes, the other income classes also follow their example in trying to diversify their food baskets.

Next, we analyze food grain deficiency gap (P1) measure which assesses the intensity of food grain deficiency, and square food grain deficiency gap (P2) measure which estimates its severity. At the all-India level we find that in the case of food grain deficiency gap there has been an increase from 55th round to 66th round across both rural and urban areas. The same is true for square food grain deficiency gap. A state-level analysis of the 55th round shows a rough congruency in the rankings of the states for the three measures P0, P1 and P2, with rankings constructed in a manner such that higher ranks (lower integer values of these ranks) correspond to higher food grain deficiency. With regard to P1 and P2 measures for rural areas, Gujarat, Kerala, Tamil Nadu and Karnataka take top ranks, while these measures are lowest in Orissa, Rajasthan, Himachal Pradesh and Assam. Regarding urban

Table 1: Food grain Deficiency per Consumer unit per Month: All India and Major States (Across all Classes)

States	55th Round						66th Round					
	Rural			Urban			Rural			Urban		
	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2
Andhra Pradesh	1.74	0.28	0.09	6.3	0.91	0.25	2.30	0.27	0.07	7.39	0.91	0.19
Assam	1.86	0.24	0.05	2.66	0.28	0.07	0.81	0.08	0.03	2.35	0.48	0.23
Bihar	2.38	0.4	0.12	3.5	0.65	0.23	3.39	0.48	0.11	4.99	0.75	0.25
Gujarat	12.96	1.99	0.49	27.19	4.86	1.35	13.37	1.88	0.47	33.54	7.13	2.40
Haryana	6.08	0.74	0.19	22.99	3.04	0.7	8.04	0.91	0.20	14.57	2.02	0.45
Himachal Pradesh	1.57	0.18	0.04	6.16	1.01	0.26	4.10	0.77	0.20	17.89	2.87	0.75
Jammu &Kashmir	1.18	0.41	0.19	1.87	0.32	0.08	0.73	0.17	0.09	2.70	0.39	0.12
Karnataka	8.04	1.37	0.39	15.57	2.44	0.66	7.83	0.85	0.15	11.64	1.56	0.36
Kerala	11.59	1.75	0.47	17.61	2.94	0.9	23.27	3.81	1.00	32.38	5.97	1.86
Madhya Pradesh	3.35	0.55	0.17	9.93	1.93	0.64	6.79	1.19	0.37	12.16	1.90	0.50
Maharashtra	4.25	0.66	0.2	17.22	2.52	0.69	4.89	0.58	0.15	22.99	4.15	1.26
Odisha	0.64	0.13	0.06	1.91	0.64	0.38	0.95	0.19	0.09	3.71	0.86	0.48
Punjab	6.27	0.94	0.25	19.77	3.52	1.08	10.93	1.46	0.35	25.42	4.03	1.14
Rajasthan	1.24	0.16	0.05	8.7	1.34	0.34	3.06	0.40	0.10	9.56	1.37	0.30
Tamil Nadu	10.04	1.45	0.37	16.29	2.56	0.72	10.38	1.35	0.31	14.39	2.04	0.46
Uttar Pradesh	2.26	0.39	0.12	9.9	1.52	0.43	3.07	0.43	0.10	9.61	1.39	0.36
West Bengal	2.77	0.48	0.15	8.84	1.78	0.68	5.71	0.75	0.19	14.38	2.66	1.05
All India	3.86	0.62	0.18	12.38	2.06	0.61	5.23	0.75	0.19	13.89	2.37	0.71

Source: Authors' own calculation

Table 2: Food grain Deficiency per Consumer unit per Month: All India and Major States (BPL Class)

States	55th Round						66th Round					
	Rural			Urban			Rural			Urban		
	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2
Andhra Pradesh	0.72	0.15	0.06	2.33	0.31	0.07	1.02	0.11	0.02	1.68	0.23	0.06
Assam	1.57	0.20	0.04	0.18	0.04	0.01	0.56	0.06	0.03	1.02	0.17	0.04
Bihar	1.57	0.29	0.09	1.28	0.24	0.08	2.13	0.30	0.06	2.75	0.36	0.07
Gujarat	2.71	0.55	0.17	5.80	1.21	0.38	2.87	0.41	0.11	10.18	2.37	0.86
Haryana	0.80	0.08	0.02	2.12	0.31	0.09	1.53	0.24	0.09	3.92	0.52	0.10
Himachal Pradesh	0.48	0.04	0.01	0.36	0.08	0.02	0.63	0.11	0.02	3.53	0.82	0.27
Jammu &Kashmir	0.14	0.02	0.00	0.44	0.11	0.03	0.16	0.02	0.00	1.10	0.13	0.02
Karnataka	3.27	0.47	0.12	5.49	0.82	0.22	2.46	0.26	0.04	4.97	0.66	0.14
Kerala	3.45	0.58	0.16	7.41	1.31	0.41	3.32	0.65	0.17	7.62	1.53	0.48
Madhya Pradesh	1.91	0.32	0.11	4.62	0.90	0.30	2.92	0.54	0.17	4.44	0.70	0.21
Maharashtra	1.67	0.27	0.08	5.52	0.75	0.21	1.22	0.17	0.04	4.29	0.79	0.22
Odisha	0.43	0.08	0.04	0.49	0.15	0.09	0.40	0.05	0.01	1.30	0.16	0.05
Punjab	1.17	0.21	0.06	1.44	0.04	0.09	1.84	0.31	0.08	7.82	1.57	0.49
Rajasthan	0.42	0.07	0.02	2.02	0.31	0.08	1.35	0.17	0.05	2.67	0.39	0.08
Tamil Nadu	3.50	0.49	0.12	5.51	0.93	0.25	1.82	0.21	0.05	3.43	0.46	0.10
Uttar Pradesh	1.05	0.22	0.08	3.96	0.67	0.20	1.40	0.20	0.04	4.43	0.64	0.15
West Bengal	1.76	0.32	0.10	1.59	0.36	0.12	1.54	0.20	0.05	3.83	0.71	0.24
All India	1.44	0.25	0.08	3.19	0.57	0.18	1.38	0.20	0.05	3.58	0.61	0.07

Source: Authors' own calculation

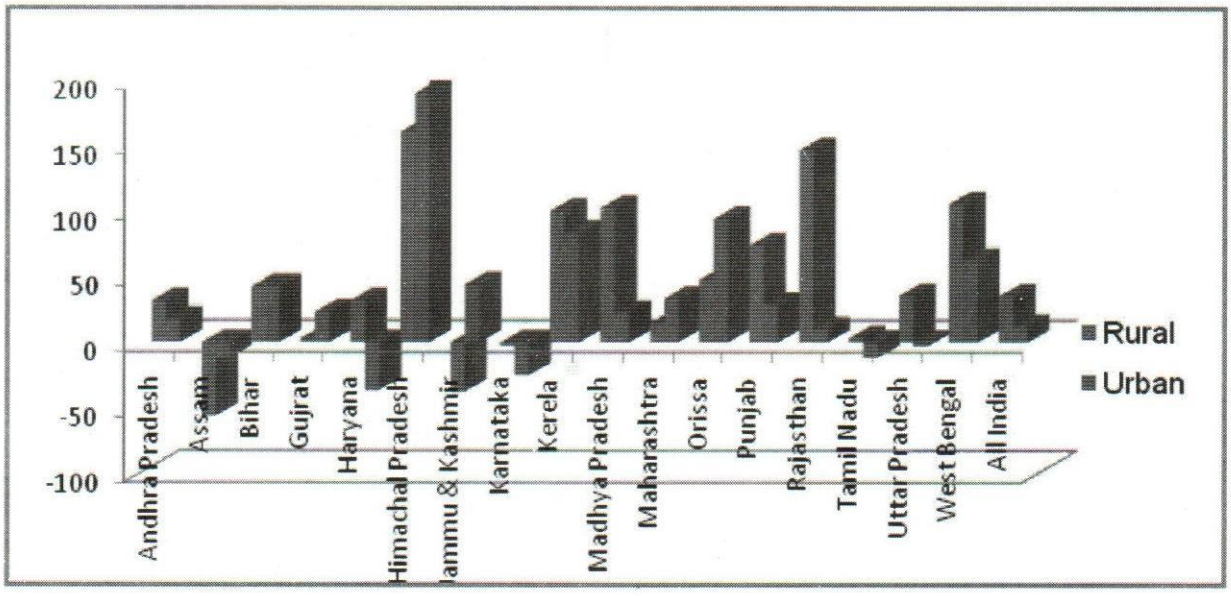

Figure 1: Percentage Change in Food grain Deficiency from 1999–2000 to 2009–10

areas, the top ranked states are Gujarat, Punjab, Haryana and Kerala for P1 and Gujarat, Punjab, Kerala and Tamil Nadu for P2; P1 is lowest in Jammu & Kashmir, Orissa and Assam, while P2 is lowest in Assam, Jammu & Kashmir and Bihar.

In the 66th round we again find a congruency in rankings with regard to the three measures of food grain deficiency; this round exhibits a marginal increase in the level of food grain deficiency measures as compared to the 55th round. In this round we find that for P1 measure for rural areas, Kerala, Gujarat and Punjab take top ranks, while for P2 Kerala, Gujarat and Madhya Pradesh take top ranks. The lowest values for P1 and P2 measures with regard to rural areas are observed for Andhra Pradesh, Assam, Jammu & Kashmir and Orissa, although not in the same order. Regarding urban areas the highest values of P1 are observed for Gujarat, Kerala and Maharashtra; the same three states occupy the top three slots for P2, with same ranks. The lowest values of P1 in urban areas are observed for Jammu & Kashmir, Assam, Andhra Pradesh and Bihar; the same three states occupy the top three slots for P2, though with different ranks.

To sum up, we have divided the states into four categories in terms of the P0 measure of food grain deficiency (only the P0 measure is taken into account since we observe a congruency among the three measures of food grain deficiency). The four categories are that of extremely low (P0<mean-1/2standard-deviation [SD]), low (mean-1/2*SD<P0<mean), moderate (mean < P0< mean+1/2*SD) and high (P0> mean+1/2*SD) food grain deficiencies. Tables 3a and 3b summarize the food grain deficiency situation in rural and urban areas for the 55th and 66th rounds of NSS respectively.

Next, food grain deficiency among the BPL consumers is analyzed. It is important to address this section of the population since the food grain deficiency observed for others is mainly because of diversification of the existing food basket and BPL consumers are the ones who suffer from poverty-driven food insecurity.

It is interesting to find that food grain deficiency in terms of P0 measure among the BPL households has declined in rural areas across various states like Assam, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu and West Bengal. In case of urban areas decline has been observed only in Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. In rural areas significant increase in food grain deficiency has been observed only in case of Rajasthan, while in urban areas food grain deficiency has increased significantly in Assam, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Orissa, Punjab and West Bengal. Overall food grain deficiency among the BPL class is again higher in the affluent states of Gujarat, Karnataka and Kerala, with the only exception being Madhya Pradesh. The change in food grain deficiency from 55th to 66th round has been shown in Figure 2. This can be attributed to the significant presence in these more affluent states of higher expenditure classes, which are characterized by a highly diversified food basket.

Table 3a: Food grain Deficiency across States in 55th round				
	Extremely Low (P0<mean-1/2*SD)	**Low (mean-1/2*SD <P0< mean)**	**Moderate (mean < P0< mean+1/2*SD)**	**High (P0>mean+1/2*SD)**
Rural	Assam, Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Odisha	Madhya Pradesh, West Bengal, Uttar Pradesh, Bihar	Maharashtra	Gujarat, Kerala, Tamil Nadu, Karnataka, Punjab, Haryana
Urban	Odisha, Bihar, Assam, Jammu & Kashmir, Himachal Pradesh, Andhra Pradesh	Uttar Pradesh, Madhya Pradesh, West Bengal, Rajasthan	Karnataka	Gujarat, Punjab, Haryana, Kerala, Maharashtra, Tamil Nadu

Table 3b: Food grain Deficiency across States in 66th round				
	Extremely Low (P0<mean-1/2*SD)	**Low (mean-1/2*SD <P0< mean)**	**Moderate (mean < P0< mean+1/2*SD)**	**High (P0>mean+1/2*SD)**
Rural	Odisha, Assam, Jammu & Kashmir, Andhra Pradesh	Maharashtra, Himachal Pradesh, Uttar Pradesh, Rajasthan, Bihar	Madhya Pradesh, Karnataka, Haryana, West Bengal	Kerala, Gujarat, Punjab, Tamil Nadu
Urban	Odisha, Assam, Jammu & Kashmir, Bihar, Andhra Pradesh	Rajasthan, Uttar Pradesh, Karnataka, Madhya Pradesh	West Bengal, Tamil Nadu, Haryana, Himachal Pradesh	Gujarat, Kerala, Maharashtra, Punjab

Source: Authors' own calculation

This leads to similar diversification among BPL classes and thus lower consumption of food grain.

Analysis of the food grain deficiency gap (P1) measure and the square food grain deficiency gap (P2) measure leads to the conclusion that these have declined from the 55th to 66th round in rural areas. However, the P1 measure has increased slightly in urban areas, while P2 measure has registered a negligible decline. As is observed for 'all classes', in the case of BPL consumers we find that there is a congruency in the rankings of the states for the three measures P0,

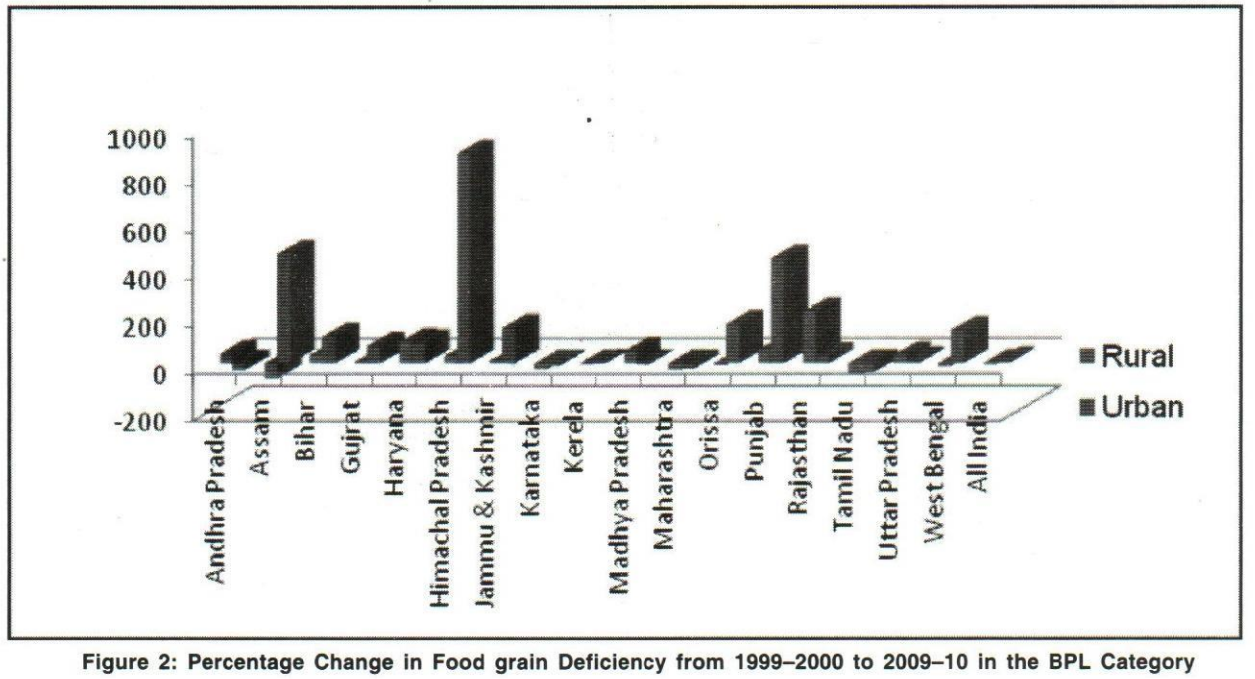

Figure 2: Percentage Change in Food grain Deficiency from 1999–2000 to 2009–10 in the BPL Category

P1 and P2, for both 55th and 66th rounds. In the 55th round we find that, in terms of both P1 and P2, food grain deficiency is higher in Gujarat, Kerala, Karnataka and Tamil Nadu, in both rural and urban areas. In rural areas, both P1 and P2 are found to be low in the states of Jammu & Kashmir, Himachal Pradesh, Rajasthan and Haryana. In urban areas, P1 is low in Orissa, Assam, Himachal Pradesh and Jammu & Kashmir, while P2 is low in the states of Assam, Himachal Pradesh, Jammu & Kashmir and Andhra Pradesh. The rural incidence of P1 and P2 measures in the 66th round is high in the states of Kerala, Madhya Pradesh and Gujarat, while it is low in the states of Jammu & Kashmir, Andhra Pradesh, Assam, Himachal Pradesh and Orissa. In urban areas, P1 and P2 are high in Gujarat, Punjab and Kerala, while it is low in the states of Jammu & Kashmir, Orissa, Assam, Andhra Pradesh and Bihar. One of the points of concern is that food grain deficiency levels have increased significantly in the urban areas of Gujarat, West Bengal and Haryana from 55th to 66th round in terms of all the measures.

Tables 4a and 4b summarize the incidence of food grain deficiency among income poor consumers in rural and urban areas in the 55th and 66th rounds respectively. States have been divided into four categories of food grain deficiency: extremely low, low, moderate and high.

4. Determinants of Food grain Deficiency

In this section, the role of some of the main determinants of food grain deficiency has been analyzed: effectiveness of PDS, consumption of home-produced food grains as a proportion of total consumption of food grains, food diversification and MPCE. Tables 5 and 6 present the determinants of food grain deficiency for 'all classes' taken together in the 55th and 66th rounds respectively, while Tables 7 and 8 capture the same for the 'BPL class'.

4.1. Effectiveness of Public Distribution System

The rationale for including this variable rests on the fact that fluctuations in open market prices are unavoidable because of the vagaries of monsoons and these fluctuations hurt consumers. An increase in food prices would erode the real income of the population and, in particular, of the poor who spend a major share of their income on food. Public distribution of food grains at affordable and stable prices is seen as an efficient way to prevent food grain deficiency and thus impact malnourishment and starvation. To capture the effectiveness of PDS, effective subsidy provided to each consumer unit per month has been computed using NSS unit level data. An important finding from this study is that our subsidy

Table 4a: Food grain Deficiency scross States in the BPL category in 55th round

	Extremely Low (P0<mean-1/2*SD)	Low (mean-1/2*SD <P0< mean)	Moderate (mean < P0< mean+1/2*SD)	High (P0>mean+1/2*SD)
Rural	Haryana, Andhra Pradesh, Himachal Pradesh, Odisha, Rajasthan, Jammu & Kashmir	Punjab, Uttar Pradesh	Madhya Pradesh, West Bengal, Maharashtra, Bihar, Assam	Tamil Nadu, Kerala, Karnataka, Gujarat,
Urban	Rajasthan, West Bengal, Punjab, Bihar, Odisha, Jammu & Kashmir, Himachal Pradesh, Assam	Andhra Pradesh, Haryana	Uttar Pradesh	Kerala, Gujarat, Maharashtra, Tamil Nadu, Karnataka, Maharashtra

Table 4b: Food grain Deficiency scross States in the BPL category in 66th round

	Extremely Low (P0<mean-1/2*SD	Low (mean-1/2*SD <P0< mean)	Moderate (mean < P0< mean+1/2*SD)	High (P0>mean+1/2*SD)
Rural	Himachal Pradesh, Assam, Odisha, Jammu & Kashmir	Maharashtra, Himachal Pradesh, Uttar Pradesh, Rajasthan, Bihar	Tamil Nadu, West Bengal, Haryana, Uttar Pradesh	Kerala, Madhya Pradesh, Gujarat, Karnataka, Bihar, Punjab
Urban	Andhra Pradesh, Odisha, Jammu & Kashmir, Assam	Himachal Pradesh, Tamil Nadu, Bihar, Rajasthan	West Bengal, Tamil Nadu, Haryana, Himachal Pradesh	Gujarat, Punjab, Kerala, Karnataka

Source: Authors' own calculation

Table 5: Determinants of Food grain Deficiency: All India and Major States (All Class): 1999–2000

States	Effective Subsidy from PDS (Rs)		Share of home produced food grains (per cent)		Food Diversification Index		Monthly per capita consumption expenditure (Rs)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	14.83	10.11	16.16	1.71	0.614	0.686	485.52	810.93
Assam	3.53	4.70	35.21	5.88	0.588	0.646	451.57	841.69
Bihar	0.70	0.27	31.96	6.40	0.591	0.639	410.67	648.03
Gujarat	4.49	2.38	12.47	1.32	0.690	0.736	576.65	887.76
Haryana	0.14	0.11	46.02	6.34	0.665	0.714	727.43	965.56
Himachal Pradesh	9.43	8.07	27.55	1.58	0.661	0.713	690.86	1261.27
Jammu & Kashmir	3.77	7.54	48.08	6.22	0.679	0.707	713.97	998.77
Karnataka	7.98	5.62	19.31	2.13	0.684	0.720	550.88	882.72
Kerala	23.73	27.06	6.35	1.91	0.722	0.744	813.61	955.56
Madhya Pradesh	0.89	0.62	39.29	5.22	0.592	0.682	439.41	716.52
Maharashtra	5.00	2.56	16.14	1.77	0.643	0.718	519.08	958.39
Odisha	9.02	5.80	23.09	6.20	0.527	0.619	410.16	703.12
Punjab	0.00	0.00	37.08	5.00	0.704	0.721	802.78	943.31
Rajasthan	0.31	0.22	43.35	3.52	0.622	0.694	574.17	808.72
Tamil Nadu	21.37	17.43	13.12	1.70	0.670	0.723	575.15	996.39
Uttar Pradesh	0.38	0.27	49.68	7.26	0.631	0.690	498.68	687.78
West Bengal	1.50	1.35	23.41	1.04	0.604	0.672	502.87	907.48
All India	3.24	2.87	29.96	3.22	0.626	0.695	539.51	883.79

Source: Authors' own calculation

Table 6: Determinants of Food grain Deficiency: All India and Major States (All Class): 2009–2010

States	Effective Subsidy from PDS (Rs)		Share of home produced food grains (per cent)		Food Diversification Index		Monthly per capita consumption expenditure (Rs)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	52.40	36.14	10.47	0.86	0.699	0.729	1115.86	1903.17
Assam	12.94	5.58	33.13	3	0.656	0.693	914.63	1316.83
Bihar	11.51	4.00	25.91	7.39	0.674	0.708	780.99	1191.77
Gujarat	13.81	5.64	18.22	2.38	0.746	0.782	1143.88	1694.20
Haryana	8.76	5.90	36.28	5.20	0.698	0.739	1521.55	1856.65
Himachal Pradesh	44.26	22.73	15.66	3.36	0.704	0.733	1417.49	2266.89
Jammu & Kashmir	25.97	49.60	44.80	12.65	0.697	0.705	1327.89	1524.64
Karnataka	43.69	20.84	11.94	1.85	0.725	0.737	932.20	1502.36
Kerala	36.82	28.84	2.30	0.31	0.757	0.759	2164.44	2243.48
Madhya Pradesh	41.21	21.48	39.02	5.36	0.649	0.718	869.85	1314.95
Maharashtra	20.00	5.46	16.17	12.00	0.704	0.751	1126.29	1923.47
Odisha	38.17	19.68	33.66	6.80	0.620	0.674	775.73	1278.09
Punjab	10.27	7.15	31.25	4.27	0.723	0.739	1661.96	1868.83
Rajasthan	6.20	3.76	27.12	4.04	0.656	0.700	1075.80	1545.22
Tamil Nadu	89.22	77.68	9.54	1.46	0.736	0.754	1078.66	1617.59
Uttar Pradesh	11.39	5.64	40.52	6.78	0.692	0.724	934.60	1262.14
West Bengal	13.25	5.62	16.64	0.75	0.718	0.770	999.84	1694.54
All India	20.23	14.19	23.42	3.45	0.683	0.724	1097.58	1633.69

Source: Authors' own calculation

Table 7: Determinants of Food grain Deficiency: All India and Major States (BPL Class): 1999–2000

States	Effective Subsidy from PDS (Rs)		Share of home produced food grains (per cent)		Food Diversification Index		Monthly per capita consumption expenditure (Rs)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	16.01	13.35	9.12	1.27	0.525	0.614	221.98	362.96
Assam	5.76	5.44	24.26	16.67	0.539	0.501	288.59	286.27
Bihar	0.69	0.75	19.26	2.20	0.538	0.563	267.06	303.27
Gujarat	5.60	4.07	3.06	0.17	0.602	0.708	261.46	392.13
Haryana	0.35	0.12	10.98	0.00	0.643	0.666	304.41	339.55
Himachal Pradesh	3.14	4.89	8.11	3.85	0.577	0.621	316.14	368.52
Jammu & Kashmir	0.36	0.23	42.11	0.00	0.607	0.637	311.41	378.98
Karnataka	8.36	5.29	4.76	1.88	0.608	0.669	258.76	391.40
Kerala	20.97	19.86	0.97	2.00	0.667	0.708	316.26	381.73
Madhya Pradesh	1.31	0.37	26.70	5.81	0.510	0.630	247.21	362.91
Maharashtra	6.18	2.56	11.66	2.17	0.551	0.664	260.03	403.94
Odisha	10.31	27.18	17.10	5.11	0.455	0.525	247.64	355.35
Punjab	0.00	0.00	7.16	3.85	0.683	0.704	315.21	337.91
Rajasthan	0.21	0.46	34.33	3.94	0.539	0.647	289.87	381.14
Tamil Nadu	23.98	26.08	7.96	1.61	0.581	0.666	252.18	372.53
Uttar Pradesh	0.74	0.30	36.42	5.45	0.561	0.640	274.34	329.07
West Bengal	2.49	2.30	12.24	1.46	0.543	0.594	280.28	337.25
All India	4.38	4.67	21.30	3.32	0.540	0.630	264.90	356.15

Source: Authors' own calculation

Table 8: Determinants of Food grain Deficiency: All India and Major States (PBL Class): 2009–2010

States	Effective Subsidy from PDS (Rs)		Share of home produced food grains (per cent)		Food Diversification Index		Monthly per capita consumption expenditure (Rs)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	50.71	60.32	8.80	0.58	0.643	0.661	551.43	688.93
Assam	27.08	14.20	25.09	1.05	0.592	0.616	560.51	628.85
Bihar	16.05	7.76	14.73	5.65	0.623	0.645	492.90	550.48
Gujarat	17.79	17.81	10.20	1.10	0.710	0.763	593.74	716.47
Haryana	29.33	16.50	4.24	0.67	0.696	0.715	622.95	737.47
Himachal Pradesh	48.38	28.63	18.68	0.00	0.654	0.704	584.18	708.67
Jammu & Kashmir	43.61	64.54	33.19	9.07	0.697	0.697	596.92	692.52
Karnataka	52.38	47.26	12.18	2.74	0.684	0.702	498.97	642.24
Kerala	73.09	47.13	0.00	0.00	0.719	0.723	633.72	637.99
Madhya Pradesh	51.40	43.44	22.42	4.88	0.594	0.651	468.77	552.15
Maharashtra	34.29	21.25	14.65	0.23	0.649	0.695	590.65	707.77
Odisha	51.25	40.08	26.11	5.39	0.536	0.567	423.24	511.64
Punjab	30.39	22.98	1.91	0.00	0.729	0.736	702.43	726.61
Rajasthan	13.06	8.34	24.18	1.03	0.633	0.666	620.89	649.81
Tamil Nadu	91.66	105.77	2.44	0.86	0.673	0.711	521.70	607.96
Uttar Pradesh	18.91	11.54	26.14	4.84	0.650	0.675	526.76	591.83
West Bengal	18.54	13.86	8.14	0.95	0.648	0.702	519.44	611.78
All India	26.11	23.07	18.74	4.05	0.628	0.669	526.16	631.94

Source: Authors' own calculation

system is progressive, since the subsidy levels of BPL consumers are higher when compared to all consumers taken together.

We find that the effective subsidy levels, often used as a measure of effectiveness of the PDS, have increased substantially at the all-India level and across all states from 1999–2000 to 2009–10. The main reason for this increase might have been the introduction of Targeted PDS in 1997, prior to which the PDS was universal. However, in some states the PDS was still universal (Andhra Pradesh and Tamil Nadu) where the additional burden was borne by the state, as the central government allocated funds to run only Targeted PDS at that point of time (i.e., 2009–10). However, with the implementation of Food Security Act (2013), PDS now provides food grains at subsidized prices to a larger section of the population.

The functioning of PDS is found to be highly effective in all the southern states, namely Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. It is also functioning very effectively in Odisha, and Himachal Pradesh. The states of Assam, Bihar, Gujarat, Haryana, Punjab, Rajasthan, Uttar Pradesh and West Bengal are ineffective in terms of functioning of PDS, since in the subsidy levels in these states are still low in comparison to other states. The above picture is true for both rural and urban areas. For BPL consumers also the above story holds good with rural areas of Assam and Haryana also showing a significant improvement in the functioning of the PDS, as compared to the 55th round, while Punjab has shown improvement in both rural and urban areas.

Lessons with regard to effective implementation of the PDS can be learnt from Chhattisgarh, where the government is not only involved in procurement and distribution of paddy but has also resorted to information and communication technology (ICT) to curb corruption (Dhand et al., undated, p. 217). Further lessons for effective functioning of PDS can also be learnt from Tamil Nadu which follows universal PDS, where nearly 93 per cent of the fair price shops (FPSs) are managed by co-operative societies. The involvement of women's self-help groups (SHGs) has ensured safety, transparency, and accessibility in the system along with a reduction in transaction costs (Paolo and Vandewaalle, 2011, p. 25).

4.2. Share of Home-produced food grains in Total Consumption of Food grains (SHP)

Share of home-produced food grains as a proportion of total consumption of food grains is an obvious important determinant of food grain deficiency: this variable varies from very high levels in rural areas, accounting for around 70 per cent of the Indian population, to practically zero for urban areas. At the all-India level, SHP across 'all classes' in rural areas is 30 per cent and 23.4 per cent in the 55th and 66th rounds respectively, while the same figures for the BPL class is 21.3 per cent and 18.7 per cent respectively. Although the share of consumption from home production is quite high in both 55th and 66th rounds, what is important to note is that there has been a sharp decline in this share of consumption from 55th to 66th round. The decline has been observed in all classes (22 per cent) and the BPL class (12 per cent). This decline in SHP is a disturbing signal especially among the BPL class because it indicates increased dependence on the market for purchase of food grains. Therefore, this declining SHP might be a contributing factor for the increasing food grain deficiency.

State-level analysis shows that across 'all classes' taken together, there is a decline in the SHP from 1999–2000 to 2009–10 in most of the states. The decline is quite high in all the four southern states of Kerala, Karnataka, Andhra Pradesh and Tamil Nadu. The decline is also high in the states of Bihar, Haryana, Himachal Pradesh, Rajasthan, Punjab, Uttar Pradesh and West Bengal, which ranges from 63 per cent to 15 per cent. The only two exceptions where we observe a significant rise in the SHP are Gujarat (46 per cent) and Orissa (45.7 per cent). State-level analysis of the BPL class shows a significant decline in the states of Bihar, Haryana, Jammu & Kashmir, Kerala, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. The decline in these states ranges from 100 per cent to 16 per cent. There are, however, some states where we observe a significant increase in SHP among the BPL class, which is very encouraging. The states which fall in this category are Gujarat, Himachal Pradesh, Karnataka, Maharashtra and Odisha. The decline in SHP in the food grain-growing belts of Punjab, Haryana, Bihar, Uttar Pradesh and West Bengal across both BPL and 'all classes' taken together is very disturbing.

4.3. Role of Food Diversification

Diversification of the food basket is an internationally accepted recommendation for a healthy diet, because it is associated with positive health outcomes, such as reduced incidence of cancer and mortality (Ruel, 2003, p. 3923S; Descher et al., 2007, p. 647). Food diversification,

by definition, would imply a lower weight of food grains in individual diets and is, therefore, considered to be a very important determinant of food grain deficiency. Here we examine the role of food diversification by analyzing the FDI. Our study finds that diversification of food basket is more prominent across 'all classes' taken together as compared to the 'BPL class' (checked through a paired t-test). This is to be expected as a rise in income is associated with a change from a basic cereal-based diet to a diet in which cereals play a much reduced role. State-level analysis shows that in rural areas diversification is more prominent in the states of Gujarat, Karnataka, Kerala, Punjab and Tamil Nadu. In urban areas diversification is prominent across almost all states.

4.4. Monthly per capita Consumption Expenditure

The MPCE is an important indicator because it is used as a proxy for income. Therefore, in our model its effect on food grain deficiency might be a manifestation of Engel's law. In rural areas MPCE is relatively higher in the states of Gujarat, Haryana, Himachal Pradesh, Kerala and Punjab, while it is lower in the states of Bihar, Madhya Pradesh and Orissa in both 55th and 66th rounds. In urban areas for 'all classes' MPCE is relatively higher in the states of Haryana, Himachal Pradesh, Kerala and Maharashtra and lower in the states of Bihar, Madhya Pradesh, Odisha and Uttar Pradesh. In the 'BPL class' MPCE is relatively high in the states of Maharashtra, Gujarat and Punjab in the 55th round, while it is high in the states of Haryana, Punjab and Gujarat in the 66th round. In the 'BPL class' MPCE is relatively low in the states of Assam, Bihar and Uttar Pradesh in the 55th round and Bihar, Madhya Pradesh and Odisha in the 66th round.

4.5. Regression Analysis

In this section we analyze the impact of the above discussed indicators on food grain deficiency across 'all classes' taken together and the 'BPL class'. Linear regression analysis has been done using panel data to capture the impact of effective subsidy from PDS (ESPDS), share of consumption of food grains from home production (SHP), FDI, MPCE and $MPCE^2$ on food grain deficiency (FD). The analysis has been done across both rural and urban areas. Table 9 presents the result of regression analysis across 'all classes' taken together, while Table 10 presents the same for the 'BPL class'.

Analyzing the regression across 'all classes', we find that in rural areas our model is able to explain 88 per cent of the variation in food grain deficiency, while in urban areas the model is able to explain 60 per cent of the variation. The model suggests that ESPDS and SHP should have a negative influence on food grain deficiency, i.e., an increase in ESPDS or SHP should result in a decline in food grain deficiency, while FDI has a positive influence over FD, i.e., an increase in food diversity must result in an increase in FD. The determinants of MPCE and $MPCE^2$ should have a negative and positive impact respectively over FD. The regression analysis shows that all the variables have the expected impact on FD except

Table 9: Regression Analysis for all Class

	Rural			Urban		
	R^2=0.88			R^2=0.60		
Dependent Variable: Food grain Deficiency	Prob.>F =0			Prob.>F =0		
	Coefficient	**Std. Error**	**Sig.**	**Coefficient**	**Std. Error**	**Sig.**
ESPDS	0.0005	(0.020)		–0.062	(0.032)	*
SHP	–0.056	(0.036)		0.270	(0.284)	
FDI	37.626	(10.237)	***	55.164	(25.339)	**
MPCE	–0.0156	(0.0034)	***	–0.022	(0.006)	***
MPCE_Square	7.67e-06	(1.12e-06)	***	9.09e-06	(1.95e-06)	***
Const.	–11.6059	(4.6088)	***	–12.4356	(15.791)	
***p<0.01, **p<0.05, *p<0.1						

Source: Authors' own calculation

Table 10: Regression Analysis for PBL Class

Dependent Variable: Food grain Deficiency	Rural			Urban		
	R^2=0.25			R^2=0.56		
	Prob.>F =0.10			Prob.>F =0		
	Coefficient	Std. Error	Sig.	Coefficient	Std. Error	Sig.
ESPDS	–0.011	(0.013)		–0.049	(0.0102)	***
SHP	–0.021	(0.023)		0.053	(0.0567)	
FDI	7.639	(12.233)		11.969	(16.063)	
MPCE	–0.010	(0.015)		–0.0193	(0.0164)	
MPCE_Square	1.08e-05	(1.36e-05)		2.54e-05	(1.65e-05)	
Const.	–0.418	(4.003)		–0.80428	(9.072)	
***p<0.01, **p<0.05, *p<0.1						

Source: Authors' own calculation

ESPDS in rural areas and SHP in urban areas. The impact of ESPDS is not found to be significant in the rural areas while it is found to be significant at 10 per cent level in urban areas. SHP is significant at 15 per cent level in the rural areas. FDI, MPCE and $MPCE^2$ are found to be significant at 1 per cent level in rural areas, while these variables are found to be significant at 5 per cent (FDI) and 1 per cent (MPCE and $MPCE^2$) level in urban areas. The role of FDI assumes great importance as a unit increase results in an increase in FD by 37 per cent and 55 per cent in rural and urban areas respectively.

Analysis of regression for the 'BPL class' shows that in rural and urban areas regression analysis explains 25 per cent and 56 per cent of the variation in FD respectively. While the coefficients of most of the variables have the expected impact on FD, none of these exert a significant influence on FD in rural areas and only one, ESPDS, is significant (at 1 per cent level) in urban areas. In the urban areas an increase in ESPDS by a rupee leads to a decline in FD by 0.04 per cent.

5. Discussion and Conclusion

An important observation from our study is that at the all-India level and across states in both 55th and 66th rounds, food grain deficiency is higher in urban areas as compared to rural areas. It is also interesting to observe that the relatively well-to-do states (e.g., Haryana, Himachal Pradesh, Kerala, Maharashtra and Punjab) have higher food grain deficiency, a result of the diversified diet of the higher expenditure classes, which account for a higher portion of the population, and the positive impact that it has on diversification of diet in the lower expenditure classes, given the mentioned strength in numbers of the former classes. The regression analysis across 'all classes' demonstrates that FDI is indeed a significant determinant of food grain deficiency across both rural and urban areas.

Another factor that explains the relatively low food grain deficiency is share of home-produced food grains in total consumption of food grains, which is significant at 15 per cent level. Effective subsidy provided through PDS has also played an important role across 'all classes', exerting a significant influence over food grain deficiency in urban areas. MPCE levels have also had a significant effect on reducing food grain deficiency. Even $MPCE^2$ has an important effect on food grain deficiency, indicating higher food grain deficiency towards the higher and lower ends of MPCE. Therefore, it can be concluded that almost all the variables taken up in our model have a significant share in explaining food grain deficiency across 'all classes'.

Food grain deficiency in the 'BPL class' is not very high and is well within manageable levels not only at the all-India level but also across the states. The role of PDS in managing food grain deficiency is evident from the experience of Tamil Nadu, where the reform of PDS has resulted in a huge decline in food grain deficiency levels. Tamil Nadu has reformed PDS by universalizing it and by providing an additional subsidy on the issue price. All this

has resulted in a reduction in food grain deficiency among the income poor from 3.5 per cent in the 55th round to 1.8 per cent in the 66th round in rural areas (a decline of 1.7 percentage points), while in urban areas the figure has declined from 5.5 per cent in the 55th round to 3.4 per cent in the 66th round (a decline of 2.1 percentage points). Therefore, the experience of Tamil Nadu shows that PDS reform can be used to manage the level of food grain deficiency. However, our regression analysis shows that although ESPDS is highly significant in urban areas (at 1 per cent level), it doesn't find a significant influence in rural areas. Some of the possible reasons for the insignificant influence of ESPDS on FD in rural areas may be the much criticized exclusion error of the targeted PDS and the accessibility issue. It can therefore be concluded that the model that we have framed helps in explaining food grain deficiency considerably across 'all classes' taken together but not much in the 'BPL class', especially in the rural region where none of the determinants has a significant effect on FD. As a policy implication, PDS should suitably target the poor in rural areas where maybe accessibility and exclusion problems are becoming barriers in proper distribution. Another important finding is that food diversification, which is highly recommended internationally since it not only ensures improved health outcomes but also sustainable agriculture, is an important determinant in explaining food grain deficiency for 'all classes' taken together. To that extent, the levels of and increases in food grain deficiency do not have negative implications for food and nutritional security.

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An evergreen revolution implies the enhancement of productivity in perpetuity without associated ecological harm.

– M.S. Swaminathan

Food Security in India: Emerging Issues and Policy Options

SANJEEV KUMAR

In recent years, Indian agricultural sector has been facing various challenges for achieving food security at the national level due to massive pressure from the ever-increasing population and the change in preferences in crop production techniques. The present paper discusses the emerging trends, patterns and determinants of food security for the period 1980–81 to 2015–16 at national level. Results reveal that the growth rate of production and productivity of food grain crops decreased at a significant rate during the study period. However, the compound annual growth rate of per capita net availability of food grains declined at a significant rate, but on the other side, growth rate of per capita availability of non-food articles increased during the study period. The results of regression model revealed that crop diversification, climate change and agricultural openness have a negative impact on food security, while food grain productivity had a positive impact on food security during the study period. There is a strong need to regulate the government policies related to food management, crop management, climate change and globalization for reducing its negative effects on food security in India.

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1. Introduction

The agriculture sector has played a very important role in the economic development of India as well as in ensuring food security for the population of the nation. The performance of this sector has been remarkable post-Green Revolution, adopting modern farming technology in the selected northern states of India. Two-thirds of the nation's population is still dependent on agriculture and related activities for livelihoods. During the recent years this sector has been facing numerous challenges. Even as the nation has made large strides in enhancing food production and achieving food security, the agriculture sector remains inhibited by low productivity and excessive dependence on climate. Uneven growth in agricultural productivity has reflected structural differences in land availability, population growth and challenges in food availability. A key challenge for a country is to make its primary sector more productive and sustainable for long term. The need to improve agricultural productivity and sustainability of this sector is well recognized in India's Twelfth Five-Year Plan, which aims to increase agricultural sector growth rate to 4 per cent per annum (Twelfth Five-Year Plan, 2012–17).

The issue of food security has been identified as a major objective to be pursued by the Rome declaration of World Food Security and World Food Summit Plan of Action conveyed by the Food and Agricultural Organization (FAO) in 1996. The World Food Summit emphasized that 'food security existence of all the people at all the times have physical and economic access to sufficient, safe and nutritious food to meet their daily life needs and food preferences for active and healthy life' (FAO, 1996).

According to FAO (2001), 'Food security exists when all people, at all times, have physical, social and economic

access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life'. Generally, food security has three components — availability, access and affordability of food and nutrition. These three parameters are closely correlated. Many studies have shown that improvement in nutrition is important, also for increase in productivity of workers. Thus, food security has essential (for its own sake) as well as instrumental value, i.e., increasing productivity.

Swaminathan (1996) found that various strategies are responsible for achieving food security: maintaining the existing growth rate in agricultural production to ensure sustainable availability of food, sustaining productivity economic cost at minimum, ensuring adequacy of household income through promotion of social security, and providing entitlement to food to vulnerable groups in the society through productive social security. Food security as access to food for all people at all times is required for a healthy life. He also mentioned that access to food is necessary but not a sufficient condition for a healthy life (Deaton, et al., 2009). Regional variations in crop production are growing stronger with time, leading to a significant polarization of effects, with substantial increase in prices and risk of hunger among the poorest nations (Parry, 2004).

In India, ensuring food security for a huge population ought to be an issue of great concern for a country where more than one-third of the population is estimated to be absolutely poor and one-half of all children are malnourished. There have been several emerging issues in the context of food security in India after the economic reform era. Firstly, economic liberalization in the 1990s and its impact on agriculture and food security; secondly, the declining trends in total factor productivity in main staple food grain crops; thirdly, challenges of climate change variables; fourthly, challenges of crop diversification from food grain to high-value cropping system; fifthly, implementation of targeting in the public distribution system (PDS); sixthly, 'Right to Food' campaign for improving food security in the country and implementation of 'National Food Security Act' (NFSA, 2013); and lastly, to achieve the Sustainable Development Goals (SDGs), officially known as transforming our world by 2030 with the agenda of 'zero poverty and zero hunger'. These developments after economic reform have provided both opportunities and challenges for food and nutrition security of the nation.

In India, maintaining food security at the national and household levels continues to be a major concern, both for the welfare of the society as well as for political stability. In order to improve food security, the policymakers have adopted a number of strategies, which include concerted efforts to increase production of food grains, market intervention, PDS and promulgation of NFSA to ensure economic and social access to adequate food and a life with dignity, for all persons in the country, at all times. However, in spite of several initiatives and strategies taken by the government, the problems of food and nutritional security continue to persist in India. One-third of the world's undernourished children are in India, almost half of the Indian children are stunted and 40 per cent are underweight; one-third of the Indian women are also underweight. And high rates of micro-nutrient deficiencies prevail across the board (Joshi et al., 2011). At the same time, India is the one of the fastest growing economies in the world. So, there is a paradox between high economic growth and slow reduction in the number of food-insecure persons. It is in this context that there is a need to understand the food security situation in India.

In this backdrop, the present study examines the emerging trends and patterns of food security at the national level, and identifies the main determinants of food security. This paper has also assessed the emerging issues and policy implications for food security at the national level.

The next section discusses the data sources and methodological framework. This is followed by the performance of Indian agriculture and emerging trends, patterns and determinants of food security at the national level. Conclusions and policy implications are in the final section.

2. Data and Methodology

The study is based on secondary data sources, such as Agricultural Statistics at a Glance, Department of Economics and Statistics (DES), Ministry of Agriculture, Government of india, Handbook of Statistics on Indian Economy, Reserve Bank of India, Government of India, Department of Agriculture and Co-operation Network (DACNET), Ministry of Agriculture, Government of India and Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India.

A widely accepted exponential model, $y = a\, b^t\, e^u$, has been fitted to the time-series data for estimating Compound Average Growth Rate (CAGR) of various aspects, such as gross domestic product (GDP) by sectors and crop groups as well as per capita availability

of food grain and non-food grain articles at the national level for the period 1980–81 to 2015–16. For analytical convenience, this period was divided into decadal sub-periods. The logarithmic form of this function is given by;

$$ln\ (y) = ln(a) + t\ ln(b) + u$$

where,

y is the dependent variable whose growth rate is to be estimated

t is the independent variable (time)

u is the disturbance or error term

a and b are the parameters to be estimated from sample observations.

The regression coefficient b is estimated by ordinary least squares (OLS) technique.

The CAGR in percentage terms is estimated as:

$$CAGR = \{antilog\ (b) - 1\}*100$$

2.1. Regression Model

Generally, food security has three components — availability, accessibility and affordability of food. Availability of food grains is the most important factor of food security in India. The present paper has tried to assess the impact of several aspects, such as agricultural productivity, climate change, crop diversification and agricultural openness on per capita availability of food grain as proxy variable of food security in India from 1980–81 to 2015–16. The functional form of the variables can be written as:

$$PCAF_{GR} = F\ (PRFG_{GR}, TEMPD_{GR}, SID_{GR}, AGOPEN_{GR})$$

where,

PCAF is per capita availability of food grain. It is measured as the ratio between production of food grain and total population of the nation.

PRFG is the productivity of food grain. It is measured by yield, i.e., production per hectare. PRFG is closely related to food security.

TEMPD is the difference between maximum and minimum temperature, i.e., climate change variable. Higher deference between maximum and minimum temperature is the main cause of decline in productivity of food grain and it have a negative implication for food security.

SID is the Simpson index of crop diversification. It is as follows:

$$SID = 1 - \sum_{i=1}^{n} P_i^2$$

where,

SID = Simpson index of diversification

P_i = Proportionate area of i^{th} crop/crop sector in the gross cropped area

The SID ranges between 0 and 1. When the value of SID is closer to 1 it indicates high diversification, and when closer to 0 it indicates no diversification. It is also related to availability to food grain.

AGOPEN is the agricultural openness variable, i.e., economic reform variable. It is measured as the ratio between agricultural sector GDP and total import and export by agricultural sector.

To avoid the problem of Multicollinearity, all variables of the model are taken in the form of annual growth rate. The specification form of the model is:

$$PCAF_{GR} = \alpha + \beta_1 PRFG_{GR} + \beta_2 TEMPD_{GR} + \beta_3 SID_{GR} + \beta_4 AGOPEN_{GR} + u_i$$

The regression equation specification is to find out the association between per capita availability of food grain as a proxy of food security (dependent variable) and productivity of food grain, climate change, crop diversification and agricultural openness (independent variables).

3. Agricultural Scenario in India

The growth spurt experienced by Indian agricultural sector during mid-1960s had led to the introduction of high-yielding variety seeds, better irrigation facilities and adoption of mechanization in the farming sector. Thereafter, the growth of agricultural output was mainly fuelled by total factor productivity growth or yield growth, wherein, yield witnessed relatively higher growth rates than acreage during the following two decades.

Before analyzing the emerging trends and patterns of food security in India during the study period, first let us have a look at the growth performance of Indian agricultural sector and allied sectors since 1980s.

The growth rate of GDP by sectors and agricultural sub-sectors during the study period, i.e., 1980–81 to 2015–16 as well as sub-periods of study periods are presented in Table 1. It has been observed that the growth rate of

Table 1: Growth Rates in GDP and Agriculture Sub-sectors (in per cent)

Time Periods	At Factor Cost (Base: 2011–12)		
	GDP	Agriculture & Allied Sector GDP	Agricultural GDP
1980–81 to 1989–90	5.17	2.97	3.08
1990–91 to 1999–2000	6.14	3.34	3.09
2000–01 to 2009–10	7.83	2.95	3.36
2010–11 to 2015–16	6.46	2.24	3.07
1980–81 to 2015–16	6.35	3.04	3.08

Value of Output by Sub-Sector Group of agriculture (Base: 1999–2000)					
Periods	Crop sector	Livestock	Horticulture Crops	Non-Horticulture Crops	Cereals
1980–81 to 1989–90	2.24	4.91	2.63	2.12	2.89
1990–91 to 1999–2000	3.02	3.79	5.95	2.07	2.24
2000–01 to 2009–10	3.07	3.91	3.37	2.89	2.21

Source: Central Statistics Office (CSO), Government of India

non-agricultural sector is always higher than the growth rate of agricultural sector during the study period. The GDP from agricultural and allied sectors has shown marginal increase in growth rate in the initial phase of liberalization, as compared to the pre-reform decade, mainly due to impressive growth rates witnessed in horticulture (fruits and vegetables) percentage per annum and other allied sectors.

However, in the second phase of the post-reform period, the agricultural sector as a whole experienced a drastic reduction in the growth rates, again principally due to decline of growth rate of cereals and fruits and vegetables. During the post-reform period, except for fruits and vegetables, which had shown significant growth in the first phase of reform, all other sub-sectors of agriculture have undergone substantial growth deceleration. This significant deceleration in the growth rate of output with respect to food grain crops has serious implications for food security of the country. It means that food grain crops are now viewed as less profitable, and farmers are likely to shift resources away from the production of this crop to high-value crops.

3.1. Performance of Food Grain Crops at National Level

Table 2 shows the trends in area, production and yield of food grain crops in India during 1980–81 to 2015–16. The performance of food grain crops in terms of growth rates of production and yield during the study period has been gradually declining from decade to decade. It indicates the serious implication of food security at the national level. The main contributors to food grains — rice and wheat crops — also support the above trends. During overall period of the study, the growth of area of rice was 0.25 per cent per annum. It is found that during the first period the growth of production and yield of rice was significant due to the effect of the Green Revolution and favourable weather conditions, but later the growth of production and yield of rice decreased. It is observed that after new economic reforms the growth of rice in terms of area, production and yield is not significant due to crop diversification of food grain crops to cash crops. In the case of wheat, the growth rate of area was 0.46 per cent during 1980–81 to 1989–90 and increased to 1.72 per cent during 1990–91 to 1999–2000, and after this the area of wheat declined. Similarly, the production of wheat was 3.58 per cent during 1980–81 to 1989–90 and there was a marginal decrease during the period 1990–91 to 1999–2000; there was a decline in the growth of production of wheat — 1.90 in 2000–2001 to 2009–10, 0.33 per cent in 2010–11 to 2015–16, and 2.52 per cent in 1980–81 to 2015–16. The trends of coarse cereals and pulses also indicated a decrease in area, production and yield with high fluctuations.

Table 2: CAGR of Area, Production and Yield of Food grain Crops (in per cent)

Time Periods		Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Food grains
1980–81 to 1989–90	**Area**	**0.41**	**0.46**	**–1.34**	**–0.26**	**–0.10**	**–0.23**
	Production	3.62	3.58	0.35	2.85	1.49	2.73
	Yield	3.19	3.10	1.71	3.10	1.59	**2.97**
1990–91 to 1999–2000	Area	0.67	1.72	–2.11	0.04	–0.60	-0.08
	Production	2.02	3.57	–0.01	2.20	0.86	2.10
	Yield	1.34	1.82	2.14	2.16	1.27	**2.17**
2000–01 to 2009–10	Area	–0.02	1.20	–0.76	0.10	1.16	0.29
	Production	1.59	1.90	2.40	1.84	2.71	1.90
	Yield	1.61	0.69	3.17	1.75	1.54	**1.60**
2010–11 to 2015–16	Area	0.23	0.99	–3.12	–0.43	–0.88	–0.52
	Production	1.25	0.33	–1.51	0.41	–1.28	0.29
	Yield	0.97	–0.41	1.43	0.85	–0.39	**0.84**
1980–81 to 2015–16	Area	0.25	0.87	–1.54	–0.17	0.11	–0.12
	Production	1.97	2.52	1.05	1.98	1.09	1.91
	Yield	1.71	1.65	2.61	2.15	0.99	2.03

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India

4. Food Security in India: An Overview

The important consideration for food security is whether the food production would remain higher than the population growth rate. Between 1970 and 1982, the world population grew at a rate of 1.8 per cent per annum but cereal production, which constitutes 94 per cent of the total food grain production, grew at a rate of 2.3 per cent per annum. Thus food production outstripped population growth by 0.5 per cent on a global scale. But there were regional disparities to the extent that near-famine conditions occurred in many parts of the world. Thus, hunger existed amongst plenty and food production did not provide food security to everyone.

The Green Revolution initiated in the late 1960s was a historic watershed that transformed the food security situation in India. It tripled food grain production over the next three or four decades and consequently reduced by over 50 per cent both the levels of food insecurity and poverty in the country, this was achieved in spite of the increase in population during the period, which almost doubled. The country succeeded in the laudable task of becoming a food self-sufficient nation, at least at the macro level. Attainment of self-sufficiency in food grains at the national level is one of the country's major achievements in the post-Independence period. After remaining a food-deficit country for about two decades after Independence, India became largely self-sufficient in food grain production.

Due to depleting natural resources, food security is the most crucial, as it hampers the development of people as well as the nation. Increase in agricultural production through active involvement of small farmers and weaker sections of the society can empower the rural poor to earn their livelihood and improve their quality of life. Hence, agricultural development deserves priority for enhancing food security.

4.1. Trends of Per Capita Net Availability of Food grain by Crops in India

The emerging trends and the compound annual growth rate of per capita net availability of food grain and sub-

group of food grain at the national level during the period 1980–81 to 2015–16 as well as sub-periods are given in Table 3. As can be seen in the Table, the CAGR of per capita net availability of food grains has declined at a significant rate from 0.56 per cent per annum in 1980–81 to 1989–90 to –1.19 per cent per annum in 2010–11 to 2015–16. While the CAGR of per capita availability of rice and wheat has marginally declined, there was a drastic reduction in the availability of coarse cereals and pulses during the study period. During 2000–2001 to 2009–10, the CAGR of per capita availability of food grains, rice, wheat, coarse cereals and pulses was recorded positive. But in the recent years, i.e., 2010–11 to 2015–16, it was recorded negative, in case of all food grain crops. It indicates serious implications for food security. This had a direct impact on the supply of proteins and minerals, which accelerated the incidences of malnutrition, particularly among pregnant women and children.

In sum, growth rate of per capita net availability of food grain as well as various crops under food grain crops shows a decline in trends during the study period at the national level. That indicates the serious implications for the availability of food grain in India and sustainability of agricultural sector.

4.2. Trends of Per Capita Availability of Non Food Articles in India

Trends and CAGR of per capita availability of certain important non-food grain articles for consumption are given in Table 4. The growth in per capita availability of non-food articles, such as milk, egg, fish, edible, sugar, tea and coffee, may be considered as an indicator of improvements in food security at the individual level. Although there have been fluctuations in per capita availability of non-food grains from year to year. Hence the Table highlights the per capita availability of certain non-food grain consumption in India during 1980–81 to 2014–15.

The per capita availability of milk (litre/day) was 127.50 in 1980–81 and increased to 316.36 in 2014–15. Similarly, the growth rate of milk was 2.42 per cent during the period 1980–81 to 2014–15, while the growth rate of milk had a declining trend during the sub-periods. In case of eggs (numbers/annum), the per capita availability was 15 in 1980–81 and increased to 62 in 2014–15. But the growth rate of eggs was 3.98 per cent during 1980–81 to 2014–15, whereas it accounted highest growth rate during 1980–81 and further declined in other sub-periods. The per capita availability of fish (gram/day) was 9.85 in 1980–81 and increased to 22.56 in 2014–15. But the growth rate of fish was 2.41 per cent during 1980–81 to 2014–15, whereas it accounted highest growth rate of 4.25 per cent during 2010–11 to 2014–15, and decreased in other sub-periods. On the other hand, the per capita availability of edible oil (litre/day) was 10.41 in 1980–81 and increased to 47.73 in 2014–15. But the growth rate was 4.01 per cent during the period 1980–81 to 2014–15, and had a positive as well as increasing growth rate during other sub-periods. The per capita availability of sugar (gram/day) was 20 in 1980–81 and increased to 54.33 in 2014–15, whereas the growth rate was 2.32 per cent during the period 1980–81 to 2014–15, and had a positive as well as fluctuating growth rate in further periods. The per capita availability of tea (gram/day) and coffee (gram/day) was 1.40 and 0.22 in 1980–81 and increased to 2.10 and 0.28 in 2014–15. Similarly, the growth rate of tea and coffee was 1.05 per cent and 0.70 per cent in the period 1980–81, and it grew insignificantly during other sub-periods. It is observed that the per capita availability of certain important non-food articles like milk, egg, fish, edible oil, sugar, tea and coffee increased during the period 1980–81 to 2014–15 in India. It means that diversification of food items is increasing from food grain items to non-food items.

4.3. Patterns of Consumer Expenditure on Food and Non-Food Items

The patterns of consumer expenditure on various commodities with respect to urban and rural areas are given in Table 5. It highlights the trends of percentage composition of consumer expenditure since 1993–94 to 2011–12 in India. The Table shows that the share of consumer expenditure on cereal was 24.20 per cent in 1993–94 and decreased to 12 per cent in 2011–12 in rural India. Similarly, in case of urban areas, the share of consumer expenditure was 14 per cent in 1993–94 and deceased to 7.30 per cent in 2011–12. In case of Gram, the share of consumer expenditure was 0.20 per cent in 1993–94, which decreased to 0.10 per cent in 1999–2000 and 0.20 per cent in 2011–12. On the other hand, the share of consumer expenditure was 0.20 per cent in 1993–94 and decreased to 0.10 per cent in 2011–12 in urban India. It is clear from the figures that the share of consumer expenditure on pulses and products was 3.80 per cent in 1993–94 and decreased to 3.10 per cent in 2011–12 in rural areas, whereas it was 3 per cent in 1993–94 and declined to 2.10 per cent in 2011–12 in urban areas.

Table 3: Per Capita Net Availability of Food grains (per day) (gram/capita/day)

Year	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Food-grains
1980–81	216.39	146.51	117.09	480.00	42.89	522.89
1981–82	210.82	148.27	123.09	482.18	45.57	527.75
1982–83	182.34	165.58	107.38	455.31	45.89	501.20
1983–84	227.74	172.34	128.46	528.54	48.85	577.39
1984–85	216.29	163.38	115.56	495.23	44.34	539.57
1985–86	231.62	170.73	95.07	497.43	48.48	545.91
1986–87	215.20	157.49	95.34	468.03	41.61	509.64
1987–88	197.69	160.52	91.65	449.86	38.11	487.97
1988–89	239.90	184.16	107.10	531.17	47.14	578.30
1989–90	245.21	166.15	115.86	527.21	42.86	570.08
1990–91	242.59	180.06	106.78	529.43	46.57	576.00
1991–92	239.02	178.24	83.18	500.45	38.47	538.92
1992–93	228.92	179.75	114.96	523.63	40.28	563.91
1993–94	246.64	183.80	94.66	525.09	40.85	565.94
1994–95	246.30	198.01	89.96	534.28	42.27	576.55
1995–96	227.27	183.34	85.71	496.31	36.34	532.65
1996–97	236.70	200.85	98.79	536.33	41.24	577.57
1997–98	234.58	188.57	86.40	509.55	39.31	548.85
1998–99	239.91	198.69	87.32	525.93	41.56	567.48
1999–2000	245.45	209.02	83.04	537.52	36.70	574.22
2000–01	228.48	187.34	83.56	499.39	29.76	529.15
2001–02	245.89	191.70	87.91	525.50	35.22	560.72
2002–03	186.33	170.61	67.64	424.58	28.88	453.46
2003–04	226.26	184.42	96.09	506.75	38.11	544.85
2004–05	209.14	172.69	84.18	466.01	33.03	499.04
2005–06	227.38	171.79	84.40	483.59	33.14	516.73
2006–07	227.97	185.11	82.83	495.89	34.67	530.56
2007–08	232.78	189.16	98.11	520.04	35.53	555.60
2008–09	235.46	191.54	95.06	522.07	34.59	556.66
2009–10	208.62	189.21	78.56	476.41	34.33	510.74
2010–11	221.72	200.67	100.26	522.65	42.14	564.79
2011–12	236.47	213.07	94.34	543.90	38.38	582.28
2012–13	233.46	207.44	88.82	529.73	40.69	570.42
2013–14	233.57	209.91	94.81	538.29	42.16	580.45
2014–15	228.09	187.11	92.68	507.88	37.08	544.96
2015–16	222.77	199.66	81.02	503.44	35.17	538.59
Compound Annual Growth Rate (in per cent)						
1980–81 to 1989–90	1.42	1.38	–1.77	0.67	–0.66	0.56
1990–91 to 1999–00	0.03	1.55	–1.96	0.20	–1.11	0.11
2000–01 to 2009–10	0.06	0.37	0.86	0.31	1.17	0.36
2010–11 to 2015–16	–0.24	–1.15	–2.97	–1.07	–2.74	–1.19
1980–81 to 2015–16	0.12	0.66	–0.78	0.13	–0.74	0.06

Source: Reserve Bank of India (RBI), Government of India

Table 4: Trends in Per Capita Availability of Important Non-Food grain Articles

Year	Milk (gram/day)	Egg (nos./annum)	Fish (gram/day)	Edible Oil (gram/day)	Sugar (gram/day)	Tea (gram/day)	Coffee (gram/day)
1980–81	127.50	15	9.85	10.41	20.00	1.40	0.22
1981–82	135.80	16	9.68	13.97	22.47	1.28	0.22
1982–83	138.53	16	9.16	12.33	24.66	1.44	0.22
1983–84	147.03	18	9.50	15.89	28.77	1.42	0.21
1984–85	153.85	19	10.38	15.07	29.32	1.58	0.20
1985–86	159.67	21	10.44	13.70	30.41	1.61	0.19
1986–87	163.82	22	10.45	13.70	31.23	1.49	0.21
1987–88	162.37	23	10.29	15.89	32.05	1.62	0.20
1988–89	164.72	23	10.73	14.52	33.15	1.68	0.22
1989–90	171.32	25	12.26	14.52	33.70	1.56	0.18
1990–91	176.01	25	12.53	15.07	34.79	1.68	0.16
1991–92	178.27	26	13.30	14.79	35.62	1.79	0.18
1992–93	182.23	26	13.71	15.89	37.53	1.78	0.16
1993–94	186.13	27	14.26	16.71	34.25	1.83	0.15
1994–95	192.08	28	14.42	17.26	36.16	1.82	0.15
1995–96	195.44	29	14.61	19.18	38.63	1.77	0.15
1996–97	200.12	29	15.49	21.92	40.00	1.80	0.16
1997–98	204.91	30	15.31	16.99	39.73	1.74	0.16
1998–99	210.15	30	14.77	23.29	40.82	1.87	0.18
1999–2000	214.31	30	15.53	24.66	42.74	1.76	0.15
2000–01	216.70	36	15.21	22.47	43.29	1.73	0.16
2001–02	222.34	37	15.69	24.11	43.84	1.78	0.18
2002–03	223.64	38	16.09	19.73	44.66	1.71	0.18
2003–04	225.16	38	16.35	27.12	44.11	1.81	0.19
2004–05	232.71	42	15.86	27.95	42.47	1.82	0.20
2005–06	240.53	42	16.28	29.04	44.66	1.88	0.21
2006–07	250.53	45	16.77	30.41	46.03	1.88	0.21
2007–08	259.77	47	17.16	31.23	48.77	1.92	0.22
2008–09	266.38	48	18.08	34.79	51.51	1.93	0.22
2009–10	272.57	52	18.73	36.44	49.04	1.94	0.24
2010–11	281.36	53	19.01	37.26	46.58	1.96	0.25
2011–12	287.22	55	19.46	37.81	51.23	1.99	0.26
2012–13	293.72	56	20.05	43.29	51.23	2.13	0.27
2013–14	301.57	60	20.97	46.03	53.42	2.04	0.27
2014–15	316.36	62	22.56	47.73	54.33	2.10	0.28
Compound Annual Growth Rate (in per cent)							
1980–81 to 1989–90	3.18	6.10	2.18	2.45	5.62	2.25	–1.50
1990–91 to 1999–2000	2.30	2.25	2.13	5.52	2.22	0.34	–0.36
2000–01 to 2009–10	2.72	4.16	2.02	5.99	1.75	1.43	3.81
2010–11 to 2014–15	2.87	4.08	4.25	7.16	3.56	1.59	3.08
1980–81 to 2014–15	2.42	3.98	2.41	4.01	2.32	1.05	0.70

Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, GoI

The share of consumer expenditure on milk and products was 9.50 per cent in 1993–94 and became 9.10 per cent in 2011–12 in rural areas, while in urban, it was 9.80 per cent in 1993–94 and decreased to 7.80 per cent in 2011–12. In the same way, the share of edible oil was 4.40 per cent in 1993–94 and declined by 3.80 per cent in 2011–12 in rural areas; whereas it was 4.40 per cent in 1993–94 and decreased to 2.70 per cent in urban areas in 2011–12. In case of egg, fish and meat, the share of consumer expenditure was 3.30 per cent in 1993–94 and increased to 3.60 in 2011–12 in rural areas, whereas in urban, it was 3.40 per cent in 1993–94 and decreased to 2.80 per cent in 2011–12. The share of consumer expenditure on vegetables was 6 per cent in 1993–94 and decreased to 4.80 per cent in 2011–12. The share of consumer expenditure on food items was 63.20 per cent in 1993–94 and decreased to 48.60 per cent in 2011–12 in rural areas, whereas the expenditure was 54.70 per cent in 1993–94 and declined to 38.60 per cent in 2011–12. On the other hand, the share of non-food terms was 36.80 per cent in 1993–94 and increased to 51.40 per cent in 2011–12 in rural areas, whereas the share of consumer expenditure was 45.3 per cent in 1993–94 and increased to 61.50 per cent in 2011–12 in urban areas. It is clear that the expenditure of consumer on various items in rural and urban areas have various differences as well as fluctuating trends during 1993–94 to 2011–12 in India. It is also seen that the share of consumer expenditure on cereals, pulses and other major food grain items have been declining, and the share of consumer expenditure on non-food items has also been declining in rural and urban areas in the country. It is observed that majority of the population is suffering from health diseases like malnutrition, disability and decline in productive work due to unavailability of nutritional food items. Hence, the government should take initiatives to provide proper calories of food items in India.

4.4. Trends of Per Capita Dietary Energy

The per capita dietary energy supply increased significantly from 2370 kcal/day in the early 1990s to about 2440 kcal/day in 2001–02 and to 2550 kcal/day in 2011–12. The prevalence of undernourishment in the total population also decreased from 25 to 20 per cent during the period 1990 to 2000, and as many as 58 million individuals were estimated to have come out of the poverty trap. The absolute number of poor persons came down from 317 million to 259 million, with other livelihood indicators such as the literacy rate and longevity increasing substantially. The life expectancy at birth for males and females in 2005–06 was 63 and 66 years, respectively, as compared to that in 1986–91, which was as low as 58 and 59 years for males and females, respectively (Agricultural Statistics at a Glance, 2013).

Notwithstanding the achievement of macro-level food security and the discernible improvement in per capita consumption, the country is still home to a-fifth of the world's undernourished population. This given situation has been ascribed to high and increasing population pressure with nearly 16 million people being added annually to the already large population exceeding 1.2 billion. This situation of hunger and malnutrition is also equally due to serious problems related to distribution and economic access to food, which adversely affects household and individual-level food insecurities.

5. Determinants of Food Security at National Level

To identify the determinants of food security (per capita net availability of food grain) at the national level, the multiple regression model was used. The present study has tried to assess the impact of agricultural productivity, climate change, crop diversification and agricultural openness on availability of food grain as a proxy variable of food security in India during 1970–71 to 2015–16 in India. The estimated results of the regression model are presented in Table 6.

To check the problem of Multicollinearity, we have used Variance Inflation Factors (VIF) test and the Table also shows the result of VIF. The mean value of VIF as well as VIF value of independent variables were less than five. It means that there is absence of Multicollinearity among the independent variables.

The value of R square was 0.9447, which implied that the regression model on the whole could explain 94.47 per cent of the total variations in per capita availability of food grain (food security). The magnitude of F-value indicated that the given model was a good fit at the zero per cent level of significance.

The results indicate that productivity of food grain had a statistically positive and significant impact on food security throughout the period of study. On the other hand, the impact of crop diversification and difference between maximum and minimum temperature (climate change) had a statistically negative and significant impact on food security throughout the study period. The impact of agricultural openness on food security was not statistically

Table 5: Patterns of Consumer Expenditure (1993–94 to 2011–12) (in per cent)

Items	Share in total consumer expenditure					Share in total consumer expenditure				
	Rural					Urban				
	1993–94	1999–2000	2004–05	2009–10	2011–12	1993–94	1999–2000	2004–05	2009–10	2011–12
Cereal	24.20	22.20	18.00	15.60	12.00	14.00	12.40	10.10	9.10	7.30
Gram	0.20	0.10	0.10	0.20	0.20	0.20	0.10	0.10	0.10	0.10
Cereal Substitutes	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.10
Pulses & Products	3.80	3.80	3.10	3.70	3.10	3.00	2.80	2.10	2.70	2.10
Milk & Products	9.50	8.80	8.50	8.60	9.10	9.80	8.70	7.90	7.80	7.80
Edible oil	4.40	3.70	4.60	3.70	3.80	4.40	3.10	3.50	2.60	2.70
Egg, Fish & Meat	3.30	3.30	3.30	3.50	3.60	3.40	3.10	2.70	2.70	2.80
Vegetables	6.00	6.20	6.10	6.20	4.80	5.50	5.10	4.50	4.30	3.40
Fruits & nuts	1.70	1.70	1.90	1.60	1.90	2.70	2.40	2.20	2.10	2.30
Sugar	3.10	2.40	2.40	2.40	1.80	2.40	1.60	1.50	1.50	1.20
Salt & Spices	2.70	3.00	2.50	2.40	2.40	2.00	2.20	1.70	1.50	1.70
Beverages, etc.	4.20	4.20	4.50	5.60	5.80	7.20	6.40	6.20	6.30	7.10
Food Total	63.20	59.40	55.00	53.60	48.60	54.70	48.10	42.50	40.70	38.60
Paan & tobacco	3.20	2.90	2.70	2.20	2.40	2.30	1.90	1.60	1.20	1.40
Fuel and light	7.40	7.50	10.20	9.50	9.20	6.60	7.80	9.90	8.00	7.60
Clothing & bedding	5.40	6.90	4.50	4.90	6.30	4.70	6.10	4.00	4.70	5.30
Footwear	0.90	1.10	0.80	1.00	1.30	0.90	1.20	0.70	0.90	1.20
Misc. & services	17.30	19.60	23.40	24.00	26.10	27.50	31. 3	37.20	37.80	39.70
Durable goods	2.70	2.60	3.40	4.80	6.10	3.30	3.60	4.10	6.70	6.30
Non-food Total	36.80	40.60	45.00	46.40	51.40	45.3	51.90	57.50	59.30	61.50
Total expenditure	100	100	100	100	100	100	100	100	100	100

Source: Directorate of Economics and Statistics, Ministry of Agriculture, GoI

Table 6: Regression Results

Dependent Variable: PCAF				
Independent Variables	**Coefficient**	**Std. Error**	**t- value**	**p-value**
Crop Diversification (SID)	–0.5055158	0.1816511	–2.78	0.008
Food-grains Productivity (PRFG)	1.269342	0.0532992	23.82	0.000
Climate Change (TEMPD)	–0.6720228	0.1686767	–3.98	0.000
Agriculture Openness (AGOPEN)	–0.0026794	0.019984	-0.73	0.794
Constant	–0.0212589	0.0046326	–4.59	0.000

	Variance Inflation Factors (VIF) for Multicollinearity		
R-squared = 0.9447	**Variables**	**VIF**	**1/VIF**
Adjusted R-squared = 0.9392	PRFG	1.07	0.932012
Root MSE = .02206	AGOPEN	1.06	0.941999
F (4, 40) = 170.93	TEMPD	1.05	0.956783
Prob. > F = 0.0000	SID	1.03	0.968312
Number of Observations = 45	**Mean VIF**	**1.05**	

Source: Author's Calculationsa

significant but negative. In this context, most of the parameters under consideration have been found to influence the most important factor of food security, i.e., per capita availability of food grain during the study period.

6. Conclusions and Policy Implications

The study has examined the emerging trends, patterns and determinants of food security in India during 1980–81 to 2015–16 with the latest available evidences in terms of per capita availability and consumption patterns of various food and non-food commodities and has also identified the various determinants of food security. Several interesting findings have emerged and the important among them are outlined below:

- The performance of food grain crops in terms of growth rates of production and yield during the study period have gradually decreased from 1980–81 to 2015–16 at a significant rate. It indicates the serious implication of nation food security.
- The per capita net availability of food grains has declined after economic reform with some fluctuations due to marginal decline in wheat and rice crops; on the other side, there was a drastic reduction in the availability of coarse cereals and pulses. This had a direct impact on the food security. On the other hand, the availability of non-food articles has increased with some fluctuation during the study period.
- The expenditure of consumers on various items in rural and urban areas had various differences as well fluctuating trends during 1993–94 to 2011–12 in India. It is also observed that the share of consumer expenditure on cereals, pulses and other major food grain items has been declining, and the share of consumer expenditure on non-food items has also been declining in rural and urban areas.
- The results of regression model revealed that crop diversification, climate change and agricultural openness have a negative impact on food security, while food grain productivity had a positive impact on food security during the study period.

The above conclusions have some essential implications for the food policies to ensure food security at the national level. The declining trend of net availability of food grains suggests the need for an enthusiastic pursuit for long-term strategies for augmenting food production, especially through enhancement in productivity of food

grains. It is also necessary to categorize the areas that benefitted from the Green Revolution and others that had a very low impact of the Revolution. Streamlining and lessening of food distribution system through PDS is equally important. There is a need for further research to understand the consistently poor performance of PDS in India.

It is also observed that majority of the population in India is suffering from health diseases like malnutrition, disability and decline in productive work due to unavailability of nutritional food items. Hence, the government should take initiatives to provide proper calories of food items for rural as well as urban areas. The future of the NFSA (2013) depends a great deal on the success of the PDS across the country and regular mentoring of the policy for efficient implementation of the programme. The government must emphasize on social safety net programmes, such as MGNREGA, NFSM, Mid-Day Meal, PDS, etc., for achieving food and nutrition security at the national level. Finally, there is a strong need to regulate the government policies related to crop management, climate change and globalization for reducing its negative effects on food security in India.

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"If agriculture goes wrong, nothing else will have a chance to go right in country."

– M.S. Swaminathan

Agricultural Production, Marketing and Food Security in India: A Peep into Progress

SHIRISH SHARMA AND PURUSHOTTAM SHARMA

Providing food for all has continued in the forefront of agricultural and development policy in India. The country mainly focussed on improving domestic availability through increasing food production in India, and Green Revolution was started with this objective. With the research and development policy efforts, the country has achieved self-sufficiency in food grain production but still depends on imports for pulses and edible oils. Although, it has reduced the prevalence of undernourishment and malnutrition in the country, however, a large number of people still suffer from these ills. On the distribution side the country has taken many policy and institutional initiatives to improve supply chain related issues in order to provide affordable access to nutritious food to its population.

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1. Introduction

Ensuring food security is continuing to be a daunting task for many countries with the growing challenges of climate change, shrinking resources and global economic environment. The world produces enough food to feed everyone, but the distribution of food is not ensured properly leading to food starvation for many in different countries. Food security for everyone is a basic need and ensuring it is the primary responsibility of all governments. Currently about 792.5 million people are estimated to be undernourished all over the globe (FAO, 2016), although reduced from 1010.7 million people undernourished in 1991. Nearly one-fourth of people are undernourished in sub-Saharan Africa, while Asia (the world's most populous region) is home to the majority of hungry people (Sharma et al., 2016). India is home to about 25 per cent of the world's undernourished population.

Providing food to each and every person is the most important issue for the Indian government, where more than 15 per cent of its total population is still undernourished and nearly 40 per cent of its children have suffered from malnourishment over the last many decades (FAO, 2016). Food availability is a necessary condition for food security. India is more or less self-sufficient in cereals but deficit in pulses and oilseeds as well as in livestock products. There have been changes in consumption patterns over the years; with increase in income, the pattern is diversifying leading to increase in demand for fruits, vegetables, dairy, meat, poultry, and fisheries (Nair and Eapen, 2012; Kumar and Joshi, 2016).

After the Green Revolution, India succeeded in the laudable task of becoming a food self-sufficient nation, at least at the macro level. It produces sufficient food to feed its population, but is unable to provide access to food to a

large chunk, especially women and children. The country's hunger and malnutrition levels are still high. It is estimated that nearly 5–15 per cent of the fruits and vegetables, and 3–10 per cent of the food grains that are produced are lost due to inefficient supply chain management and do not reach the consumer markets (Jha et al., 2015).

Markets for agricultural and food commodities have always exhibited volatility on account of production fluctuations mainly due to weather aberrations, volatility in international markets, seasonality in production, increased demand with increase in consumer income, etc. The asymmetric nature of extreme volatility in food and agricultural prices, with upward price spikes much larger than downward price declines, affects the affordability of poor and even farmers who are net buyers. Small and marginal farmers tend to sell their agricultural produce immediately after harvest at lower than prevailing market prices for the want of money, and purchase food in the lean season at higher prices. Recent price peaks have served to attract new attention to this phenomenon of food market volatility and to demonstrate the importance of developing appropriate and effective responses to a situation that can have dire social consequences.

Food price volatility raises serious concerns particularly in India as the poor spend a large share of their income on food, and agriculture is the main source of income for many poor people. Persistent situation can result in sharp declines in the incomes of poor, potentially pushing them into poverty, and pose serious threats to their food security. The policy challenge in this scenario is to identify combinations of policies that can ensure livelihood security as well as food security of vulnerable sections of the population. Moreover, the large amount of post-harvest losses of agricultural commodities not only reduces availability of food to the people but also pushes commodity prices up, leading to poor access and affordability of food for the vulnerable. With this background the paper addresses the issues of food security in India with the following objectives: (i) To analyze the growth in production and availability of food in India; (ii) Examine the changes in consumption of food items; (iii) To study the trend and progress in food security, and (iv) To understand the progress in agricultural marketing to improve food security in the country.

Section one of the paper examines the availability of food, while section two deals with food availability and demand estimation at the national level. Section three discusses price behaviour over time, while section four examines post-harvest loss at the national level. The final section comprises the conclusions from the study.

2. Data and Methodology

The paper is mainly based on secondary data sourced from publications and websites of the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, International Food Policy Research Institute, Food and Agricultural Organisation of United Nations, etc.

3. Trend in production and availability of food commodities

Food security at the national level mainly depends on domestic production-led higher availability at affordable prices to meet the increasing demand. Sufficient availability of food commodities can be made available either through domestic supply or imports. The growth in production of food commodities and the per capita availability is presented and discussed in this section.

Production of food grains in India increased by more than five-fold from 50.8 million tonne during 1950–51 to 265 million tonnes during 2013–14. Although, the diversity in production of different food grains has decreased, as wheat and rice together accounted for about 50 per cent of the total food grains production during 1950–51, which has increased to about 76 per cent presently. With tremendous growth in production of wheat and rice, the country has not only achieved self-sufficiency but also has net surplus for export. In case of pulses (the major source of protein for the vegetarian population of the country) and oilseeds, the growth in production was sub-optimal leading to higher dependence on import. Production of milk has also increased significantly in the country from 17 million tonnes during 1950–51 to 146.3 million tonne presently (Table 1).

With the fast increase in production of wheat and rice, the per capita availability of food commodities has increased significantly in India (Appendix 1). Although, self-sufficiency is not the satisfactory condition for providing food security to the population; if a country has enough foreign exchange earnings, importing food commodities can help improve food availability and food security. However, the countries with not enough export earnings, where livelihood of majority of households depends on agriculture and food production, and the number of people living below the poverty line is quite significant, some degree

Table 1: Production of Selected Commodities in India (in million tonne)

Year	Rice	Wheat	Cereals	Pulses	Food grains	Oilseeds	Milk
1950–51	20.58	6.46	42.42	8.41	50.82	5.16	17.0
1960–61	34.58	11.00	69.32	12.70	82.02	6.98	20.0
1968–69	39.76	18.65	83.59	10.42	94.01	6.85	21.2
1970–71	42.22	23.83	96.60	11.82	108.42	9.63	
1973–74	44.05	21.78	94.66	10.01	104.67	9.39	23.2
1980–81	53.63	36.31	118.96	10.63	129.59	9.37	31.6
1990–91	74.29	55.14	162.13	14.26	176.39	18.61	53.9
2000–01	84.98	69.68	185.74	11.08	196.81	18.44	80.6
2010–11	95.97	86.87	226.24	18.24	244.48	32.48	121.8
2011–12	105.30	94.88	242.20	17.09	259.29	29.80	127.9
2012–13	105.24	93.51	238.79	18.34	257.13	30.94	132.4
2013–14	106.65	95.85	245.79	19.25	265.05	32.75	137.7
2014–15	105.48	86.53	234.87	17.15	252.02	27.51	146.3

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare

of self-reliance in food production may be a necessary condition for food security (Acharya, 2003, 2009).

4. Trend in Consumption of Food Items

For assessing the adequacy of food and nutrition among the population, the trends in the per capita calorie, protein and fat intake are often used. The mean per capita per day intake of calorie, protein and fat for rural and urban population are presented in Table 2 pertaining to the period starting from 1983–84 to 2011–12 sourced from different survey rounds of National Sample Survey Organisation (NSSO).

The pattern of calorie and protein intake for rural and urban households shows a dissimilar trend during the period 1983–84 to 2011–12, while per capita calorie intake declined from a level of 2240 kcal per day in 1983–84 to 2047 kcal per day in 2004–05 for the rural population, although improved recently to 2165 kcal per day in 2011–12. The per capita protein intake for the rural population declined from 63.5 gm to 58.5 gm per day. In case of urban population, the per capita calorie intake, however, increased marginally from 2070 kcal per day during 1983–84 to 2140 kcal per day during 2011–12, whereas per capita protein intake declined marginally from 58.1 gm per day to 57.4 gm per day in the corresponding period. However, the per capita fat intake has increased gradually over time for both rural and urban populations.

Expenditure on food items by rural population in India was 64 per cent of the total household expenditure in 1987–88, which has reduced to 48.6 per cent in 2011–12. Urban people were spending 56.4 per cent of their total household expenditure on food, which has reduced to 38.6 per cent during the same period (Table 3). The diversification in the food intake has increased in rural as well as urban India, as the proportion of total expenditure on cereals and pulses has reduced from about half during 1987–88 to less than one-third of food expenditure during 2011–12 in rural India and about one-third to one-fourth in urban India. The share of milk & products and eggs, fish and meat in total food expenditure has increased in rural as well as in urban areas over the years. Thus, the consumption is moving away from food grains and changing towards horticultural products like fruits and vegetables, food items of animal origin like milk, eggs, meat, fish, etc., and processed products (Shalendra et al., 2013).

Table 2: Average per capita Consumption of Calorie, Protein and Fats in India (per capita/day)

Year	Round	Calories (kcal)		Protein (gm)		Fats (gm)	
		Rural	Urban	Rural	Urban	Rural	Urban
1983–84	38	2,240	2,070	63.5	58.1	27.1	37.1
1987–88	43	2,233	2,095	63.2	58.6	28.3	39.3
1993–94	50	2,153	2,073	60.3	57.7	31.1	41.9
1999–2000	55	2,148	2,155	*59.1	58.4	36.0	49.6
2004–05	60	2,047	2,020	55.8	55.4	35.4	47.4
2009–10	66	2,147	2,123	59.3	58.8	43.1	53.0
2011–12	68	2,165	2,140	58.5	57.4	43.7	54.2

Source: Various survey rounds, NSSO, GoI.

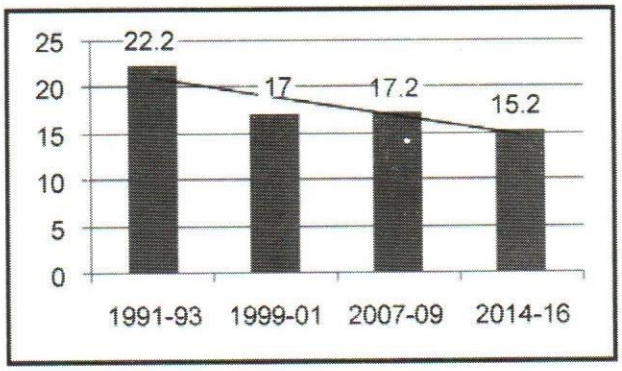
Table 3: Trends in Composition of Consumer Expenditure since 1987–88

Item group	Rural						Urban					
	1987–88	1993–94	1999–2000	2004–05	2009–10	2011–12	1987–88	1993–94	1999–2000	2004–05	2009–10	2011–12
Cereal	26.3	24.2	22.2	18.0	15.6	12.0	15.0	14.0	12.4	10.1	9.1	7.3
Pulses & products	4.0	3.8	3.8	3.1	3.7	3.1	3.4	3.0	2.8	2.1	2.7	2.1
Milk & products	8.6	9.5	8.8	8.5	8.6	9.1	9.5	9.8	8.7	7.9	7.8	7.8
Edible oil	5.0	4.4	3.7	4.6	3.7	3.8	5.3	4.4	3.1	3.5	2.6	2.7
Egg fish & meat	3.3	3.3	3.3	3.3	3.5	3.6	3.6	3.4	3.1	2.7	2.7	2.8
Vegetables	5.2	6.0	6.2	6.1	6.2	4.8	5.3	5.5	5.1	4.5	4.3	3.4
Fruits & nuts	1.6	1.7	1.7	1.9	1.6	1.9	2.5	2.7	2.4	2.2	2.1	2.3
Suger	2.9	3.1	2.4	2.4	2.4	1.8	2.4	2.4	1.6	1.5	1.5	1.2
Salt & spices	2.9	2.7	3.0	2.5	2.4	2.4	2.3	2.0	2.2	1.7	1.5	1.7
Beverages, etc.	3.9	4.2	4.2	4.5	5.6	5.8	6.8	7.2	6.4	6.2	6.3	7.1
Food Total	64.0	63.2	59.4	55.0	53.6	48.6	56.4	54.7	48.1	42.5	40.7	38.6
Non-food Total	36.0	36.8	40.6	45.0	46.4	51.4	43.6	45.3	51.9	57.5	59.3	61.5
Total expenditure	100	100	100	100	100	100	100	100	100	100	100	100

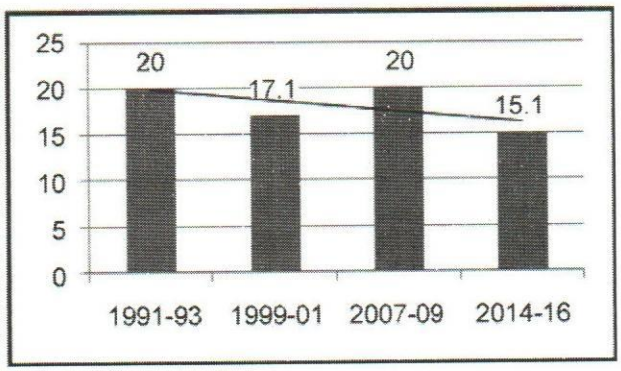
Source: NSSO, M/O Statistics & Progamme Implementation, Key Indicators of Household Consumer Expenditure in India, various issues.

5. Trend and progress in food security

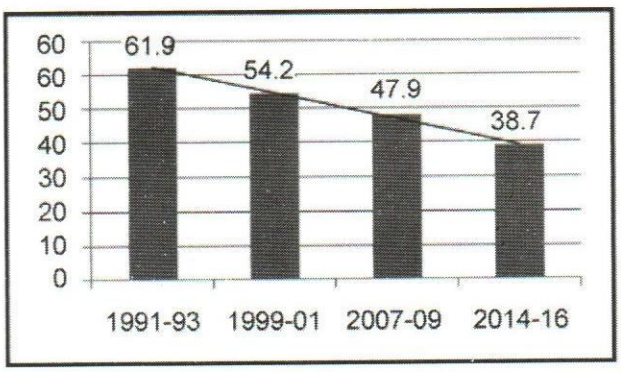
As per the Global Hunger Index (GHI), computed by International Food Policy Research Institute, considering under nutrition, child malnutrition and child mortality, India is ranked 97 in the list of 118 countries. Although, GHI of India has improved from 46.1 during 1991–93 to 28.5 during 2014–16, total number of people not getting adequate food is still high (IFPRI, 2016). The country is home to a quarter of the total undernourished population all over the globe.



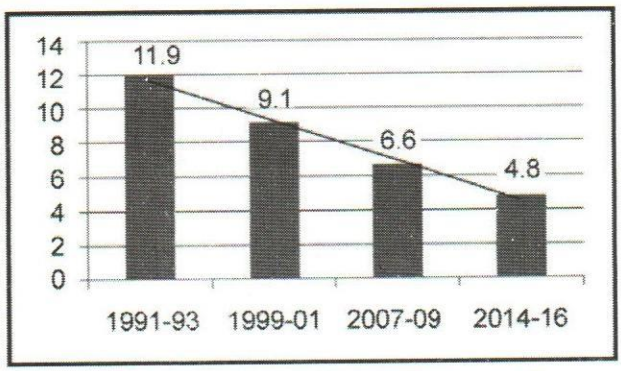
1a. Proportion of undernourished in the population (in per cent)



1b. Prevalence of wasting in children under-five years (in per cent)



1c. Prevalence of stunting in children under-five years (in per cent)



1d. Under-five mortality rate (in per cent)

Figure 1: Trends and Progress in Food Security

Source: IFPRI Global Hunger Index, 2016

The progress on food security indicators shows that the prevalence of undernourishment has decreased from 22.2 per cent during 1991–93 to 15.2 per cent during 2014–16 (Figure 1a). Child malnutrition indicators also point to good progress over the period as child wasting has decreased from 20 per cent to 15 per cent, and child stunting has dropped significantly from 62 per cent to 38.7 per cent during the corresponding period (Figure 1b and 1c). Significant achievement has also been made in reducing child mortality from 11.9 per cent to 4.8 per cent during the same period (Figure 1d).

5.1. Undernourishment and economic growth

On the importance of economic growth in reduction of hunger, FAO report on 'State of Food Insecurity in the World 2012' stated that economic growth is 'necessary but not sufficient' for reductions in hunger and malnutrition. The relevance of economic growth is weakly supported by Figure 2.

The importance of economic growth in reduction of undernourishment is worked out through fitting regression equation, seemingly the simplest possible for testing the hypothesis that reductions in undernourishment are driven by economic growth:

$$H = a+b\ GDPpc + e \qquad \text{.....(1)}$$

where,

H denotes the prevalence of undernourishment (hunger) as a percentage of the population of country over the period 1990–2014,

GDPpc denotes the real GDP per capita of country in 2011 PPP over the same period,

a and *b* are estimated parameters and

e is an error term

The results of the analysis are presented in Table 4.

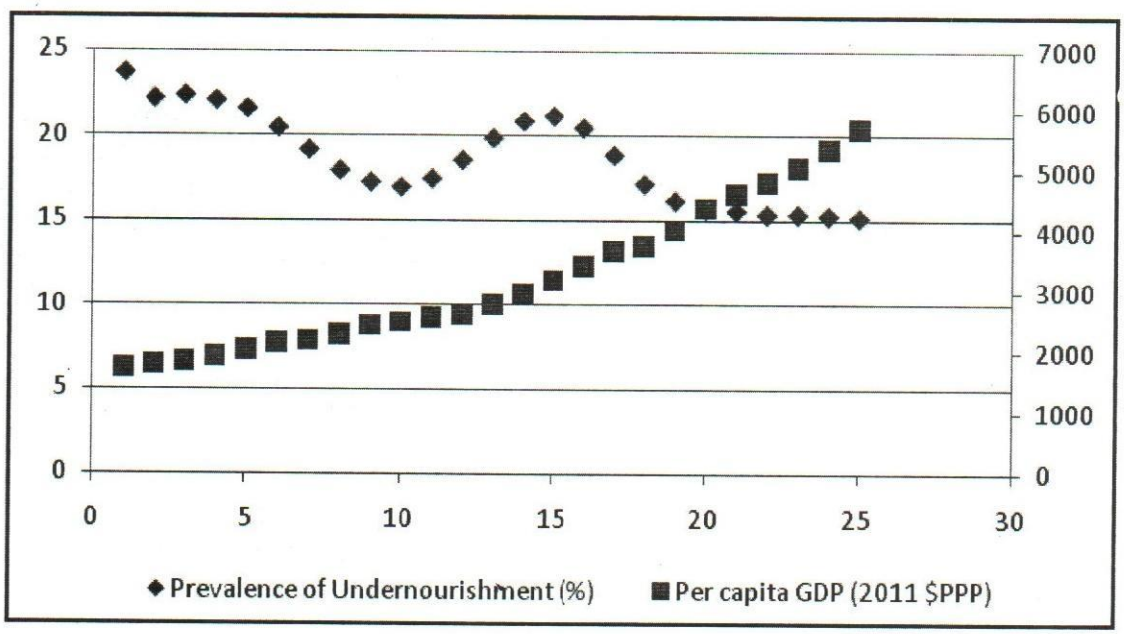


Figure 2: Undernourishment and Economic Growth in India

According to these results, undernourishment declines with the increase in economic growth per capita, but very marginally. The relationship is statistically significant. Thus, reduction in undernourishment and economic growth per capita are weakly associated. Economic growth is not sufficient for reduction in undernourishment (Warr, 2014).

Table 4: The Weak Relationship between Undernourishment and Economic Growth

Variables	Coefficients	*p*-value
Real GDP per capita (2011 $PPP)	–0.00191***	1.09E-18
Constant	25.53318***	8.38E-07
N	25	
R^2	0.659	
adj. R^2	0.644	
F-stat	44.469	8.38E-07

Note: *indicates ***$P < 0.01$. The regressions for 'Developing countries' and 'Asia-Pacific' exclude China on the grounds that its GDP data may be unreliable.

Source: Author's calculations using data from FAO 'Food Security Indicators', 2016 and World Bank, 'World Development Indicators'.

In India, the food basket has become more diversified with a significantly higher share of milk and other high nutritive food items. Dietary shift towards high-value food commodities has a profound impact on agricultural production, marketing, processing and retailing sector. However, despite increasing demand for high-value commodities, the importance of cereals and pulses will continue towards attaining food and nutritional security in the country, as food grains account for more than three-fourth share in the total calorie and protein intake.

5.2. Post-harvest Losses for Food Commodities

A recent study conducted by ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana (Jha et al.,

2015) estimated the various stages, from harvesting to the food reaching the hands of the consumers. The results of the report revealed that harvest and post-harvest losses in cereals were to the tune of 4.65 per cent to 6 per cent of total production, i.e., 6.02 million tonne of paddy (calculated at 2016–17 production level) produced is lost in the post-production and marketing activities (Table 5). Similarly, 4.76 million tonne of wheat produced during 2016–17 will be lost post-production. The harvest and post-harvest losses of major cereals produced estimated at about 12.78 million tonne in the country, which could have saved a large chunk of people from undernourishment if stored and properly distributed.

The harvest and post-harvest losses were estimated at 6.36 per cent to 8.4 per cent of total production in case of major pulses and 3.24 to 9.96 per cent in case of major oilseeds, at present the production level amounts to 1.38 million tonne of pulses and 2.44 million tonne of oilseeds. Since the country depends greatly on imports to fulfil the growing domestic requirement of pulses and edible oils, the reduction in harvest and post-harvest losses of these commodities not only will help reduce protein malnutrition in the country but also save a lot of foreign exchange.

Providing adequate technique and infrastructure for harvest and post-harvest handling of farm produce is much needed. The losses at the supply chain can be minimized through integrating supply chain activities and stakeholders, providing appropriate infrastructure and policy support. Under the changing demand and supply scenario, the location of markets, marketing practices, handling methods and polices needs to be relooked.

Table 5: Harvest and Post-harvest losses of Food Commodities in India

Commodities	Production (mt)*	% Loss**	Loss Quantity (mt)
Cereals			
Paddy	108.86	5.53	6.02
Wheat	96.64	4.93	4.76
Maize	26.15	4.65	1.22
Bajra	9.42	5.23	0.49
Sorghum	4.75	5.99	0.28
Pulses			
Pigeon pea	4.23	6.36	0.27
Chickpea	9.12	8.41	0.77
Black gram	2.89	7.07	0.20
Green gram	2.13	6.60	0.14
Oilseeds			
Mustard	7.192	5.54	0.40
Soybean	14.125	9.96	1.41
Safflower	0.059	3.24	0.00
Sunflower	2.41	5.26	0.13
Groundnut	8.472	6.03	0.51

Note: *2nd advance estimates for 2016–17, Department of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI,**

Source: Jha *et.al.*, 2015.

5.3. Agricultural Prices and Food Security

Market price of food and agricultural commodities is one of the critical factors in assuring food safety. Agricultural sector of India is exposed to sudden disturbances, mainly after globalization and liberalization of trade, caused by domestic demand–supply conditions as well as by volatility in international prices and exchange rate. Extreme price volatility or high food inflation poses threat to food security. The impact of higher food prices on food and nutrition security is more prominent on those who can least afford it. Rising cost of food coupled with other natural and economic crises can greatly impact food security by pushing most vulnerable households into poverty and impacting ability to access adequate food (Gustafson, 2013). The efficiency of the price system begins to break down when price movements are increasingly uncertain and subject to extreme swings over an extended period of time. Improvement in functioning of agricultural markets is the key to insulate vulnerable population from extreme price surge or high volatility.

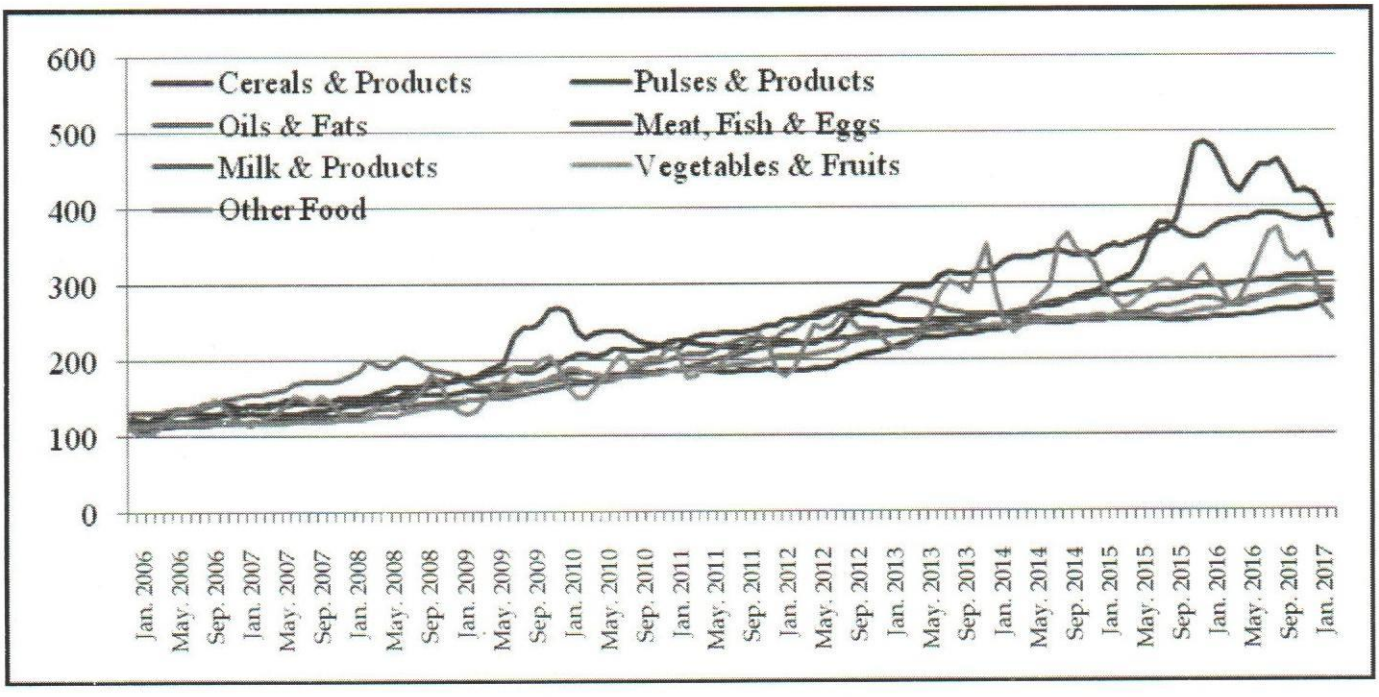


Figure 3: Consumer Price Index for Industrial Workers (Food sub-groups) 2001=100

The monthly consumer price index for industrial workers for different food sub-groups is presented in Figure 3. It is clear from the Figure that the price index for all the food articles started rising sharply and price rise has remained alarmingly high in case of protein foods. Prices of pulses and vegetables remain highly volatile.

In a report on food inflation in India, Bhattacharya (2016) revealed that 'India has witnessed sustained high rate of inflation in both wholesale and retail food prices since 2007 and till the beginning of 2014. Since 2007, the average year-on-year (YOY) inflation rate in WPI food articles and CPI-IW food group have been 9.99 and 10.12 respectively.' The study further reported that high food inflation was on account of lack of competitive agricultural markets and required infrastructure, apart from demand–supply factors.

5.4. Agricultural Marketing and Food Security

Food security entails not only producing sufficient food but also sustainable round-the-year access to entire population. Marketing system for food and agricultural commodities and trade policies directly affect the prices received by the farmers for their produce and, thus, influence the profitability of agriculture, also the price paid by the consumers. Profitability of farming sector depends on the productivity and the relative prices of inputs and output. The prices of inputs and output are determined by the market structure and efficiency of the marketing system. The structure and conduct of the market participants decides the performance and efficiency of agricultural marketing system.

Even with satisfactory agricultural growth, rural poverty and food insecurity in the country persist, which led to interventions in agricultural marketing sector intended to improve the performance and efficiency of the agricultural marketing system. Interventions were made to improve the performance of physical and institutional infrastructure focused on integrating the supply chain. In order to further the reforms in agricultural marketing sector, central government drafted Model APMC Act, 2003, as per the comprehensive action plan by Inter-ministerial Task Force and circulated among the states.

The Model APMC Act, 2003, mainly focused on addressing concerns in order to (a) empower farmers, especially small farmers, with knowledge, information and capabilities to undertake market-driven production (b) provide multiple choice for competitive marketing channels to farmers (c) provide efficient services at a reasonable transaction cost, and (d) attract investment needed for building post-harvest infrastructure. In order to keep pace with the changing production pattern and growing marketable surplus, the government advocates development of adequate number of markets equipped with modern infrastructure, with increased private sector participation and development of other marketing channels like direct marketing and contract farming, etc. The government is actively pursuing states to amend their marketing laws to provide suitable legal framework and policy atmosphere to usher such developments. The reform agenda of the government focuses on seven vital areas for reform vis-à-vis Model APMC Act. State-wise progress, as updated on 25 February 2016, is given below.

Area of Reforms	States adopting the suggested area of marketing reforms
1. Establishment of private market yards/ private markets managed by a person other than a market committee	Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Goa, Himachal Pradesh, Karnataka, Maharashtra, Mizoram, Nagaland, Odisha (excluding for paddy/rice), Rajasthan, Sikkim, Telangana, Tripura, Punjab, UT of Chandigarh, Jharkhand, Uttarakhand, West Bengal.
2. Establishment of direct purchase of agricultural produce from agriculturist (direct purchasing from producer)	Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Goa, Haryana (for specified crop through establishment of Collection Centres) Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Mizoram, Nagaland, Rajasthan, Sikkim, Telangana, Tripura, Punjab (only in rule), UT of Chandigarh (only in rule), Jharkhand, Uttarakhand and West Bengal, UP (Only for bulk purchase under executive order issued time to time).
3. To promote and permit e-trading	Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Haryana, HP, Karnataka, Rajasthan, Sikkim, Goa, Madhya Pradesh, Maharashtra (has granted license to Commodity Exchanges registered under FMC), Mizoram, Telangana, Uttarakhand.
4. Establishment of farmers/ consumers market managed by a person other than a market committee (direct sale by the producer)	Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Goa, Himachal Pradesh, Karnataka, Maharashtra, Mizoram, Nagaland, Rajasthan, Sikkim, Tripura, Jharkhand, Uttarakhand, West Bengal.
5. Contract Farming Sponsor shall register himself with the Marketing Committee or with a prescribed officer in such a manner as may be prescribed	Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Haryana Himachal Pradesh, Jharkhand, Karnataka, Maharashtra, Madhya Pradesh, Mizoram, Nagaland, Odisha, Punjab (separate Act), Rajasthan, Sikkim, Telangana, Tripura, Uttarakhand.
6. Single point levy of market fee	Andhra Pradesh, Rajasthan, Gujarat (for processor, grader, packer, value addition and exporter), Goa, Himachal Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Nagaland, Jharkhand, Sikkim, UT of Chandigarh, Punjab, Mizoram, Telangana, Uttar Pradesh and Uttarakhand.
7. Single registration/ license for trade/ transaction in more than one market	Andhra Pradesh, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka (in rules only), Rajasthan, Chhattisgarh, Madhya Pradesh, Maharashtra, Mizoram, Nagaland, Telangana (in rules only), Sikkim.

Further, as a part of reforms, the government announced a scheme for setting up of e-National Agriculture Market (e-NAM). Under e-NAM, a common e-market platform is being deployed for online trading across the states/country. It is expected that e-NAM would address the marketing constraints of fragmentation, lack of transparency in bidding, poor price discovery, information asymmetry between sellers and buyers and provide

farmers with a larger share of the consumer rupee. Total 585 mandies are palnned to be integrated with this platform and more than 20 states have expressed interest in linking their *mandis* with this project. So far, 417 markets from 13 states have been integrated with e-NAM against the target of 400 *mandis* by March, 2017, and remaining *mandis* will be integrated by March 2018.

6. Programmes to Improve Food Security

Government of India is determined to improve the food security in the country and is making concerted efforts to strengthen production, availability, access and affordability of food commodities through making investments, incentivizing use of key inputs by providing subsidies, enacting social protection programmes, and favourable trade policies to increase supply and stabilize prices (Joshi, 2016).

Efforts towards increasing food production in the country includes Rashtriya Krishi Vikas Yojana (RKVY), National Food Security Mission (NFSM), Bringing Green Revolution in Eastern India (BGREI), National Horticulture Mission (NHM), schemes for irrigation development, etc. To ensure remunerative prices to farmers and for assured procurement of food grains, government announces Minimum Support Prices (MSP) for about 25 commodities before the sowing season starts. These initiatives contributed significantly to increasing food production and making India a food-secure country.

Towards proper distribution of food to vulnerable sections and empowering them, government has launched mega programmes such as mid-day meal scheme for school children, Public Distribution System (PDS) and Mahatma Gandhi National Rural Employment Guarantee Act (MGNERGA). These programmes were implemented to ensure availability, access and affordability of food, apart from increasing production.

7. Conclusions

Increasing agricultural production is critical for ensuring India's food security, but this may not be sufficient to meet the increasing demand. The country has achieved a lot towards reducing undernourishment and malnourishment in the country through targeted approach. But still a large section of the population is suffering from undernourishment. The food security programme at present is challenged by multiple factors like limited land and water availability, dwindling natural resources, climate change, labour shortage, etc. To achieve the goal of food security on sustainable basis, food availability needs to be improved through reductions in harvest and post-harvest losses at farm, retail and consumer levels. Agricultural marketing infrastructure and integrating supply chain for food commodities is highly needed, which is gradually improving. Perfect synchronization of institutions, infrastructure, technologies and policies is needed in order to increase food supply and ensure food availability at affordable prices.

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Appendix 1

Table 6: Per capita Food grain, Pulses and Milk Availability in India (gm/capita/day)

Years	Rice	Wheat	Other Cereals	Cereals	Pulses	Food grains	Edible Oil (kg/capita/yr)	Milk
1951	158.9	65.7	109.6	334.2	60.7	394.9		130
1961	201.1	79.1	119.5	399.7	69.0	468.7	3.2	126
1971	192.6	103.6	121.4	417.6	51.2	468.8	3.5	112
1981	197.8	129.6	89.9	417.3	37.5	454.8	5.1	164
1991	221.7	166.8	80.0	468.5	41.6	510.1	5.4	200
2001	190.5	135.8	56.2	386.2	30.0	416.2	8.8	222
2011	181.5	163.5	65.6	410.6	43.0	453.6	13.8	290
2012	190.2	158.4	60.0	408.6	41.7	450.3	15.8	299
2013	159.6	145.8	52.7	358.1	43.3	401.4	16.8	307
2014	199.0	183.1	62.0	444.1	47.2	491.2		322

Source: Agriculture Statistics at a Glance, Ministry of Agriculture & Farmers' welfare, GoI and Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture & Farmers' welfare, GoI

"The quest for food security can be the common thread that links the different challenges we face and helps build a sustainable future"

– José Graziano da Silva

NFSA: A Legal Entitlement to Right to Food

RUCHI GUPTA

India achieved food sufficiency years ago through investment in technology, institution and infrastructure, yet its efforts in achieving food security for all its citizens' remain unimpressive. Food security means access to enough food for all citizens at all times for a healthy and active life. The paper deals with food productivity in India, food grain requirement, the role of National Food Security Act (NFSA) in providing right to food, food grain stock with the Food Corporation of India (FCI), buffer requirement and the challenges faced by the implementing authorities along with food grain wastage in FCI godowns.

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1. Introduction

According to Food and Agriculture Organization (FAO) Annual Report 2015, India is home to 144.6 million undernourished people — the highest in the world. It ranks 97 out of 118 developing countries on the International Food Policy Research Institute (IFPRI) Global Hunger Index (GHI) 2016, i.e., our country is rated with a serious hunger level. India scored 28.5 on the GHI up from 36 in 2008. The above data exhibits that around 15 per cent of the country's population is undernourished. According to Suresh Tendulkar Panel Report (2011–12), 21.9 per cent of India's population lives below poverty line, that is, 269.3 million people are poor (Planning Commission, June 2014).

Even now two-thirds of the Indian population hovers around the poverty line. In India, the amount spent on food by individuals on a daily basis form a significant part of their budget. India achieved food sufficiency years ago through investment in technology, institution and infrastructure, yet its efforts in achieving food security for all its citizens remain unimpressive. Without individual food security, a basic requirement for life, India will not be able to make progress in other aspects of human development. It had ranked 130 among 188 countries in Human Development Report 2015.

Food security means access to enough food for all citizens at all times for a healthy and active life. According to FAO, 'food security emerges when all people at all times have physical and economic access to adequate safe and nourishing food to meet their nutritional needs and food preferences for healthy life'. It has been one of the important developmental objectives of the Indian government since the Five-Year Plans were initiated. The government has been continuously making efforts to achieve food security by increasing the quantum of food grain production to meet the increasing demand of the population.

2. Objective of the Study

The main objective of the paper is to study food productivity in India, food grain requirement to meet the demand for successful implementation of the food security programme of the government through public distribution system (PDS). The paper further deals with the role of National Food Security Act (NFSA) in providing right to food to individuals, the food grain stock with the Food Corporation of India (FCI), buffer requirement and the challenges faced by the implementing authorities. Food grain wastage is dealt with in the latter part of the paper, along with the challenges in the delivery mechanism — Targeted Public Distribution System (TPDS).

3. Methodology

For the purpose of the study, descriptive methodology has been adopted, and for auxiliary information, books, journal articles, annual reports, economic surveys, draft papers and data available on the websites of FCI, Food security portal, FAO have been referred to. The data thus collected from these secondary sources are tabulated and analyzed for drawing conclusions.

4. Food Availability in India

The government has been striving for decades to make food available, accessible and affordable for all, as food is essential for living. In spite of having placed itself amongst one of the largest food grain producers in the world, India fails to provide its population of 1.25 billion enough food to live a healthy life. The data released by various government and non-government organizations regarding malnutrition, poverty, hunger, etc., presents us a frightening picture.

The prices of food items are on the rise due to inflation, making it tougher for the poor to survive. For providing food security one of the key elements is food availability, which in turn depends on agricultural growth. Table 1 exhibits the status of food grains in India. Food availability means total food production, which includes import and buffer stock in the government granaries. In the last few years, food availability for the masses has been increasing, but its accessibility depends on the food prices and people's incomes. In order to keep the food prices low and still have a reasonable farm income, it requires reduced unit cost of production which can be achieved with the use of technology.

Table 1: Food Grain Production in India (million tonne)

Year	Rice	Wheat	Other Cereals	Pulses	Total Food grain	Increase per Year
2000–01	84.98	69.68	31.07	11.08	196.81	–
2001–02	93.34	72.77	33.37	13.37	212.85	8.1
2002–03	71.82	65.76	26.06	11.13	174.77	–17.8
2003–04	88.53	72.16	37.59	14.91	213.19	21.98
2004–05	83.13	68.64	33.46	13.13	198.36	–6.95
2005–06	91.79	69.35	34.08	13.38	208.60	5.2
2006–07	93.36	75.81	33.91	14.20	217.28	4.2
2007–08	96.69	78.57	40.76	14.76	230.78	6.2
2008–09	99.18	80.68	40.04	14.57	234.47	1.6
2009–10	89.09	80.80	33.56	14.66	218.11	–7.0
2010–11	95.98	86.87	43.4	18.24	244.49	12.2
2011–12	105.3	94.88	42.02	17.09	259.29	6.1
2014–15	104.8	88.9	37.9	17.2	252.7	

Source: Various issues of *Economic Survey*

Table 2: Food Grain Production in India (million tonne)

Year	Total food grain
2000–01	196.81
2001–02	212.85
2002–03	174.77
2003–04	213.19
2004–05	198.36
2005–06	208.60
2006–07	217.28
2007–08	230.78
2008–09	234.47
2009–10	218.11
2010–11	244.49
2011–12	259.29
2012–13	257.10
2013–14	265.00
2014–15	252.00

Source: Various issues of *Economic Survey*

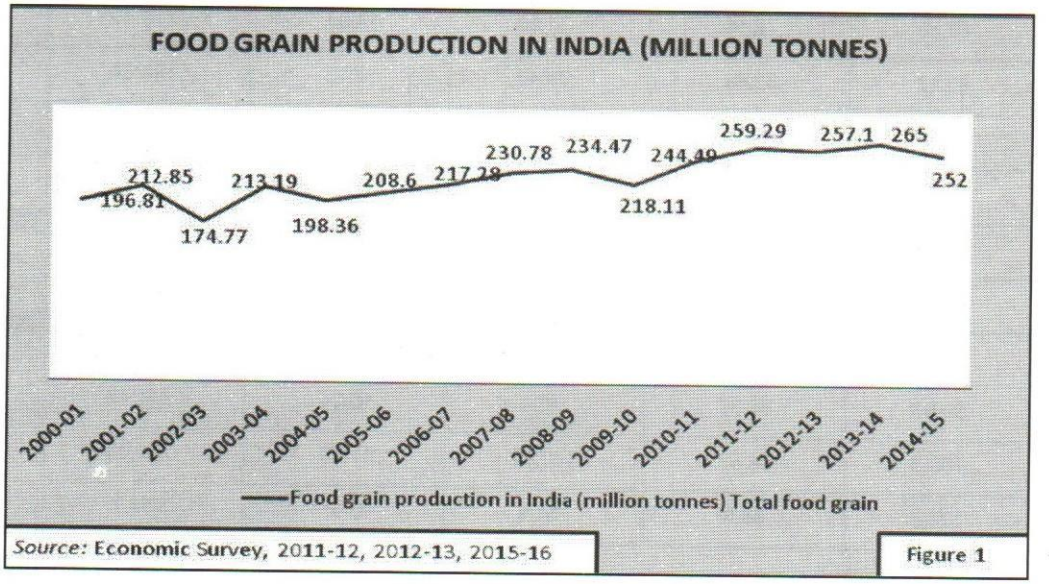
Food security depends on not only production but also the policies and institutions that put the drafts into action (food availability, accessibility and its utilization by the people). To make food accessible, the government has made certain food-based interventions — such as, Integrated Child Development Services (ICDS), Mid-Day Meal (MDM), Targeted Public Distribution System (TPDS), Antyodaya Anna Yojana (AAY), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) — to meet the needs of the poor and vulnerable sections of the society. The think tankers and the policy makers have recognized the need for effective and efficient research system for delivering the technology that makes the Indian agricultural system more competitive and helps to reduce the cost of production.

4.1. Public Distribution System (PDS)

Post-Independence, our country often had to face the shortage of food, which led to rapid food price inflation. In 1980, the Green Revolution ensured supply of food grains and the PDS, that evolved in 1950s and 1960s as a mechanism for providing price support to producers and food subsidy to consumers, gained strength. In 1992, the government introduced the Revamped Public Distribution System (RPDS) to provide essential commodities to the people living in remote rural and hilly tribal regions, in order to reach areas with high poverty incidence. Under this system people could buy essential items from Fair Price Shops (FPS) at low subsidized rates.

4.2 Targeted Public Distribution System (TPDS)

In 1997, TPDS was launched with specific focus on providing subsidized food and fuel to the poor through ration shops. The food grains that are distributed through TPDS are procured from the farmers at Minimum Support Price (MSP) and allocated to the states to be distributed through



Source: Economic Survey, 2011-12, 2012-13, 2015-16

Figure 1

a network of ration shops from where the beneficiaries can buy the necessities. The central government plays a prime role in implementing TPDS, whereas the states have the flexibility to change it as per their priorities. For example, in Tamil Nadu universal PDS has been implemented, in Chhattisgarh and Madhya Pradesh information technology has been used to streamline TPDS — ration card digitalization, GPS tracking of delivery, SMS-based monitoring, etc. (Balani, 2013).

TPDS at the time of its launch was intended to benefit around 600 lakh poor families for whom 72 lakh Million tonnes of food grains was earmarked annually and total BPL families were estimated at 596.23 lakh. With the shifting of the base to the population projection from 1995 to 1 March 2000, the total number of BPL families is 652.03 lakh. Since 1997, the release of food grains under TPDS for BPL families has been increased from 10 to 35 kg per family per month to enhance the food security programme and liquidate the surplus stock of food grains in the central pool of FCI (Annual Report 2014–15, pp. 50, 51, 57).

4.3 Implementing Food Security through National Food Security Act (NFSA) 2013

On 23 September 2013, the President of India Pranab Mukherjee gave the nod for making the National Food Security Bill (NFSB) an Act. This legislation is a landmark and is the largest food security programme ever initiated by any government in the world. The prime objective of this programme is to ensure that the majority of the Indian population has access to adequate quantity and quality of food at affordable prices. Through this Act the government seeks to make Right to Food a legal entitlement through existing TPDS mechanism for its delivery. Under the NFSA, 75 per cent of the rural and 50 per cent of the urban population are entitled to 5 kg food grains per month at Rs 3, Rs 2 and Rs 1 for a kg of rice, wheat and coarse grains (millets), respectively, for three years from enactment (Annual Report 2015–16, p. 38). The Act classifies the population into three categories: excluded (i.e., no entitlement), priority (entitlement), and AAY (higher entitlement) (Balani, 2013).

Table 3: Offtake of Food Grains (till November 2015)

Scheme TPDS	Offtake		
	Rice	Wheat	Total
AAY	33.49	7.39	40.88
BPL	57.85	17.48	75.34
APL	37.97	45.90	83.87
NFSA	73.19	90.86	164.06

Source: Ministry of Consumer Affairs, Food and Public Distribution, Annual Reports (p. 39, 2015–16).

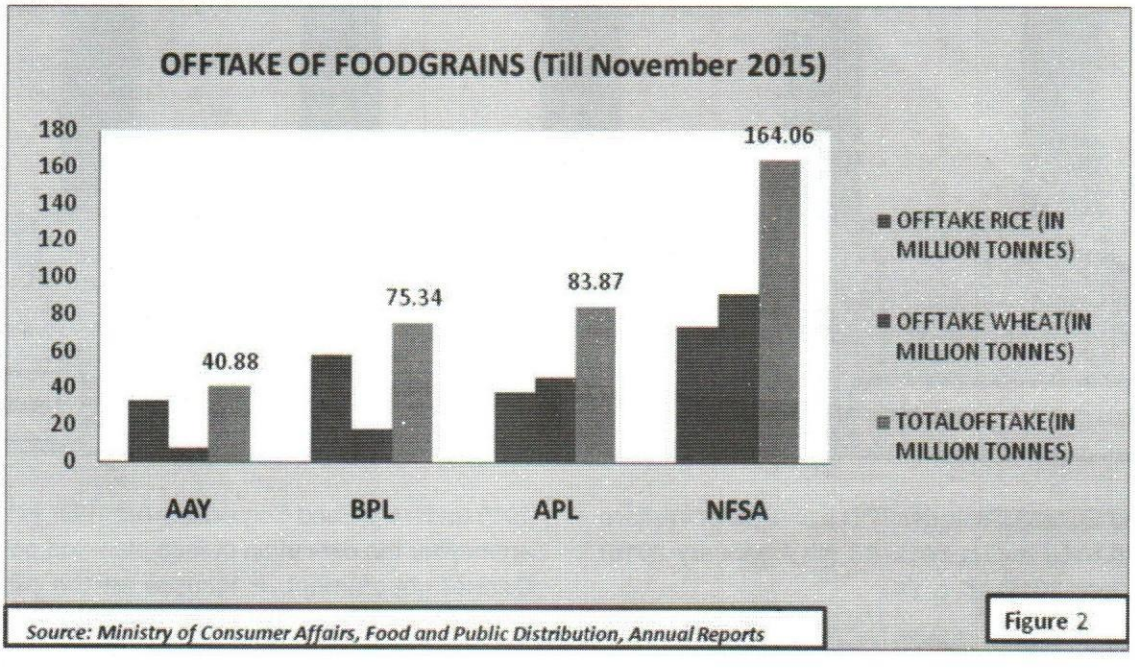


Figure 2

Under the NFSA, 61 million tonnes of food grains would be required consistently every year to deliver to the beneficiaries. In the year of low rainfall, India would have to resort to import of wheat and rice to meet the domestic demand. The Green Revolution made the country self-sufficient in food production, resulting in eliminating food import. Presently, 27 States/Union Territories have implemented NFSA — Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Daman & Diu, Delhi, Goa, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Lakshadweep, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Punjab, Rajasthan, Sikkim, Telengana, Tripura, Uttarakhand, Uttar Pradesh, West Bengal, Andaman & Nicobar and Meghalaya (Annual Report 2015–16, p. 38).

4.4 Present Scenario of Food Management in India

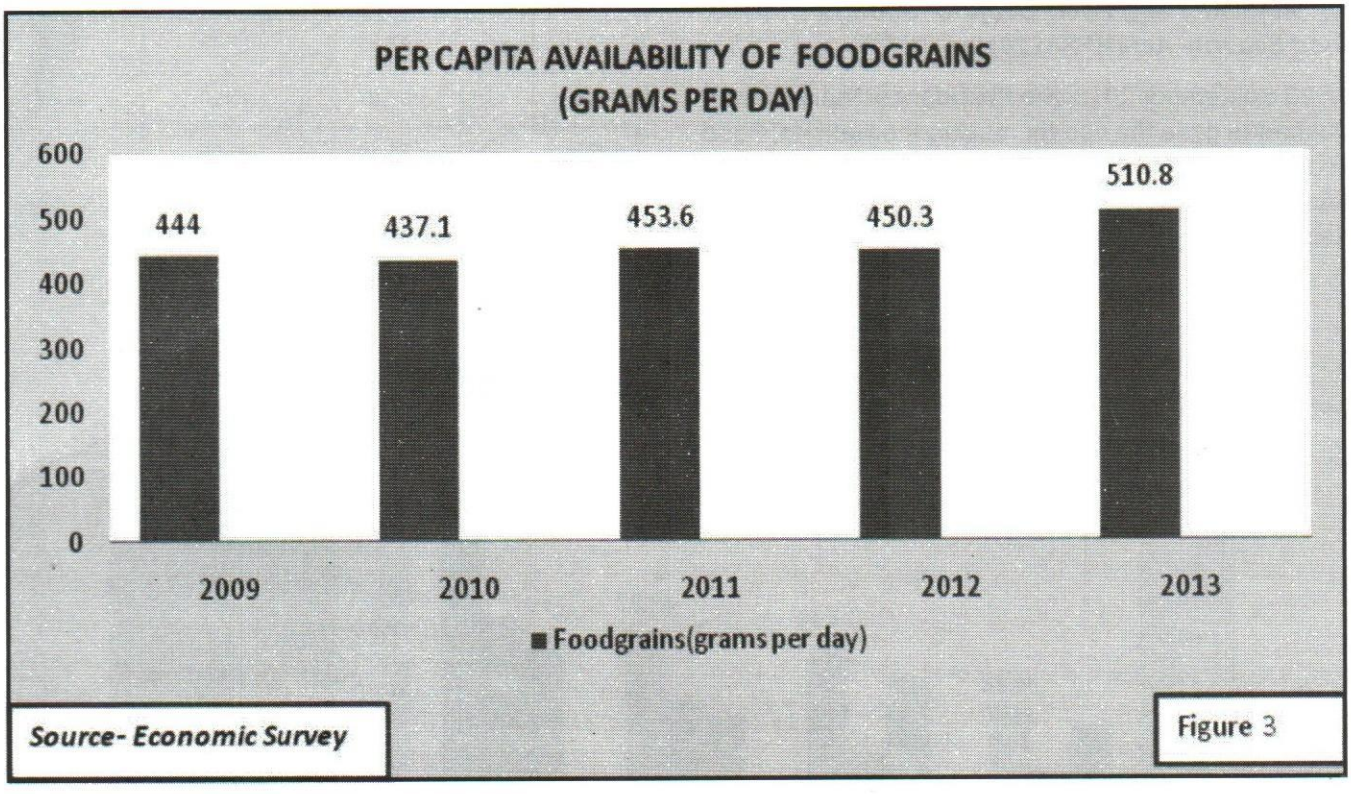
As per the data of Directorate of Economic and Statistics, the food production was 50 MT in year 1950-51, which went up to 264 MT in 2013–14. The data present a variation in the productivity level, which in turn affects the per capita availability. The per capita availability of food grains is given as follows:

Table 4: Per Capita Availability of Food Grains

Year	Food grains (grams per day)
2009	444.0
2010	437.1
2011	453.6
2012	450.3
2013	510.8

Source: Various issues of *Economic Survey* and Jain, (2016), p. 15.

The government is committed towards providing food and nutritional security through accessibility of adequate quality and quantity of food at affordable prices for a healthy and dignified living — 610.08 lakh MT of food grains were



allocated to States/UTs under TPDS and Other Welfare Schemes (OWS) during 2015–16 (till 4 January 2016) (Annual Report 2015–16, p. 24).

Food Corporation of India (FCI), which was set up in 1965 under the Food Corporation Act 1964, is the principal agency for the execution of food plan and policies of the Central government. It focuses on the procurement, movement, storage, distribution and sale of food grains. It

Table 5: Procurement of Wheat and Rice for Central Pool

Year	Wheat (in LMT)	Rice (in LMT)
2009–10	253.82	320.34
2010–11	225.14	341.98
2011–12	283.35	350.41
2012–13	381.48	340.28
2013–14	250.92	318.45
2014–15	280.23	149.18
2015–16 (as on 1 Jan 2016)	237.88	260.25

Source: Ministry of Consumer Affairs, Food and Public Distribution, Annual Reports (2013–14, 2014–15, 2015–16).

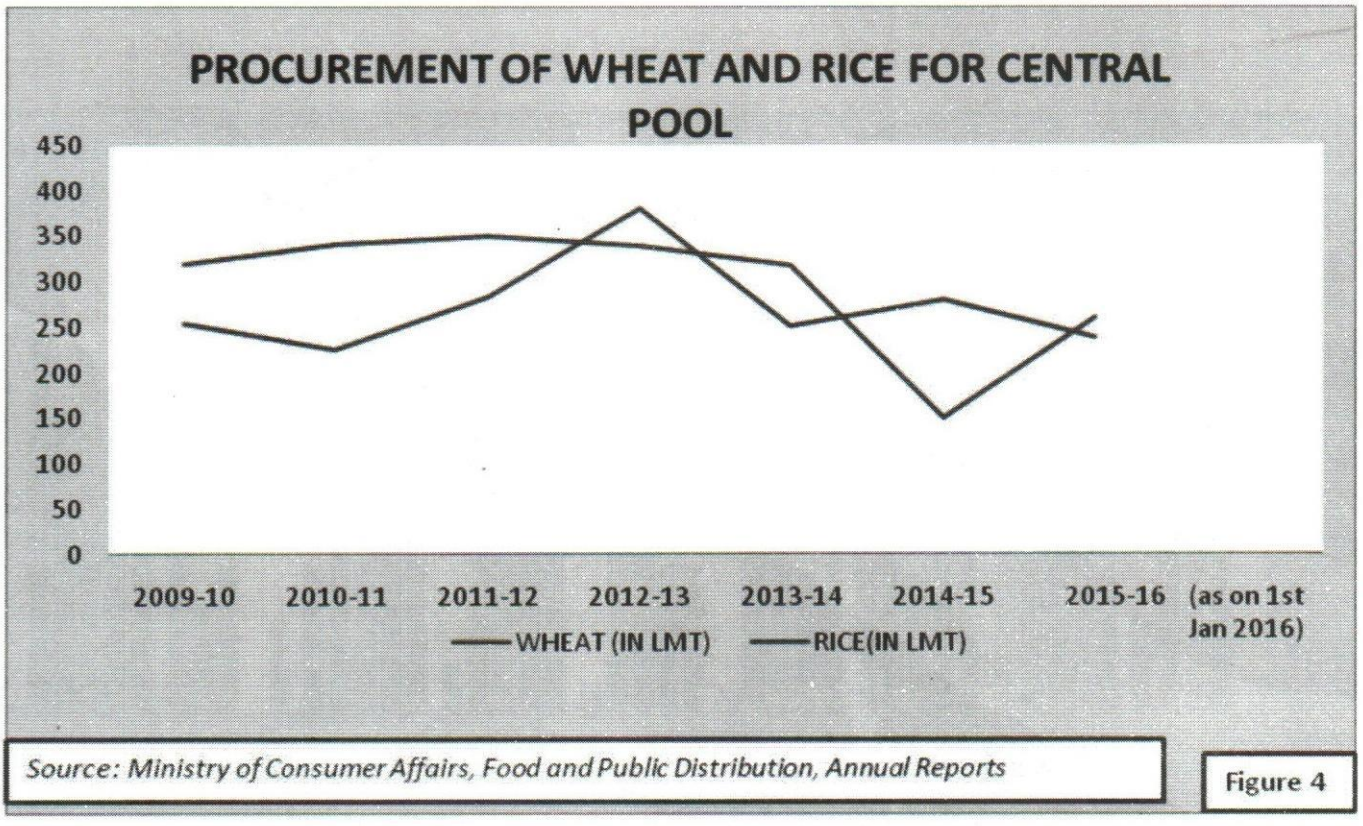


Figure 4

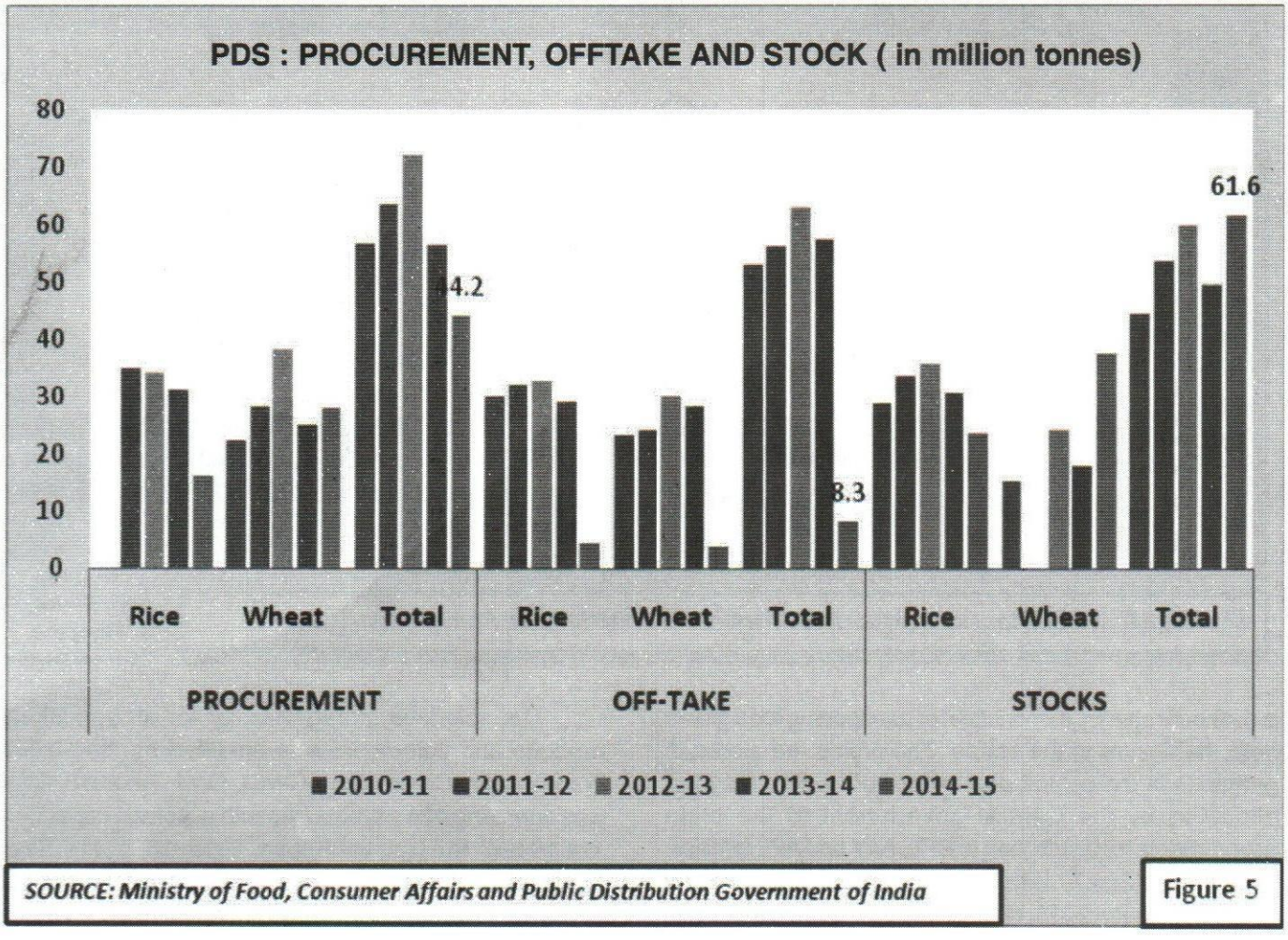
is the nodal agency responsible for transporting food grains from the Centre to the states. The grains are stored in granaries in the central pool stock from where they are allocated by the Central government to the state governments for distribution to BPL, AAY and APL families. The FCI has 364.77 lakh MT of food grains in its central pool, as on 1 Jan 2016, despite two successive monsoon deficits (Annual Report, 2015–16, p. 22).

The scientific storage facility for all agricultural produce and commodities is provided by the Central Warehousing Corporation (CWC). On 1 Jan 2016, CWC was operating 464 warehouses with a storage capacity of 114.10 lakh MT (Annual Report, 2015–16, p. 11). Since FCI and the state agencies are responsible for the procurement and selling of food grains to states at Central Issue Price (CIP), they are reimbursed by the Centre with

Table 6: Public Distribuion System: Procurement, Off Take and Stock Data (in Million Tonne)

Year	Procurement			Offtake			Stocks		
	Rice	Wheat	Total	Rice	Wheat	Total	Rice	Wheat	Total
2010–11	34.2	22.5	56.7	29.9	23.1	53.0	28.8	15.4	44.3
2011–12	35.0	28.3	63.4	32.1	24.2	56.3	33.4	20..0	53.4
2012–13	34.0	38.2	72.2	32.6	30.1	62.8	35.5	24.2	59.8
2013–14	31.3	25.1	56.4	29.2	28.2	57.4	30.6	17.8	49.5
2014–15	16.2	28.0	44.2	4.5	3.8	8.3	23.5	37.3	61.6

Source: Ministry of Food, Consumer Affairs and Public Distribution, Government of India



SOURCE: Ministry of Food, Consumer Affairs and Public Distribution Government of India

Figure 5

food subsidy, which is the difference between the cost (MSP plus transportation and handling costs) and the issue price at which the beneficiaries buy food grains (Balani, 2013, p. 7).

Table 7 shows the year-wise breakup of the subsidy released by the government to FCI and the states for distribution of food grains and buffer stocks (Annual Report 2015–16, p. 47).

The Table 7 exhibits that the quantum of subsidy given by the government to FCI and states has been rising year after year. It was '62,929.56 crore in 2010–11 and went on to increase to '10,7075.85 crore in 2015–16 (Annual Reports, 2015-16, p. 47).

Table 7: Subsidy Released by the Centre to FCI and States

Year	Subsidy Released		(Rs in crore)	
	FCI	States	Total	Annual Growth (per cent)
2010–11	50,729.56	12,200.00	62,929.56	8.05
2011–12	59,525.90	12,845.00	72,370.90	15
2012–13	71,980.00	12,574.00	84,554.00	16.83
2013–14	75,500.02	14,240.00	89,740.02	6.13
2014–15	91,995.35	21,175.81	1,13,171.16	20.15
2015–16	87,000.00	20,075.85	1,07,075.85	–

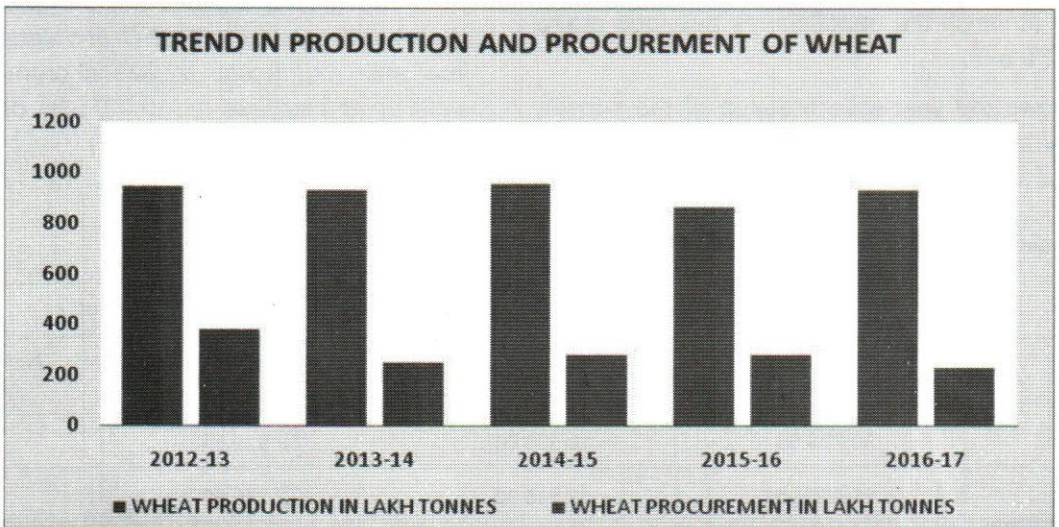
Source: Ministry of Consumer Affairs, Food and Public Distribution, Annual Report (2015–16), p. 47.

Under the NFSA, 80 crore persons have been covered out of the total intended coverage of 81.34 crore, as per the report of Ministry of Consumer Affairs (Food and Public Distribution, January–December 2016, p. 2). For the first time '2200 crore has been released to the state governments by the Centre to meet the expenditures incurred in intra-state movement of food grains (Food and Public Distribution, January–December 2016, p. 2). In 2016–17, 628.83 lakh MT of food grains were allocated to States/UTs for distribution under TPDS and other welfare schemes (Food and Public Distribution, January–December 2016, p. 3). In the same period, the central pool stock of FCI, 275.34 lakh MT of food grains were available — 155.89 LMT wheat and 119.45 LMT rice (Food and Public Distribution, January–December 2016, p. 5). The trend of production and procurement of wheat and

Table 8: Trend of Production and Procurement of Wheat

Year	Production (in lakh tonne)	Procurement (in lakh tonne)
2012–13	948.82	381.48
2013–14	935.01	250.92
2014–15	958.54	280.23
2015–16	865.27	280.88
2016–17	934.94	229.61

Source: Ministry of Consumer Affairs, Food and Public Distribution, Jan to Dec 2016, p. 14.



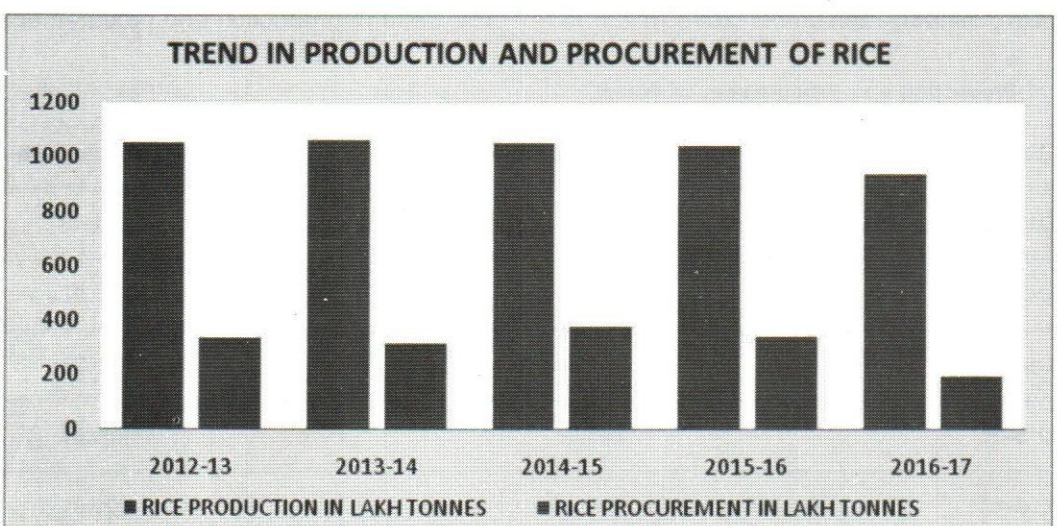
Source: Ministry of Consumer Affairs, Food and Public Distribution, "Significant initiatives and Achievements of Department of Food and Public Distribution" Jan 2016 to Dec. 2016 pg14

Figure 6

Table 9: Trend of Production and Procurement of Rice

Year	Production (in lakh tonne)	Procurement (in lakh tonne)
2012–13	1052.42	340.44
2013–14	1066.45	318.45
2014–15	1054.82	382.69
2015–16	1043.17	342.19
2016–17	938.8	196.87

Source: Ministry of Consumer Affairs, Food and Public Distribution, January to December 2016, p. 14.



Source: Ministry of Consumer Affairs, Food and Public Distribution, "Significant initiatives and Achievements of Department of Food and Public Distribution" Jan 2016 to Dec. 2016 pg14

Figure 7

rice by the FCI in the last 5 years has been shown in the tables 8 & 9 and figures 6 & 7:

4.4.1 Challenges

- There have been numerous reports of huge leakages in the TPDS from different states. In 2011–12, 46.7 per cent of the grains sent for distribution did not reach the intended beneficiaries (Standing Committee on Food, Consumer Affairs and Public Distribution, 2015–16, p. 14).
- Inaccurate identification of households to be covered under the NFSA. This responsibility of identifying households eligible for availing the benefits lies with the states, which they have failed to identify.
- There were many complaints related to under-weighing of food grains, errors and irregularities in AAY (a scheme launched in 2000 for the 'poorest of the poor') and TPDS (Standing Committee on Food, Consumer Affairs and Public Distribution, 2015–16, p. 140).
- According to an analytical report by Sakshi Balani (2013, p. 2), 'PDS suffers from nearly 61% error of exclusion and 25% inclusion of beneficiaries, i.e. the misclassification of the poor as non-poor and vice versa.'
- Decentralized procurement is required owing to the shortage of technical staff in the state governments.
- There is a requirement for staff training for skill development or short-term training for officers to tackle hurdles efficiently.

v Studies have shown that there are ghost cards (cards made in the name of non-existent people (Balani, 2013, p. 7), which divert the food grains from deserving households to the open markets.

4.4.2 Steps Initiated to Overcome Challenges

- Number of steps initiated by the Department of Food and Public Distribution (DFPD) included setting up of a grievance redressal mechanism to smoothen the delivery process.
- The High Level Committee (HLC) suggested that the states implementing NFSA must first improve their PDS by introducing biometric and unique identifier (UID) to bring in more transparency in the delivery mechanism. The JAM trinity (issue of Jhan Dhan, Aadhaar and Mobile) has been introduced to check leakages in APL category. Direct transfer of food subsidy will be made in the accounts of the beneficiaries. But it all requires computerization of the TPDS system, which is lagging way behind the banks and the railways (Standing Committee on Food, Consumer Affairs and Public Distribution, 2015–16, p.15)
- The need is to prioritize those crops that suit the agro-climatic region of our country so that higher net return can be achieved through crop diversification.
- For preventing leakages and improving identification, a Unique Identification Number (UDN) has been introduced for cash transfer.
- Digitalization of ration cards has been done in 34 states/UTs, with over 24 crore ration cards digitalized and over 10.10 crore have been linked with Aadhar. At present 27 States/UTs have implemented the NFSA.
- The aim is to meet the monthly allocation in Northeastern states despite adverse climatic conditions. Law and order problems are being tackled and all possible steps are being taken by the FCI to make food grains available for distribution.
- Online allocation of food grains has been implemented fully in 29 states (Food and Public Distribution, January–December 2016, p. 22).
- 1,77,391 Fair Price Shops (FPS) and automated (POS) devices have been installed across the country (Food and Public Distribution, January–December 2016, p. 22).
- A strong monitoring system, GPS/GPRS-based tracking of PDS vehicles, IT-based centralized solutions have been set to minimize the flaws and bring more transparency.
- Lack of accountability in the supply chain of PDS is one of the causes behind inefficiency of the system.
- A quality control mechanism has been adopted for strengthening the quality of food grains at the time of procurement, storage and distribution so as to avoid damages or losses.

4.5 Issues that need to be addressed

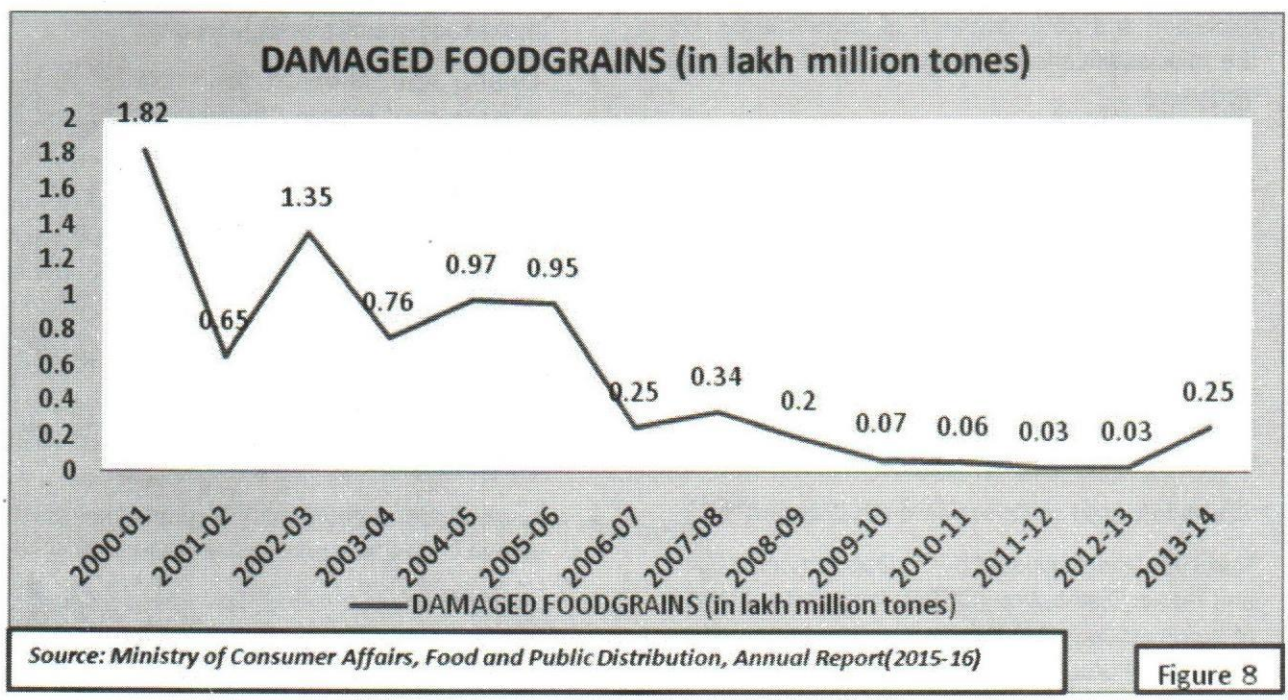
During 1999 to 2000, a total of 2,05,250 tonne of food grains was accounted as damaged, which had cost more than '185 crore to the government (*The Hindu*, 20 December

2000). The problem of food grains going stale has posed a big challenge for the FCI and a matter of concern for a country where thousands of people go to bed hungry. According to FCI data (2 May 2016), 46,658 tonne of food grains rotted in 1,889 warehouses in the last three years, while 143.74 tonne were reported as stolen. This huge amount would have fed nearly 8 lakh people from priority families under NFSA for an entire year. Public sector food grain stocks are a significant support to NFSA. FCI being the key agency procures, stores and distributes the food grains to the people. In addition to the requirement of wheat and rice for TPDS, a central pool is required to have sufficient stock to meet the emergencies of drought, crop failure, etc. To meet the requirements of PDS and other welfare measures, a minimum amount of food grains are required to be kept in the central pool as buffer. To solve the problem of huge cost of storage, interest on value of produce and wastage buffer stock has been maintained. This stock is also used to absorb the shocks due to production variation and other climatic challenges. Table 10 exhibits data related to damaged food grains. Owing to various quality control moves there has been a sharp decline in the quantity of damaged food grains in FCI. It was 1.35 lakh MT in 2002–03 to 0.25 lakh MT in 2013–14 (31 March 2014).

Table 10: Damaged Food grains in FCI Godowns

Year	Damaged Food grains (in lakh Million Tonne)	Year	Damaged Food grains (in lakh Million Tonne)
2000–01	1.82	2007–08	.34
2001–02	.65	2008–09	.20
2002–03	1.35	2009–10	.07
2003–04	.76	2010–11	.06
2004–05	.97	2011–12	.03
2005–06	.95	2012–13	.03
2006–07	.25	2013–14	.25

Source: Ministry of Consumer Affairs, Food and Public Distribution, Annual Report (2015–16).



Source: Ministry of Consumer Affairs, Food and Public Distribution, Annual Report(2015-16)

Figure 8

To avoid rotting of food grains, the government has taken steps for safe and scientific storage of food grains, which are procured on the basis of uniform specifications formulated by the government. The food grains in the FCI godowns are regularly monitored and inspections are carried out. The government has made certain rules to be followed by the FCI and the state agencies for proper upkeep and quality control to avoid rotting or damage of food grains in the central pool stock. But in spite of all the precautionary measures, some quantity of food grains does

get damaged or non-issuable for public distribution due to varied reasons, such as storage pest attack, leakages in godowns, procurement of poor quality stocks, exposure to rains, floods, negligence by the concerned authorities, etc. The data in Table 11 reveal the quantum of food grains becoming non-issuable in the FCI godown.

Table 11 shows that there has been continuous decrease in the damaged or non-issuable food grains in FCI, reflecting on the measures taken by the authorities to minimize the losses. The total storage capacity of the central pool stock of food grains is about 812.09 lakh MT,

Table 11: Non-Issuable Food grains in FCI

Year	Damaged/non-issuable food grains (in tonne)
2010–11	6,346
2011–12	3,338
2012–13 (upto 1 Feb 2013)	1,454

Source : FCI Annual report

which stood at 364.77 lakh MT as on 31 December 2015 (Food and Public Distribution, January–December 2016, p. 23). In January 2016, the current buffer norms were revised and according to the new norms the central pool comprises:

Table 12: Buffer Stock in Central Pool

	2015	2014
1 July – Rice	41.1 MT	32 MT
1 Oct – Wheat	30.7 MT	21 MT

Source: FCI Annual report

FCI buys almost one-third of the total rice and wheat produce in the country at MSP — buffer stock is important to ensure national food security. In 2015, granaries of FCI overflowed with wheat and rice as it was stocking much higher than the buffer stock norms. This resulted in not only rotting of food grains but also high carrying costs.

Table 13 shows that the off take of food grains was 160.90 lakh MT in 2011–12, which went up to 168.99 lakh MT in 2012–13, but in 2013–14 and 2014–15 there was fall in the total off take of food grains by APL families,

Table 13: Food grains Allocation and Offtake of Food grains

Year	Food grain allocation (lakh tonne)	Offtake of food grains (lakh tonne)
2011–12	211.99	160.90
2012–13	227.91	168.99
2013–14	202.68	156.39
2014–15 (upto Feb)	125.43	96.16

Source: Standing Committee on Food, Consumer Affairs and Public Distribution, Eighth Report, 2015–16, p. 12.

because of which these families were not covered under NFSA 2013.

FCI has been continuously trying to reduce the buffer stock. As on 1 August 2016, it had 39.65 MT of food grains (least that it has ever held in the past 6 years) and in 2013 it was 59.75 MT, which was more than double of the buffer stock (*Times of India*, 'Grains rotting with FCI could have fed 8L for a year', 2 May 2016). The government and FCI data for food grain spoilage and wastage are appalling when we look at our country ranking in the Global Hunger Index.

Food leakages had been one of the biggest challenges before implementing authorities like NFSA. The TPDS has been criticized for misappropriation, inefficiency, negligence and high level of leakages, thereby causing heavy losses to the government who is committed towards social objectives.

5. Analysis

From the data gathered through various sources it has been found that in India food grain production was 196.81 MT in 2000–2001 which increased to 234.47 MT in 2008–09 and further to 264.4 MT in 2013–14. The use of new techniques, seeds, fertilizers and irrigation methods have resulted in surplus food grains. As per the statistics for food grains required (Table 4) per day, it has gone up from 440 gm per person per day in 2009 to 510.8 gm per day in 2013. To liquidate the surplus food grains lying with the FCI, which due to mismanagement were either stolen or wasted, the food grains issued to BPL families under TPDS has been increased from 10 to 35 kg per family per month. As mentioned earlier, NFSA now covers about 80 crore persons against the total intended coverage of 81.34 crore.

With the government taking measures to minimize wastage and make FCI godowns more scientific, the quantum of wastage has declined. The quantity of damaged/non-issuable food grains in FCI has come down from 1.35 lakh MT in 2002–03 to 0.115 lakh MT in the year 2014–15. In terms of percentage, damaged/non-issuable stock in FCI has come down from 0.10 per cent in 2007–08 to 0.04 per cent in the year 2014–15 (Annual Report 2014–15, p. 25). FCI is the nodal agency to be assigned the herculean task of execution of food plan and policies of the central government. The annual reports of the FCI show that it has been successfully carrying out the procurement, storage, distribution and sale of food grains to various states to be distributed to BPL families through PDS. The government is committed towards making NFSA a success and is making all efforts for its successful implementation through FCI.

6. Conclusion

In spite of remarkable food production in the recent decades, complete food security has not been accomplished. Millions of poor people suffer from persistent hunger and malnutrition. The government admitted that 2.255 lakh tonne of food grains had rotted in the godown of FCI. The data of food production in India shows that there are ample food grains but lack of proper food management and its distribution hinders its flow to the people. Various initiatives and steps have been taken by the government and the agencies to successfully implement the food security programmes. Right to Food Act is a significant contribution by the government towards humane and accountable governance. A report by National Centre for Agricultural Economics and Policy Research (NCAP) states that India will require 280.6 MT of food grains, 130 MT of rice and 110 MT of wheat by 2020. Our country is self-sufficient in food grains, however, a well-chalked procurement, allocation and distribution system will minimize the wastages and enable the government to redeem its pledge to provide sufficient food to its citizens. The need is to sincerely work to enable the government machinery to provide the benefits to the beneficiaries and make the objective behind national food security a success.

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"If a free society cannot help the many who are poor and food insecure, it cannot save the few who are rich."

– John F Kennedy

Targeted Public Distribution System in Himachal Pradesh: A Gateway to Food Security

SHYAM KAUSHAL AND RAKESH KUMAR

Food security determines the health and capacity-building of the citizens, which contributes to growth and development of a nation and vice versa. In underdeveloped or developing countries the State plays a pivotal role in providing two meals a day. The present paper is an attempt to examine the working of targeted public distribution system in Himachal Pradesh, a hill state. It has been found that the system has enhanced its coverage through well-thought-out distribution channels and networks over the years, contributing significantly to the wellbeing of poor people.

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1. Introduction

Food security implies that enough nutritious food is available for all citizens, who should have the capacity to buy food of acceptable quality and there are no barriers in access to food. India, being the second-most developing nation and one of the largest producers of food in the world, still faces these challenges as nearly 300 million people struggle to get two meals a day, and around 21 per cent of the national population (230 million) is malnourished. To face the challenge of ensuring nutritious food for all, the government has been taking various steps and implementing many programmes, one of these is the public distribution system (PDS). The programme has been implemented to provide essential commodities to all sections of the society especially the poor. It was revamped in 1997 to improve its functioning and become more focused. It was renamed as targeted public distribution system (TPDS) on 1 June 1997. TPDS focuses on poor in all areas and envisages issue of 10 kg of food grains per family per month for the population below poverty line (BPL) at special subsidised rates. TPDS was introduced in June 1997 and assists states to formulate and implement foolproof arrangements for identification of poor, effective delivery of food grains to fair price shops (FPS), and its distribution in a transparent and accountable manner at FPS level. The PDS has been functioning for decades in the country, including in Himachal Pradesh, but has still been unable to cover the 100 per cent targeted population and deliver quality service.

Various studies such as the one by Bhatia (1970) examined several aspects of food in India, like problems faced and price control. He observed that PDS provides essential commodities at reasonable prices to weaker

sections of the society. Bahl (1974) explained that the main objective for establishment of PDS was to provide essential commodities to weaker sections of the society and observed that PDS achieved a limited objective of assuring equitable distribution of available supplies to the poorer sections. Paul (1980) identified its problems as inadequate supply of food grains and low quality. Kanwar (1985) proposed to set up a state civil supplies corporation and suggested that PDS should operate through co-operative societies at retail level. Jha (1992) reported that the tribal consumers complained about general shortage of essential commodities at FPSs. Dev & Ranade (1998) found that PDS is contributing to solve the problem of malnutrition but delivery system is poor in rural areas. Raghuvanshi & Sohane (1998) reported that TPDS has added to food security for the poor. Sharma (1999) observed that co-operatives are the best instruments to promote social justice and prevention of exploitation at the grass root level, especially for the weaker sections. Sundaram (2000) identified four major problems — bogus ration cards, inadequate storage arrangement, ineffective functioning of the vigilance committee and failure to issue ration cards to all eligible households under PDS. Dreze (2004) advocated that the right to food should be seen as a right to nutrition, as in Article 47 of the Constitution. He observed that this right is essential to achieve 'Economic Democracy' and found that underwritten level in India was one of the highest in the world. Pattanaik (2004) examined PDS in Himachal Pradesh and concluded that it helped in eradication of rural poverty and inequality by providing justice to the poor in the state under the Minimum Needs Programme (MNP) in the Seventh Five-Year Plan. Asthana (2008) suggested monitoring the distribution of grains and selection of BPL families, and ensuring good quality of food items. Deb (2009) suggested distributing computerized ration cards to all cardholders. Das (2010) found problems in implementation of PDS — leakage in delivery mechanism, with the result that food grains are often not received by the beneficiaries. He gave suggestions — issue of food coupons, introduction of IT-based initiatives through computerization of TPDS, introduction of smart card delivery of food grains, etc. Hazra (2011) suggested that the government should encourage increased investment in agriculture, expand safety nets and social assistance programmes and enhance income-generating activities in rural areas. Khera (2011) found that irregular supply of food grains and the problem of malpractices and corruption in PDS in India has been affecting the success of TPDS in reality. B.S. Sawant (2013) suggested how to make PDS effective to ensure timely supply of commodities with good quality, fix the number of cardholders under FPS and establish complaint redressal mechanism for the common people. Gupta (2014) concluded that TPDS played a vital role in reducing poverty in the state. Fernandes (2014) studied that PDS is facing many problems such as poor quality of food grains, irregular supply, irregular FPS timings, inadequate storage and lack of administration from top to lower level. Kispotta (2015) suggested making PDS successful through effective control in allotment, making everything computerized, establishing a call centre for complaints and a public participation website. Rajendran (2015) suggested making PDS effective by improving agricultural productivity and making storage mechanism efficient.

From the studies it is clear that TPDS is suffering from unavailability of rations on time, poor quality of grains, improper selection of BPL families, lack of purchasing power among the poor, fraud ration cards, unsuitable location of FPSs, poor storage capacity and inadequate space of FPSs. However, studies still lauded the role of TPDS in enhancing social justice and ensuring food security for the common as well as the deprived, in particular. To improve its functioning, authors suggested proper selection of BPL families, computerized ration cards and scientific management of FPS. Timely availability of rations and quality of grains needs the attention of the government. Thus, more research and debate on such relevant topics of mass interest deserve additional attention of administrators and academics. The present paper is also an endeavour in this direction.

2. Objectives and Methodology

Present study has been carried out to scan the functioning of TPDS in Himachal Pradesh. The study is based on secondary data taken from books, journals, magazines, newspapers and primary data has been collected from various office circulars/records.

3. TPDS in Himachal Pradesh: An Appraisal

Himachal Pradesh is one of the provincial and developing states in India. Although it was declared a state in 1971, it had been developed since its independence. TPDS in the state was implemented since its inception, and it contributes in lifting the living standard of the people.

Geographically, Himachal Pradesh is a hilly state. The living conditions are quite difficult here. About 70 per cent of the population is engaged in agriculture and its allied activities. Being a hilly area, the production of food grains is limited as it depends on timely rainfall and weather conditions. Therefore, to provide sufficient food materials and other necessary products to the people is a real challenge for the Government of Himachal Pradesh. It has to arrange adequate amount of food grains and other essential commodities required well in advance. So TPDS has a very important role to play in a state like Himachal Pradesh. Another tough challenge for the state government is to bring these arranged commodities within the reach of the people living in remote areas. In Himachal Pradesh, Department of Cooperative and Food and Supplies and Himachal Pradesh Civil Supplies Corporation are undertaking the function of providing food grains and other essential commodities through TPDS.

A strong network plays a vital role in the success of any scheme/plan or system. Therefore, all agencies involved in PDS are responsible for taking this system to the real beneficiaries or weaker sections of the society. Initially all functions of PDS were performed by Cooperatives and Food and Supplies Department. In 1966, the Department was divided into two branches — department of co-operatives and department of food and supplies. These two departments remained responsible for all activities of PDS, from procurement to distribution, till 1980. A third agency, Himachal Pradesh State Civil Supplies Corporation Limited (HPSCSC), was involved in the functioning of PDS in the state in early 1980s. The HPSCSC was established under the Companies Act, 1956. The Corporation was established to reduce the workload of food and supplies department and to improve the working of PDS in the state.

3.1. TPDS and Food and Supplies Department

The main function of food and supplies department is to make adequate arrangement for procurement of food grains and other essential commodities on the basis of each district's requirements. The department also plays a vital role in the distribution of commodities to actual deserving beneficiaries and making PDS a success. It identifies the needy people with the help of district administration, gram panchayats and municipal corporations/committees. The district administration identifies the people in the urban area, whereas in the rural area the gram panchayats and Rural Development Department (RDO) perform this task. The department also takes care of all legal requirements and procedures to issue ration cards. In the state, which consists of 11.34 lakh APL (above poverty line) cardholders, 30.1 lakh BPL (below poverty line) cardholders and 1.96 lakh AAY (Antyodaya Anna Yojana) cardholders as on 31 March 2015 (www.himapurti.gov.in), the task is a bigger challenge. Another important role of the department in the success of PDS is to monitor the working of FPSs. The department is the only competent authority to issue licences to FPSs. A dealer can start an FPS only after getting a licence from the department. In addition to this, the department also keeps a regular check on the functioning of the FPSs. For this purpose, from time to time the officials inspect the FPSs.

3.2. TPDS and HPSCSC

The HPSCSC shares the workload of food and supplies department in Himachal Pradesh. The primary function of HPSCSC is that of a Central Procurement Agency for all the controlled and non-controlled essential commodities identified by the central and state governments under PDS at wholesale level. The Corporation procures most of the commodities from Food Corporation of India (FCI) or from the mills at wholesale rate for the entire state. These commodities are distributed to District Cooperative Federation and Tehsil Cooperatives Union as per the requirement of the district or tehsil. The federation or unions further distribute these commodities to FPSs. As on 31 March 2015, the Corporation owned 108 FPSs in the state, out of the total 4802. Its means 2.24 per cent of the total FPSs are in the most remote areas of the state where they are run by the Corporation. The Corporation has also been entrusted to undertake trading, storage, movement and distribution of other essential commodities, which may be required as per demand by the consumers in general, so as to ensure their availability in the open market at reasonable prices. The Corporation is playing an important role in transporting food grains/essential commodities to the real beneficiaries in the state.

The progress of the PDS in the state has been quite encouraging with the establishment of this Corporation whose sales turnover has increased manifold over the years. The sale of the Corporation over the years has been presented in Table 1.

Table 1: Sale Performance of Himachal Pradesh State Civil Supply Corporation

Year	Sales (Rs in lakh)	Percentage Increase over Previous Year
1981–82	1,427.57	
1982–83	2,625.70	83.92
1983–84	3,001.85	14.32
1984–85	3,695.35	23.10
1985–86	4,517.17	22.23
1986–87	4,818.60	6.67
1987–88	6,392.66	32.66
1988–89	6,842.68	7.04
1989–90	6,161.07	
1990–91	7,975.22	29.42
1991–92	9,608.89	20.48
1992–93	10,953.82	14.00
1993–94	13,241.08	20.88
1994–95	13,766.74	3.97
1995–96	14,342.36	4.18
1996–97	19,280.10	34.42
1997–98	21,359.53	10.78
1998–99	26,541.05	24.26
1999–00	23,886.13	– 10.00
2000–01	21,568.20	– 9.70
2001–02	29,936.05	38.80
2002–03	31,134.83	4.00
2003–04	37,328.55	19.89
2004–05	41,863.20	12.15
2005–06	50,398.29	20.39
2006–07	56,865.93	12.83
2007–08	80,492.91	41.55
2008–09	91,559.44	13.75
2009–10	1,01,936.50	11.33
2010–11	1,07,330.00	12.73
2011–12	1,11,120.61	3.53
2012–13	1,12,192.02	0.96
2013–14	1,21,609.86	8.39

Source: HP State Civil Supplies Corporation Limited, Shimla Status Report, 2015 p. 12, www.himapurti.gov.in/reports/statusreport 2015.

Table 1 shows that sales of HPSCSC have increased over the years. The total sale of the Corporation was 1,427.57 lakh in 1981–82, which rose to 12,1609.86 lakh in 2013–14, thus contributing significantly to the society and ensuring food security.

3.3. TPDS and Cooperative societies

Another agency involved in PDS is cooperative society. During the first Five-Year Plan, the system had a narrow scope — to supply food to the urban and food-deficit areas. The other essential commodities like sugar, kerosene, etc., were added in Second Five-Year Plan. The PDS has evolved as a market intervention mechanism for price stabilization, and introducing private trading system and extending the coverage of consumer cooperatives. Cooperative societies have played a vital role in the success of PDS in Himachal Pradesh. Cooperative sector in Himachal Pradesh has already contributed to the social and economic uplifitment of the people. The cooperatives since then have been dealing in both controlled and non-controlled items. On 31 March 2015, out of 4,802 FPSs, 3,181 were owned by cooperative societies in Himachal Pradesh (Economic Survey of Himachal Pradesh, 2014–15, p. 35).

4. Fair Price Shops in Himachal Pradesh

The entire population of the state has been covered under the TPDS. It is being implemented through a network of FPSs. There are 4,802 FPSs as on 31 March 2015. The sector-wise breakup of these shops is given in Table 2.

Table 2: Ownership-wise Distribution of Fair Price Shops in Himachal Pradesh

Ownership	2001	2015
Cooperatives	2,868	3,181
Panchayats	54	37
HPSCSC	126	108
Individuals	879	1,469
Mahila Mandals	3	7
Total	3,930	4,802

Source: Compiled from Economic Survey 2001–02, 2015 & Himapurti Food, Civil Supplies and Consumers Affairs Department, p. 1.

Table 2 shows that largely FPSs are run by cooperatives societies in the state. The minimum number are run by mahila mandals. Only 2.2 per cent (108) are run by HPSCSC, and 97.7 per cent (4694) are run by cooperatives societies, panchayats, individuals and mahila mandals. The state government is providing more employment opportunities to private depot holders. In comparison to 2001, it has been noted that panchayats are withdrawing from running FPSs and mahila mandals were also not very enthusiastic about it, but cooperatives and individual owners emerged as the major players.

Table 3 shows that in the rural areas maximum FPSs are in district Kangra, and highest in urban areas are in district Shimla, as compared to others districts. Only 7 per cent (319) FPSs are run in urban areas and 93 per cent (4,443) are run in rural areas in the state. However, almost all districts have indicated an increase in the number of FPSs over the years, in both rural and urban areas. Thus, it must have expanded the coverage and convenience to target beneficiaries and consequently more food security to the citizens.

5. Ration Cards and Essential Commodities Distribution in Himachal Pradesh

There are 16,32,836 families registered under TPDS in Himachal Pradesh and their distribution in different categories — APL, BPL and AAY — is given in Table 4. In order to streamline TPDS, the poorest of the poor 1,96,638 families in the BPL list have been identified and placed under the AAY scheme .The Government of India has been allocated 3942 MT wheat and 2953 MT rice per month. The scale of issue per family as per the norms is 35 kg of food grains per family per month. Himachal Pradesh has alloted 20 kg of wheat and 15 kg of rice per family. The retail issue price is Rs 2 for wheat and Rs 3 for rice in a month.

Table 4 represents APL/BPL/AAY families in the state — maximum APL families are in Kangra and minimum in Lahaul and Spiti; most BPL families are in Kangra and least are in Kinnaur; highest number of AAY families are in Kangra and lowest in Lahaul and Spiti. As per Table 4, BPL families are 18.4 per cent, APL families 69.4 per cent and AAY families 11.7 per cent out of the total number of families, and as compared to other states the poverty ratio is less in Himachal Pradesh. When comparing 2003 and 2015, Table 4 exhibits clear increase in beneficiaries in all groups, but it has been the highest in AAY — more than double. But the number of APL families in the state is highest as compared to other groups availing benefits of various schemes.

Table 3: Districts-wise Fair Price Shops in Himachal Pradesh

S. No.	District	Urban 2003	Rural 2003	Total 2003	Rural 2013	Urban 2013	Total 2013
1	Bilaspur	8	177	**185**	209	12	**221**
2	Chamba	19	357	**376**	467	18	**485**
3	Hamirpur	29	256	**285**	265	26	**291**
4	Kangra	42	826	**868**	975	41	**1,016**
5	Kinnuar	0	56	**56**	56	—	**56**
6	Kullu	20	341	**361**	400	31	**431**
7	Lahaul-Spiti	0	56	**56**	66	—	**66**
8	Mandi	34	569	**603**	722	33	**755**
9	Shimla	60	426	**486**	460	64	**524**
10	Sirmour	19	336	**355**	298	24	**322**
11	Solan	38	232	**270**	258	43	**301**
12	Una	32	231	**263**	267	27	**294**
	Total	301	3,863	**4,164**	4,443	319	**4,762**

Source: Directorate of Food and Supplies of Himachal Pradesh.

Table 4: APL/BPL/Antodaya Families in Himachal Pradesh

	District	2003				2015			
		APL	BPL	AAY	Total	APL	BPL	AAY	Total
1	Bilaspur	62,099	13,676	4,791	80,566	55,769	18,169	12,272	86,210
2	Chamba	44,222	35,100	12,959	92,281	63,876	32,825	31,999	1,28,700
3	Hamirpur	82,718	15,746	5,539	1,04,003	85,339	20,626	13,318	1,19,283
4	Kangra	2,44,078	48,012	17,583	3,09,673	2,62,601	67,936	43,339	3,73,876
5	Kinnaur	16,847	2,105	791	19,743	12,648	4,293	1,790	18,731
6	Kullu	71,811	8,641	3,137	83,589	63,760	17,653	7,720	89,133
7	Mandi	1,76,191	31,824	11,550	2,19,565	1,83,103	46,101	28,970	2,58,174
8	Shimla	1,19,987	23,678	8,730	1,52,395	1,30,310	31,440	21,249	1,82,999
9	Sirmaur	64,826	11,420	3,775	80,021	85,569	20,545	10,138	1,16,252
10	Solan	79,266	14,032	4,933	98,231	98,913	20,421	12,813	1,32,147
11	Una	85,072	13,474	4,240	1,02,786	86,669	20,843	11,640	1,19,152
12	Lahaul & Spiti	5,231	1,773	672	7,676	5,684	1,095	1,400	8,179
Total		10,52,348	2,19,481	78,700	13,50,529	11,34,061	3,01,947	1,96,638	16,32,836

Source: Himapurti Food, Civil Supplies and Consumers Affairs Department, 31 March 2015, pp. 1–2.
Food & Civil Supplies Department, Govt of HP, 30 November 2003, p. 264.

Table 5: Distribution of Essential Commodities under TPDS in Himachal Pradesh

S. No.	Name of Commodities	2001–02 (in MT)	2014–15 (in MT)
1	Wheat/Atta APL	9,041	1,87,428
2	Rice APL	4,116	85,535
3	Wheat BPL	19,672	24,279
4	Rice BPL	22,671	22,035
5	Wheat AAY/NFSA	9,400	1,17,266
6	Rice AAY/NFSA	13,570	81,716

Table 5 presents major commodities and their distribution in 2014–15 as compared to 2001–02. Comparative analysis shows that essential commodities' distribution has expanded a lot over the years till 2015, especially in favour of APL families, whereas surprisingly there was fallout with regard to BPL beneficiaries. It could be attributed to misuse of cards, fraud cards, etc. However, it may be concluded that TPDS has expanded its coverage even more, to all deprived and weaker sections of society effectively as its cherished objectives. It may also be inferred that wheat is the most preferred commodity under TPDS in Himachal Pradesh.

6. Quality Control and Enforcement

The department ensures in all probability that a Fair Average Quality (FAQ) of food grains and their products is provided to the consumers under TPDS and all other welfare schemes. The technical staff members conduct regular and periodical checking and suggest remedial measures and safe preservation of food grains. However, this is a critical aspect of TPDS, which needs more attention and teeth.

To ensure the availability of essential commodities at reasonable rates, the following actions were taken by the department officer/officials as inspection targets. The details are given in Table 6.

Table 6: Enforcement Activities Undertaken

	Department Officials	Number of Inspections
1.	District Controller	25 per month
2.	District Inspector	30 per month
3.	Inspector	37 per month

Details regarding the inspections/checking done during the period 1 April 2014 to 31 March 2015 are shown in Table 7.

Table 7: Enforcement Actions Undertaken

	Particulars	Numbers
1.	Number of Inspections	32,925
2.	Cases registered	1
3.	Departmental actions	2,343
4.	Written Warning issued	1,115
5.	Amount of security forfeited	Rs 17,19,848
6.	Amount of goods confiscated in money terms into the State exchequer	Rs 41,49,329

In order to check hoarding, profiteering and other malpractices in the open market, the department is vigorously enforcing various controls and acts and exercising strict vigil to ensure that no undue price rise takes places in the state. However, this dimension of PDS needs to be given special attention so that the needy get fair treatment.

7. Observations and Conclusions

Himachal Pradesh is primarily a hilly state where majority of the population lives in villages and difficult to reach areas, facing various hardships to get two meals a day. Thus, TPDS has a vital role to play. The state has 16,32,836 families (APL, BPL, AAY) under TPDS at present but the number is increasing rapidly, in which the share of APL group is comparatively larger. Wheat has been noted as the most preferred commodity, but interestingly the quantum distributed to BPL families has reduced over the years. It could be attributed to either misuse of the controlling mechanism or their poor purchasing power. No doubt, total demand/sale is expanding in the state, and number of FPSs and ration cardholders is increasing. Cooperatives and individual/private ownership of FPS was observed to be the preferred option in Himachal Pradesh. In order to check any irregularities, the government conducted 32,925 inspections during 2014–15 to ensure quality and quantity of items to be distributed under TPDS. It can be said that people in the state need TPDS for livelihood and food security and various agencies and departments involved in TPDS are contributing effectively

in delivering the service. However, still more needs to be done to ensure proper quality of grains, timely availability of rations, checking fraud ration cards and affordability for poor families including subsidy, etc. Notwithstanding, TPDS is emerging as the key instrument of food security in Himachal Pradesh.

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www.himapurti.gov.in

"In a world of plenty, no one, not a single person, should go hungry. But almost 1 billion still do not have enough to eat. I want to see an end to hunger everywhere within my lifetime."

– Ban Ki-moon

Enhancing Food Security through Sustainable Agriculture in Uttarakhand Himalaya

VISHWAMBHAR PRASAD SATI

Cultivating traditional subsistence cereals is the main occupation of the people in Uttarakhand Himalaya as about 70 per cent people are involved in its cultivation. Meanwhile, production and yield of cereals are considerably low and thus rural Uttarakhand Himalaya is suffering from the menace of food insecurity. This paper examines the scope of enhancing food security through practising sustainable agriculture in Uttarakhand Himalaya. We gathered data from both primary and secondary sources. Data on area, production and yield of cereals, fruits, vegetables, flowers and spices were gathered from the statistical diary of Uttarakhand (2010–11) and a descriptive statistical method was used to calculate minimum, maximum, mean values and standard deviation. A case study of 12 villages of Khanda Gad sub-watershed was conducted to analyze cost-benefit of crops. Our study shows that cost-benefit of cash crops is 434:1338 and subsistence crops is 2806:5021, which denotes that total benefit from growing cash crops is higher than that of subsistence crops. It is suggested that sustainable agriculture by means of cultivating cereals, fruits, vegetables, flowers and spices according to crop suitability, agro-climatic conditions and landscape can enhance food security.

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1. Introduction

The United Nations (2008) defines food security as a state where both the availability and accessibility of food are ensured and it is enough to cover the food demand of the people. The issue of food security emerged in the 1970s when acute food crises occurred at the national and global level. Many countries, mostly underdeveloped, are still facing the menace of food scarcity and malnutrition. According to FAO (2003), about 850 million people are undernourished or chronically hungry in the world, out of which, 830 million people are from the developing world and 212 million people are from Sub-Saharan Africa. In India, 231 million people are facing the same problem, out of which, 175 million people live in the rural areas (FAO, 2008).

There are four food security indicators (Figure 1) – food availability, food accessibility, food consumption and sustainability. Food availability is mainly based on the production factor. Higher the production, higher is the food availability. Access to food is another major factor, which includes market access, market price and institutional support. Access to food means that it is well distributed according to the demand. Food insecurity takes place when the demand grows higher than the supply. Both food availability and its proper distribution may attain food security. It is observed that food insecurity is not only due to population growth and low production of crops but also due to mismanagement in the food grain distribution system. Braun et al. (2003), Chappell and LaValle (2011) and FAO (2011) have noted that the current global food production is sufficient to feed the world if it is distributed according to the need. Food consumption that includes nutritional adequacy and local preferences is dependent on population size and food habits of the people. If these factors are adequate, then economic, social and environmental sustainability can be attained.

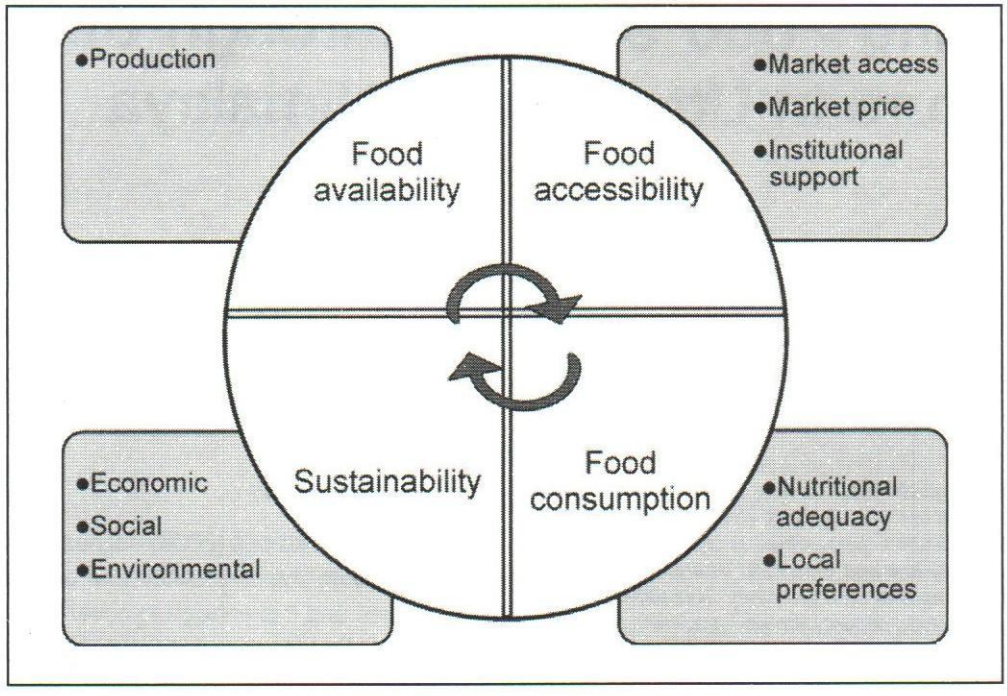

Figure 1: Food security indicators

Most of the people living in mountainous regions are economically vulnerable. A report from the World Bank (2007) says that about 80 per cent of the hungry people live in the mountainous regions of developing world, where 50 per cent farmers are smallholders and they have little access to productive lands (Tscharntke et al., 2012). Joshi et al. (n.d.) observed that agriculture in South Asia is gradually diversifying towards high-value commodities and their growth in production during the 1990s was much higher than cereals, pulses and oilseeds. A shift in favour of high-value food commodities opens growth opportunities, generates income, augments employment, alleviates poverty, and improves sustainability of agricultural systems (Pingali and Rosegrant, 1995; Braun, 1995a). However, cultivating food grains, non-food grains and high-value cash crops is inevitable as these crops have high potential of income generation, employment augmentation, poverty alleviation and export promotion (Braun et al., 2003; Pingali & Rosegrant, 1995; Jha, 1996; Chand, 1996; Vyas, 1996; Delgado & Siamwalla, 1999; Ryan & Spencer, 2001; Joshi et al., 2004). Evidence from African countries shows that processes of agricultural diversification and productivity growth are often driven by cash crops with reliable markets and predictable returns (von Braun and Kennedy, 1986). The production of cash crops offers farmers the opportunities for investment and improving management of their farms, stimulating agricultural innovation and increasing yields (Thom et al., 2014).

Agriculture is the basis of livelihood of about 80 per cent of the rural population in the Himalayan countries, however, more than 90 per cent of the farmers are marginal (Partap, 1998). On account of potential productivity of crops and soil fertility, it is declining and consequently the farmer faces food shortages (Jodha and Shrestha, 1993). It is, therefore, necessary to explore all possible ways of increasing the sustainable productivity and carrying capacity of farming systems in order to improve the livelihoods of marginal households (Partap, 1999). In Uttarakhand Himalaya, the phenomena of high growth of population (19.17 per cent from 2001–11), low production and low per ha yields of subsistence crops (28.0), traditional modes of farming (69.45 per cent) are reported (Census of India, 2011), and of course, the phenomena of climate change has further led to food insecurity. As a result, food scarcity and malnutrition are very common.

Cultivation of traditional subsistence cereals is based upon centuries old practices and is carried out on the narrow patches of terraced fields (Sati, 2004). Production and per ha yields from traditionally grown subsistence crops is considerably low. Further, high landscape fragility

and slope gradient restrict the possibility of expansion and use of modern innovation on agricultural land (Sati, 2012). A majority of rural people do not get sufficient nutrition in their diet, consequently suffering from nutrition deficiency related diseases (Pant, 1996). Further, farming has become unsustainable due to increasing food needs as well as pressure of population on the arable land (ICIMOD, 1996). Meanwhile, agro-climatic conditions are suitable for practising sustainable agriculture.

This paper studies the scope of sustainable agriculture through cultivating high-value cash crops to attain food security in Uttarakhand Himalaya. It focuses on the potential of cash crops and explains how its cultivation can cope with food insecurity and malnutrition. It also envisages that agricultural diversification through cultivating both cash and subsistence cereal crops is suitable in all the agro-climatic zones of this ecologically fragile mountain terrain.

2. Materials and Methods

2.1. The Study Area

The Uttarakhand Himalaya is located in the centre of the Himalayan mountain region. Himachal Pradesh in the northwest, Haryana in the west, Uttar Pradesh in the south, Nepal in the east and China in the north delimit its national and international boundaries, respectively (Figure 2). It occupies an area of 51,125 sq. km and stretches between 28°53' 24"–31°27' 50" N and 77°34' 27"–81°02' 22" E. Of its total geographical area, about 47,325 sq. km (92.6 per cent) is covered by mountains, which forms the mainland of Uttarakhand. Tarai plains and Doon valley occupy about 3,800 sq. km (7.4 per cent) of the area. The total snow-covered area of its mountainous region is 7,632 sq. km (16.1 per cent), which is elevated over 3,600 m and is called the Greater Himalaya. There are seven districts in the Garhwal Himalaya: Chamoli, Rudraprayag, Tehri, Uttarkashi, Pauri, Dehradun and Haridwar; six districts in the Kumaon Himalaya: Udham Singh Nagar (USN), Nainital, Pithoragarh, Champawat, Almora and Bageshwar. The socio-economic and cultural aspects of both these geographical entities are varied and, in turn, reflected on the livelihoods of the people. Out of the total geographical area, arable land is only 13.52 per cent. Meanwhile, millets, oilseeds and pulses dominate the farming systems. The total population of the study area is about 10.12 million and the density of the population is 189 persons/sq. km (Census of India, 2011).

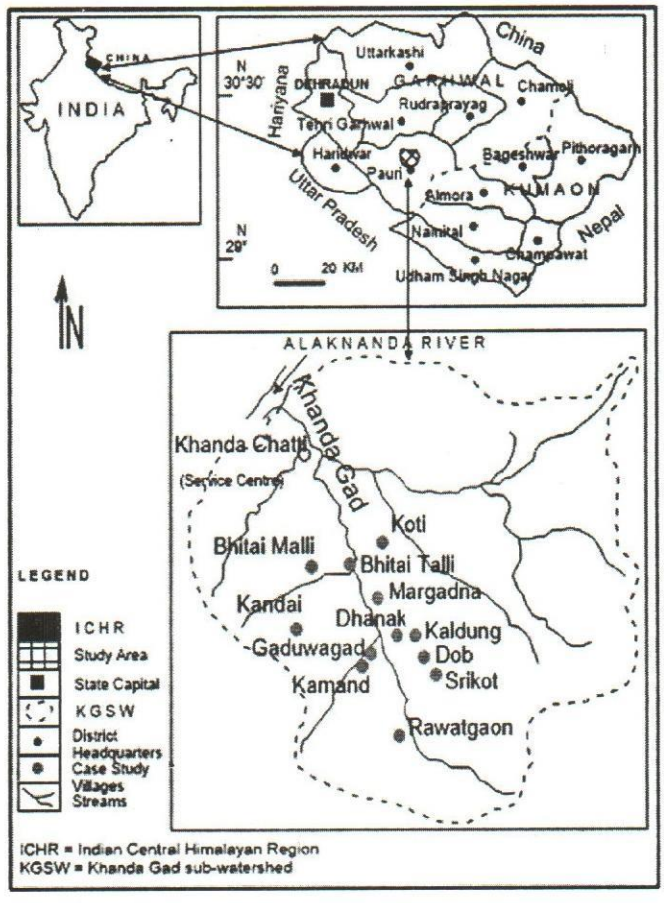

Figure 2: Location map of Indian Central Himalayan Region and the case study villages of Khanda Gad Sub-Watershed

2.2. Methodology

A set of qualitative and quantitative approaches was employed to conduct this study. Data were mainly gathered from primary and secondary sources, and through participatory rural appraisal. Data on area production and yield of cereals, fruits, vegetables, flowers and spices were gathered from the State Statistical Diary and the State Horticultural Department (2010–11). Descriptive statistics (SPSS software) was used to find out minimum, maximum, mean value and standard deviation. The author visited the entire study area a number of times during 2008–9. A case study of 12 villages of the Khanda Gad Sub-Watershed (KGSW) of the Alaknanda River was carried out in 2008. Household-level survey was conducted and 433 households were surveyed. We gathered data on cash and cereal crops and analyzed cost-benefit of crops. Data were also shown by graphs.

2.3. Result

2.3.1. Farming practices in the Uttarakhand Himalaya

Agriculture, mainly cultivation of subsistence cereal crops, which grow in the narrow patches of terraced fields, is the main occupation of the people; whereas the production thereof and per ha yields are quite low (Kumar and Tripathi, 1989). Horticultural practices also go parallel and varieties of fruits, vegetables, spices and flowers are cultivated. However, their proportion in the total cropped land is significantly less. Table 1 shows descriptive statistics of the area, production and productivity (yield/ha) of various crops in Uttarakhand Himalaya. Minimum, maximum and mean values of these data were calculated. We used mean value for further discussion. These data were originally gathered from secondary sources mainly from the statistical diary of Uttarakhand State and the Directorate of Horticulture, Dehradun, Uttarakhand (2010–11). Subsistence crops have the highest area with 186 thousand ha mean value, fruit crops follow it (16.5 thousand ha). Vegetable crops occupy 5.55 thousand ha area, similarly spices occupy 1.67 thousand ha and flowers have only 0.218 thousand ha area. In terms of production, subsistence crops have the highest production (340 thousand t), followed by vegetables (55.1 thousand t), fruits (54.7 thousand t), spices (12.1 thousand t) and flowers (0.966 thousand t). Vegetables retain the highest productivity (9.9 thousand t/ha). Spices (7.2 thousand t/ha), flowers (4.4 thousand t/ha), fruits (3.3 thousand t/ha) and subsistence crops (1.8 thousand t/ha) follow them.

Apart from the crops discussed above, sugarcane, one of the most important crops, grows in the plain regions of Uttarakhand Himalaya, viz., the tarai plains and the Doon valley, which includes districts of USN, Haridwar, Nainital (partially), Pauri (partially) and Dehradun (partially). As sugarcane is cultivated in the five (out of 13) districts of the state, the area under its cultivation is less in comparison to other crops (8.2 per cent). However, its

Table 1: Descriptive Statistics of Subsistence Crops, Fruits, Vegetables, Spices and Flowers in Uttarakhand State

Crops	Variables	Minimum	Maximum	Mean	Std Deviation
Subsistence crops	Area (in 000 ha)	24	397	186	161
	Production (in 000 t)	26	814	340	339
	Productivity (in 000 t/ha)	1.1	2.1	1.8	2.1
Fruits	Area (in 000 ha)	0.40	39	16.5	12.4
	Production (in 000 t)	0.07	136	54.7	62.1
	Productivity (in 000 t/ha)	0.2	3.5	3.3	5.0
Vegetables	Area (in 000 ha)	2.10	11.9	5.55	3.5
	Production (in 000 t)	12.7	119	55.1	34.1
	Productivity (in 000 t/ha)	6.0	10	9.9	9.7
Spices	Area (in 000 ha)	0.30	4.10	1.67	1.4
	Production (in 000 t)	1.20	41.9	12.1	14.8
	Productivity (in 000 t/ha)	4.0	10.2	7.2	10.6
Flowers	Area (in 000 ha)	0.03	0.60	0.218	0.228
	Production (in 000 t)	0.10	3.40	0.966	1.24
	Productivity (in 000 t/ha)	3.3	5.7	4.4	5.4

Source: Statistical diary of Uttarakhand State, 2010–11, and Directorate of Horticulture, Uttarakhand; data calculated by the authors

productivity (61.9 thousand t/ha) is high. The main reasons for its high production and productivity are: feasible climatic conditions, high soil fertility and availability of ample water supply. Further, high demand, accessibility and availability of market, developed transportation and the presence of sugar industries provide ample bases for cultivating sugarcane in the plain regions. Wheat and paddy crops grow both in the mountainous mainland (92.6 per cent) and the tarai plains and the Doon valley, but the proportion of cultivable land under these crops in the mountainous mainland is significantly less. They grow mostly in the narrow patches of arable land along the river valleys. Cultivating subsistence cereal crops — millets, pulses and oilseed — is the main occupation as a large number of people are dependent on the output from these crops. Therefore, the area under these crops is substantially high. Meanwhile, production and productivity of these crops is less. Although, agro-climatic conditions are quite feasible for cultivating fruits and vegetables in the mountainous mainland, it lacks infrastructural facilities — market, transportation and cold storage, and inaccessibility of the fruit- and vegetable-growing areas lead to less area and production of these crops. Meanwhile, productivity is substantially high. Among the fruit crops, apple, pear, peach, plum, apricot and walnut grow in the highlands; citrus fruits — lemon, orange, mandarin and elephant citrus — grow in the mid-altitudes; and mango, guava and papaya grow in the valleys. Similarly, in terms of vegetable crops, onions are cultivated in the valleys and the mid-altitudes, whereas potatoes grow in the highlands. Other vegetables grow at all altitudes.

2.3.2. Sustainable Agriculture and Agro-Biodiversity

The Uttarakhand Himalaya is a hotspot of agro-biodiversity, varies with differences in altitudes (Figure 3). Here, 86 agronomic and 11 horticultural crops have been growing from time immemorial (Mehta et al., 2010). Under the traditional systems of cultivating 'Barahnaja'[1] together in a cropped land is a centuries-old practice (Singh and Tulachan, 2002; Sati, 2009). This is practised under a 'Sar system'[2] (Sati, 2009). It characterizes the cropping pattern together with a vertical distribution of crops — in the valley regions, the mid-altitudes and the highlands. It also supports the maintenance of agricultural diversity. The traditional agricultural systems are the repository of many crops and cultivators. Most of them are still little known to mainstream societies and have a better adaptability than modern agricultural systems to environmental and social conditions (Altieri, 1995; Ramakrishnan and Saxena, 1996). *Mandua* (finger millet), *ramdana/chua* (*amaranthus*), *rajma* (common kidney beans), *ogal* (buckwheat), *urad* (black gram), *moong* (green gram), *naurangi* (mix of pulses), *gahath* (horse gram), *bhat* (soybean), *lobiya* (French beans), *bhang* (cannabis) and other crops are grown together in a mix-cropping pattern. It optimizes productivity, maintains soil fertility, conserves crop diversity and meets the diverse household requirements. The farmers grow about 100 varieties of paddy, 170 varieties of kidney beans, eight varieties of wheat, four varieties of barley and about a dozen varieties of pulses and oilseeds each year (Zardhari, 2000). Various pulses and oilseeds grow in the intercropping system during the monsoon season. Dry and wet paddy, taro, pumpkins, beans, corn, ginger, chilli, cucumbers, leafy vegetables and tobacco also grow. Potatoes have become an important cash crop growing in areas unsuitable for other plants. About 80 per cent of the cropped area is rain-fed. However, crops grow almost every season of the year.

Correlation between altitudes and agro-biodiversity was calculated. The hypothesis was: 'higher the altitude, higher is the crop diversity' and vice versa. The significant value was 0.1. It was noticed from the present study that the farmers growing all crops such as traditional cereals, fruits and vegetables together are more food secured. Contrary to this, those farmers who are growing only cereal crops are facing food insecurity problems. It denotes that cultivating varieties of cash crops at a commercial level can maintain agro-biodiversity and food security as well. Occupations of inhabitants of Uttarakhand Himalaya change according to changes in altitude. A close relationship between occupation and food security was noticed in the study area. Those who are engaged in tertiary activities are comparatively more secure in terms of food and livelihood. However, the farming community is still struggling to ensure the two time meal. It means that food scarcity problem is higher in the high altitudes.

2.3.3. Case Study of Khanda Gad Sub Watershed

Twelve villages of the KGSW were studied — Kandai, Srikot, Margadna, Bhitai Malli, Bhitai Talli, Kaldung, Dhanak, Gaduwa Gad, Kamand, Dov, Koti and Rawatgaon — that lie between 700 m and 2000 m altitudes. Economic valuation of cash and subsistence crops was also carried out through cost-benefit analysis (Table 2). Cost of crops, from sowing seeds to harvesting, was calculated on the bases of expenditure on labour (human and animal),

Figure 3: A– traditional crop land; B– paddy field; C– tomato cultivation and D– apple trees in the wheat crop fields

fertilizer (manure and chemical), seeds, transportation and irrigation. Similarly, net benefit was calculated through deducting total cost from gross benefit. Cash crops are sold in the local/regional market, thus their economic valuation is high. Cost-benefit analysis reveals that average net benefit from subsistence crops is higher (Rs 2,215 thousand) than cash crops, which is 904. Meanwhile, average percentage of net benefit from cash crops is 208 per cent whereas subsistence crops have only 78 per cent. The high net-benefit of subsistence crops is mainly due to large area under its cultivation. Among cash crops, the highest net-benefit is obtained from cauliflower, which stands for Rs 299 thousand (31.1 per cent of the total benefits), it is followed by potato, Rs 163 (18 per cent). Tomato stands in the third place with Rs 145 thousand net benefits (16 per cent). Capsicum (10 per cent) and beans (9.7 per cent) are the other cash crops grown in the case study villages. In terms of subsistence crops, net-benefit is the highest from paddy crops with Rs 1,220 thousand (51.1 per cent of the total benefit). It is followed

Table 2: Cost–Benefit Analysis of Cash and Subsistence Crops

Cash crops	Cost	Benefit	Net benefit	Subsistence crops	Cost	Benefit	Net benefit
Cauliflower	210	509	299	Wheat	924	1,472	548
Cucumber	98	217	119	Paddy	1,300	2,520	1,220
Tomato	34	179	145	Barley	400	760	360
Capsicum	28	118	90	Pulses	80	121	41
Beans	27	115	88	Millets	50	70	20
Potato	37	200	163	Oilseeds	52	78	26
Total	434	1,338	904	Total	2,806	5,021	2,215

Source: Primary collection

Note: Cost–benefit and net benefit of cash and subsistence crops is shown in '000 Indian Currency (IC)

by wheat crop (24.7 per cent). Paddy and wheat crops are the main food staples in these villages and the area and production of these crops is high. Barley stands third in terms of its share in net benefit, which is Rs 360 thousand (16.2 per cent). The other crops are pulses (1.9 per cent), oilseeds (1.1 per cent) and millets (1 per cent). They are consumed domestically. This study reveals that the economic viability of cash crops is higher than that of cereal crops and if a sizeable proportion of arable land is devoted for cultivating cash crops, food security can be attained. The study further shows that yield of cash crops are higher than cereals (Figure 4).

3. Discussion

3.1. Changing Agricultural Patterns and its Impact on Food Security

In Uttarakhand Himalaya, agricultural pattern has been changing on trial-and-error basis. Cultivation of traditional subsistence crops was dominated in the past, as the farming community was able to carry their livelihoods only through cultivating these crops. Over time, increasing human population has put pressure on the limited agricultural land. Consequently, food scarcity situation was cropped up. Many programmes at the state level have

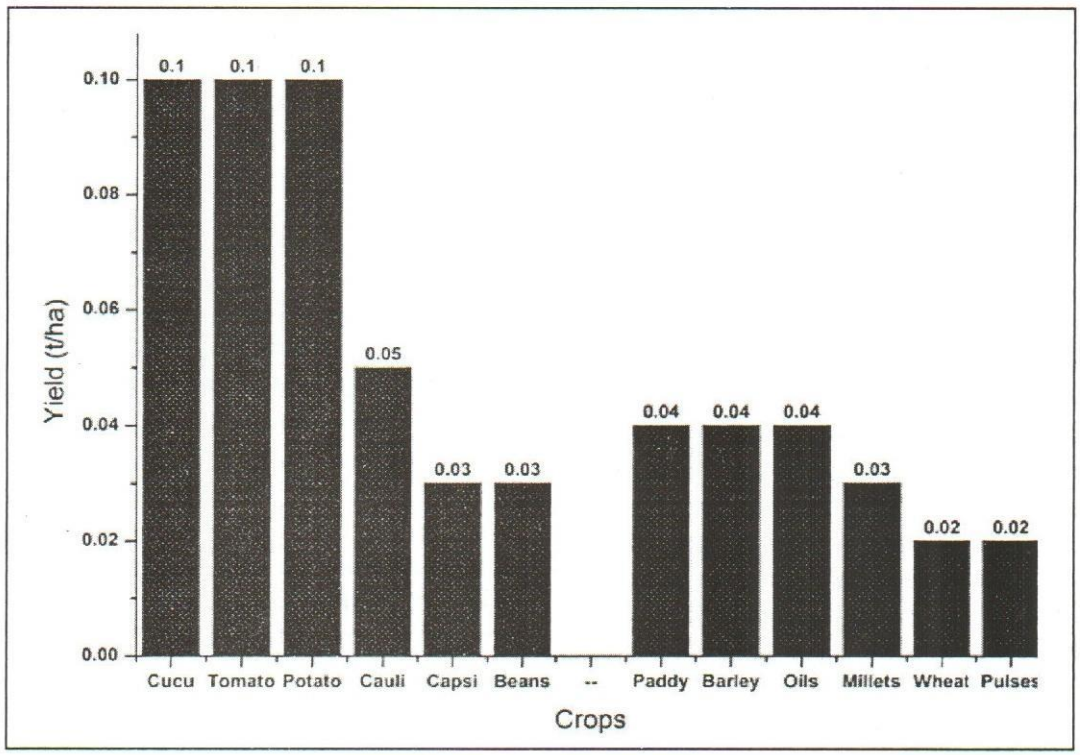

Figure 4: Crop yield — Cash and Cereals

been framed to cope with the food scarcity. During the 1970s, the temperate regions of the highlands and the mid-altitudes were demarcated for creation of fruit belts, as the highlands are suitable to grow apple crop and mid-altitudes are suitable to grow citrus fruits. The farmers of the region were largely engaged in practising horticulture. Absence of infrastructural facilities — market, cold storage, transportation and training programmes — have pushed the horticultural practices to the verge of extinction, as the farmers were not able to continue them. Besides, the impact of climate change on the cultivation of fruits has also been noticed. Apples, which were earlier grown between 1600 m and 2200 m, have now completely vanished. Similarly, citrus fruits, grown between 1200 m and 1600 m, have also disappeared. The climatic conditions for cultivating these fruit crops have shifted to the higher altitudes as the valleys and the mid-altitudes have become warmer. During the recent past, the farmers have started cultivating medicinal plants in open farmlands and in poly-houses with financial assistance from the state. Initially, many farmers of the highlands were motivated to adopt this cultivation as the agro-climatic conditions were quite

suitable. However, with the passage of time, the drive has fizzled away. Medicinal plants take about two years to turn into a product. For want of market facilities, the farmers did not receive proper returns from the cultivation. They were rather shrunken to struggle even for daily food requirements. This situation further compelled the farmers to cultivate subsistence crops.

3.2. Enhancing Food Security through Sustainable Agriculture

Agricultural diversification, increase in soil fertility, water availability, access to market, transportation facilities, equal distribution of products to access and institutional support can enhance food security and livelihood sustainability. Food security can also be achieved through high-crop diversity in all the altitudinal zones, mainly the cultivation of cash crops, as cash crops throughout the Himalayan region have moved a step forward in terms of generating income and augmenting employment. Several other factors have also affected the level of food security. One of the factors is a rapid technological change in agricultural production, improved rural infrastructure and changes in food demand patterns (Pingali and Rosegrant, 1995).

In Uttarakhand Himalaya, increase in population on the limited terraced agricultural fields has further accelerated the food insecurity syndrome. It was noticed that the implications of agricultural diversification on food security have been tremendously high. In the past, when the farming community was absolutely dependent on subsistence farming, the phenomenon of food scarcity and malnutrition was high. Changes in cropping patterns, on the other hand, from subsistence crops to paddy, wheat, fruits and off-season vegetables have attained food security. However, the never-ending debate on the suitability of crops for food security still continues. Saxena and Rao (1994) pointed out that preferences for consumption of wheat and paddy are the recent changes in food habits that have caused this situation of food insecurity in the region. The cultivation of paddy and wheat crops demands more water and fertilizers, rendering them into scarcity and adversely affecting the productivity of paddy and wheat crops (Kumar et al., 1998). This point of view has been supported by Singh and Raghuvanshi (2012) as they observe that cultivating traditional subsistence crops is one of the most potential approaches adopted for improving household food security. However, the author drawing on his experience and years of observation of the area may say that only cultivation of subsistence crops is not enough to feed the mounting population. The economic viability of paddy, wheat and cash crops — fruits and off-season vegetables — is comparatively very high and the landscape and agro-climatic conditions are also feasible to cultivate them. There were many incidences in the past when the farmers suffered due to food scarcity and malnutrition. Thus, they transformed their subsistence cropped land into cultivating paddy and wheat and became self-reliant in food production.

In the study region, the major hurdles in the way of cultivating cash crops are market, transportation and storage facilities. Absence of market adversely affects the cash crops and opportunities for higher income (Tewari et al., 2001). Access to market and ample infrastructural facilities play a vital role in determining cultivation of cash crops. Vegetables and fruits are perishable in nature and they need cold storage immediately after harvesting. Further, fruits and medicinal plants also require two to five years to grow and get output; due to lack of market facilities, the farmers do not receive the actual benefits from these crops. Therefore, adequate infrastructural and market facilities will reduce transaction costs, improve market integration, reduce price volatility and finally food security can be attained. Further, integration of production, marketing and value addition to agricultural commodities leads to food security, and there are many success stories of this innovation response in the developing countries (Warning and Key, 2000; Narayanan and Gulati, 2002). Development efforts through providing adequate infrastructural and market facilities tend to focus on exploring farming approaches to increase the productivity and carrying capacity of farms (Partap and Partap, 1997).

6. Conclusions

Food security cannot be achieved by cultivating subsistence or cash crops individually; it requires cultivation of both the crops simultaneously. In Uttarakhand Himalaya, the major portion of land is devoted in cultivating subsistence crops but the production and productivity of these crops is comparatively lower than that of the cash crops — fruits, vegetables and spices. The study reveals that the landscape and agro-climate is quite suitable for agricultural diversification. To fully harness these agro-climatic conditions, a proportion of arable land should be devoted to the cultivation of economically-viable cash crops, taking into consideration the suitability and accessibility of land. Farming of subsistence crops, mostly in the highlands, should go parallel, as it maintains ecology and diversity in the cropping pattern. A policy should be

framed and implemented to identify the suitability of crops in different altitudinal zones. From the valley regions to the alpine meadows, through the mid-altitudes and the highlands, selection of crops should be ensured so that high production and per ha yields of crops can be achieved. The alpine meadows should be protected and optimal use of naturally grown medicinal plants should be substituted. The highlands are very productive for cultivating subsistence crops. These crops can grow even under adverse climatic conditions. Wheat and paddy crops can grow in mid-altitudes and valley regions. Variety of fruits — apple, pear and peach in the highlands; nut and citrus fruits in the mid-altitudes and mango, guava and papaya in valley regions can grow abundantly. Similarly, off-season vegetables — potato in the highlands and onion in the mid-altitudes and in the valley regions along with tomato and all leafy vegetables and spices — can grow in different altitudinal zones. Community participation along with institutional support should be ensured for cultivating different crops in all the altitudinal zones. Infrastructural facilities, such as availability of market, transportation and cold storages in the study villages, are lagging behind. Access to market and establishment of cold storages will lead to agricultural diversification. If all these measures are taken into account, food security can be enhanced in Uttarakhand Himalaya.

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Notes :

[1] Barahnaja denotes the twelve cultivars/crops grown together in a cropped land, including millets, pulses and oilseeds.

[2] Refers to crop rotation, in which crops (mono or intercropping) are grown in the first sar in rabi season and then shifted to second sar in kharif season, and finally cropped land is left fallow for six months, once in a year.

"Civilization as it is known today could not have evolved, nor can it survive, without an adequate food supply."

– Norman Borlaug

Food Security in Uttar Pradesh: Its Status and Challenges

NOMITA P. KUMAR

Food security is a prerequisite to sustainable and equitable economic development and indeed a critical factor for economic and social stability in every country. Decentralized district-based planning is essential in India because of large inter-district variations. In the absence of vital data at the district level, the state-level estimates are used for formulating district-level plans. This statistical fallacy compounds the problems of the districts acutely, more so in the food security sector. Using data from government reports, the paper shows that it is the apt time for constructing a Food Security Index (FSI) and tries to identify the districts that fare particularly badly and the factors behind the poor performance of these districts in Uttar Pradesh.

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1. Introduction

The much awaited Food Security Bill which was tabled in August 2013 has now taken centre stage in policy discussions around the academic discourses. Along with issues of food production, issues of access of the poor to food also prevail. In India, despite high GDP growth rates over the past decade or so, the record in reducing hunger is not very impressive. Thus the question of inclusive growth, particularly the inclusion of the most deprived sections of our society and regions of our country into benefiting from the growth process still looms large. Increased access to food comes forward as a basic component of inclusive growth.

Decentralized district-based planning is essential in India because of large inter-district variations as reported in Annual Health Survey (AHS, 2011) in the context of health issues. The same is true for other issues, be it food security, education, poverty, etc. In the absence of vital data at the district level, the state-level estimates are used for formulating district-level plans as well as setting the milestones thereof. In the process, the hotspots very often get masked by the state average. This statistical fallacy compounds the problems of the districts acutely, more so in the food security sector. Using data from government reports effort is being made to throw light on some critical issues in Uttar Pradesh. The time is apt for constructing a Food Security Index (FSI), try to identify the districts that fare particularly badly and the factors behind the poor performance of these districts in Uttar Pradesh. The identification of regions and social groups that are most food insecure should help seek attention of the policy formulators act accordingly. At the same time, analysis of factors behind poor food security should help attain district-level interventions in dealing with these factors in these districts.

2. Objective and Data Source

The objective of this study is to:

- To examine and identify the regions and social groups most affected by food insecurity;
- Suggest policy interventions appropriate to improving food security for those regions and social groups.

The study uses data from different sources of state government — mainly district-wise Development Indicators of Uttar Pradesh, 2012, Annual Health Survey of Uttar Pradesh, 2011–12 and Census of Uttar Pradesh, 2011. The study was carried out on the basis of UNDP methodology of Range Equalisation Method to convert indicators into indices. Following the efforts done by 'Food Security Atlas of Rural Uttar Pradesh' sponsored by World Food Programme, recent data set are used to formulate FSI and demarcate districts lagging behind for policy formulators to pay heed to.

3. Defining Food Security

The definition of food security has gone through two phases of understanding. In the 1970s food security was understood as the 'availability at all times of adequate world food supply of basic foodstuffs' (United Nations, 1975). Food security is conceptualized and contingent on three basic parameters: availability, accessibility and affordability. Availability derives from production and accessibility is all about distribution. Spatial constraints are not the major issues but attention is required for socio-political ones. People can afford food if they can buy it and have the provisions. But Amartya Sen's work (1981) brought forward a new understanding of the problem of hunger or food security and is linked to what Sen calls 'endowment and exchange entitlements'. One can buy food if one has the resources and these resources have to come from assets such as land and other productive means or wage labour. The adequacy of these determines one's capacity for food affordability (Krishnaraj, 2005).

Sen hypothesized that availability of food does not itself create entitlements for food. In other words, his emphasis on entitlements is similar to Keynes' notion of 'effective demand'. Both entitlement and effective demand are quite different from need. Since Keynes was dealing with a fully capitalist market economy, with only two classes, employers and workers, all effective demand was related to monetary income. But Sen is dealing with a 'mixed economy' with existing three classes, employers, workers and peasants or other own-account producers. For those who produce food, part, if not all, of their entitlement is due to their own production. This portion of consumption of food does not have a market in between. Consequently, this is not captured by the market-based notion of effective demand.

What an individual or household can consume or access depends on the individual's or household's entitlements. Entitlements draw attention to the conditions under which people access food, whether from direct production (or exchange with nature), market exchange (income from either goods produced or wage labour) and social security measures. Entitlements also draw attention to the rules that govern intra-household allocation of food, in particular, to the role of gender inequality in depriving women and girls equal access to food within the household.

Food, of course, is not an end in itself. Food is consumed for nutrition. Instead of focusing attention on the commodity, one can look at the objectives for which food is consumed, which is providing nutrition. The purpose of nutrition itself is not just to survive, but to lead a healthy and meaningful life — to be in the state one wants (well-being) and to do various things one wants to do. The basic or elementary state of adequate nutrition is that aspect of well-being that is the concern of food security or the elimination of hunger.

At one level, health concerns, focused on the availability of clean water and access to health facilities, are as much a part of the very concept of food security itself. At another level, some health questions affect the ability of the individual/household to engage in those livelihood activities that could ensure food security. Consequently, in order to deal with food security, it is not sufficient to pay attention to food alone, but also access to, and at least, clean water and sanitation which affect the ability to absorb food, or turn consumption of food into nutrition.

Given women's general responsibility for food security in household economy, and given the pervasive gender bias in our society, consequently food security requires increasingly direct attention to eliminating gender inequality and obtaining women's empowerment as important preconditions. Agency of poor women, or of the poor as a whole, is not only a matter of individual agency (which itself might be dependent on collective mobilization), but also of the poor putting their stamp on economic policies. This is necessary to bring about the

much-needed political will that is often referred to as what is missing in order to get adequate attention to food security policies. Without adequate political pressure for reform, proper food security policies are unlikely to be adopted. There is no question that the political mobilization of the poor is not required for such a food security policy to be implemented.

All these changes in understanding meant that 20 years after the 1975 World Food Summit, there was a substantial shift in understanding the meaning of food security. From the emphasis on adequate food supply in 1975, the 1995 World Food Summit thus declared, 'food security, at the individual, household, national, regional and global levels ... exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life' (FAO, 1996, p. 3). The declaration further recognizes that 'poverty eradication is essential to improve access to food.'

The recent discourse on food security has further developed along the lines of the right to food and identifies three kinds of obligations of states: not to adopt measures that would prevent access to food; to adopt measures to ensure that no individuals are deprived of access to adequate food; and to proactively engage in activities that strengthen people's access to food, including means to ensure their livelihood and food security. There is also an obligation of states to fulfil that right directly, when people through the means at their disposal (normal entitlements) cannot obtain adequate food.

4. Measuring Food Security

As the existing literature conveys that food security refers to the condition of sufficient nutrition obtained from a combination of food access of the household/individual and the ability of the body to absorb these nutrients. Now given the definition of food security it is pertinent to enquire the method of its measurement. Food security is a combination of access to food and its absorption by the body, which depends on a number of non-food factors, such as sanitation, access to clean drinking water, access to health facilities and so on. The outcome of food security can be taken to be the nutritional status of any individual, with the understanding that food intake is basic, though not the sole factor that affects the nutritional status.

In Uttar Pradesh, the rural population and particularly children are vulnerable to malnutrition because of low dietary intakes, lack of appropriate care and inequitable distribution of food within the household. The measurement of nutritional status of children is done through anthropometric methods; these include weight-for-age; height-for-age and weight-for-height. The height-for-age index measures linear growth retardation. Children who are more than two standard deviations below the median of the reference population in terms of height-for-age are considered short for their age or 'stunted'. The proportion in this category indicates the prevalence of 'chronic under nutrition', which often results from failure to receive adequate nutrition over a long period of time or from chronic or recurrent diarrhoea (NFHS, 2007).

The weight-for-height index counts body mass in relation to body length. Children who are more than two standard deviations below the median of the reference population for the same index are considered too thin or 'wasted' and this indicates prevalence of acute under nutrition. Wasting is associated with failure to receive adequate nutrition in the period immediately before the survey and may be the result of seasonal variations in food supply or recent episodes of illness (NFHS, 2007).

Children who measure two standard deviations below the reference median on the index of weight-for-age are considered to be 'underweight'. We have taken the proportion of underweight children as the indicator for malnutrition. The primary reason being that weight-for-age is a composite measure that takes into account both chronic and acute under nutrition. Secondly, while information on stunting and wasting are available at state level from the National Family Health Survey (NFHS), the same is not available at district level. The Annual Health Survey has recently provided district-level information on children below 2.5 kg. Therefore, we have selected this index as one of the two indicators for measuring food insecurity status.

Malnutrition in children is a curse and weakens their immune system making them more susceptible to disease. It has been noted by scholars that a child is almost 10 times more likely to die from key diseases if he or she is severely underweight, and two and a half times more likely to die if moderately underweight, as compared to an average weighing child (Black et al., 2008).

Therefore, the second indicator for measuring food insecurity has been child mortality. The under-five mortality rate indicates the probability of dying between birth and five years of age, expressed per thousand live births. There

are a number of advantages of using child mortality ratio as an indicator of food insecurity. Child mortality portrays an 'outcome' of the development process rather than an 'input', such as per capita calorie or protein consumption or access to medical facilities — which are means to an end. Child mortality is known to be the outcome of a wide variety of factors, for instance, the child's and the mother's nutritional status, food availability in the family, level of immunization, availability of maternal and child health services, economic status, availability of safe drinking water, basic sanitation and so on (UNICEF, 2005). Thus, child mortality encompasses a number of facets, most of which have been used as explanatory indicators, as already enumerated and discussed later.

A statistical analysis of the NFHS-3 data across states reveals a significant negative correlation between micro-nutrient intake and proportion of underweight children and under-five mortality, thereby implying that an increased intake of micronutrient, i.e., high food security, significantly reduces the risk of under nutrition, which in turn, as discussed, contributes to reduction in child mortality (Table 1).

Table 1: Correlation between Micronutrient Intake and Under-nutrition and Mortality Status

	Under 5 Mortality	Underweight Children	Vitamin Intake	Iron Intake
Under 5 Mortality	1.00	0.714**	- 0.501**	- 0.523**
Underweight Children		1.00	- 0.227	- 0.450*
Vitamin Intake			1.00	0.555**
Iron Intake				1.00

As it emanates from the preceding discussions, child under nutrition status and mortality appear to be an overall outcome of nutritional and food insecurity. It, therefore, makes sense in forming a combined index of these two indicators to compute an indicative index of food security in Uttar Pradesh. Districts have been divided into five groups on the basis of this index — secure, moderately secure, insecure, very insecure, and extremely insecure — each category representing the relative severity of outcome of food insecurity.

The regional analysis of the Food Security Outcome Index (FSOI) presents an interesting picture. Our analysis shows that there are eight districts which are secure in terms of FSOI, 13 districts are moderately secure, 24 districts are moderately insecure, 18 districts are severely insecure and seven districts are extremely insecure. So together there are 25 districts which are severely and extremely insecure in Uttar Pradesh. As discussed in inter-state comparison, Uttar Pradesh has a very high incidence of under nutrition of children and high child mortality. The fact that remains is that 21 out of 70 districts of Uttar Pradesh fall in the category of secure and moderately secure and the rest, i.e., 49 districts are still in the vicious cycle of deprivation, whether moderately, severely or extremely insecure (see Table 2).

Our analysis shows that the outcome of food insecurity is very stoutly disclosed by our effort of ranking districts on the basis of this index. But as our objective is bit wider in its angle, with a focus on required interventions in order to improve food security, we have moved further and conducted an exercise to look into three contentious issues of availability, access and affordability in the following analysis.

4.1 Food Availability

The food availability depends on production and other related aspects that sustain a desired level of food production. Food grains are the lifeline household food and nutritional security. The reason being that cereals and pulses are staple foods and there is no perfect substitution for it (Chand, 2007). Food grains are also the cheapest source of energy and proteins compared to other foods, and are indispensable for food security among low-income classes (Chand and Kumar, 2006).

The growth rate in agriculture sector has been recorded above 5 per cent during the Fifth Plan and two Annual Plan periods. The expected growth rate in the Tenth Plan is 2.10 per cent in the state, whereas the national growth rate is 1.80 per cent in the same period. Plan-wise growth status has been presented in Table 3 and also graphical presentation in Figure 1.

Table 2: Status of Districts in Food Security Outcome (FSO) Index

Secure	Index Value	Moderately Secure	Index Value	Moderately Insecure	Index Value	Severely Insecure	Index Value	Extremely Insecure	Index Value
Firozabad	0.694	Etah	0.495	Bareilly	0.397	Ballia	0.292	Ghaziabad	0.185
Sant Ravidasr Nagar Bhadohi	0.587	Faizabad	0.468	Kannauj	0.394	Ambedkarr	0.291	Kanpur	0.138
Kheri	0.573	Kushinagar	0.455	Chandauli	0.391	Deoria	0.281	Mahoba	0.136
Budaun	0.566	Balrampur	0.452	Mirzapur	0.385	Moradabad	0.279	Lucknow	0.136
Hardoi	0.553	Sitapur	0.448	Pratapgarh	0.384	Kanpur Dehat	0.270	Sultanpur	0.130
Farrukhabad	0.534	Maharajganj	0.447	Barabanki	0.383	Muzaffarnagar	0.270	Hamirpur	0.108
Kaushambi	0.526	Chitrakoot	0.438	Bahraich	0.378	Azamgarh	0.269	Jhansi	0.055
Shahjahanpur	0.512	Shrawasti	0.437	Bulandshahr	0.377	Gautam Budha Nagar	0.267		
		Allahabad	0.431	Banda	0.377	Fatehpur	0.261		
		Saharanpur	0.430	Sonbhadra	0.375	Baghpat	0.253		
		Aligarh	0.428	Ghazipur	0.373	Jalaun	0.244		
		Gonda	0.415	Varanasi	0.364	Rae Bareli	0.241		
		Rampur	0.407	Pilibhit	0.363	Etawah	0.238		
				Bijnor	0.355	Auraiya	0.232		
				Siddharth Nagar	0.352	Gorakhpur	0.227		
				Lalitpur	0.349	Mathura	0.223		
				Basti	0.346	Agra	0.214		
				Mau	0.340	Meerut	0.208		
				Unnao	0.336				
				Jyotiba Phule Nagar	0.335				
				Sant Kabirr Nagar	0.331				
				Jaunpur	0.313				
				Mainpuri	0.309				
				Hathras	0.301				

Source: Author's calculation.

As we know the agricultural economy in Uttar Pradesh is at not on a very good level of development. As a result, the whole state has been considered a food-deficit state. But there is inter-district variation in availability of food. The districts of western region appear to be much ahead of the rest of the state in terms of food availability, while those of southern and eastern region lags behind (Table 4). In the western region, Bagpat, followed by Muzaffarnagar and Hathras have large area under irrigation and Basti, Pilibhit and Meerut has a very high per capita value of agricultural output. Extent of irrigation coverage has in all the cases not been translated into per capita value of agricultural output. Bagpat has high irrigation coverage and also the highest level of per capita value of agricultural output, while Sonbhadra and Chitrakoot have low irrigation coverage, less paved roads and hence lowest availability status.

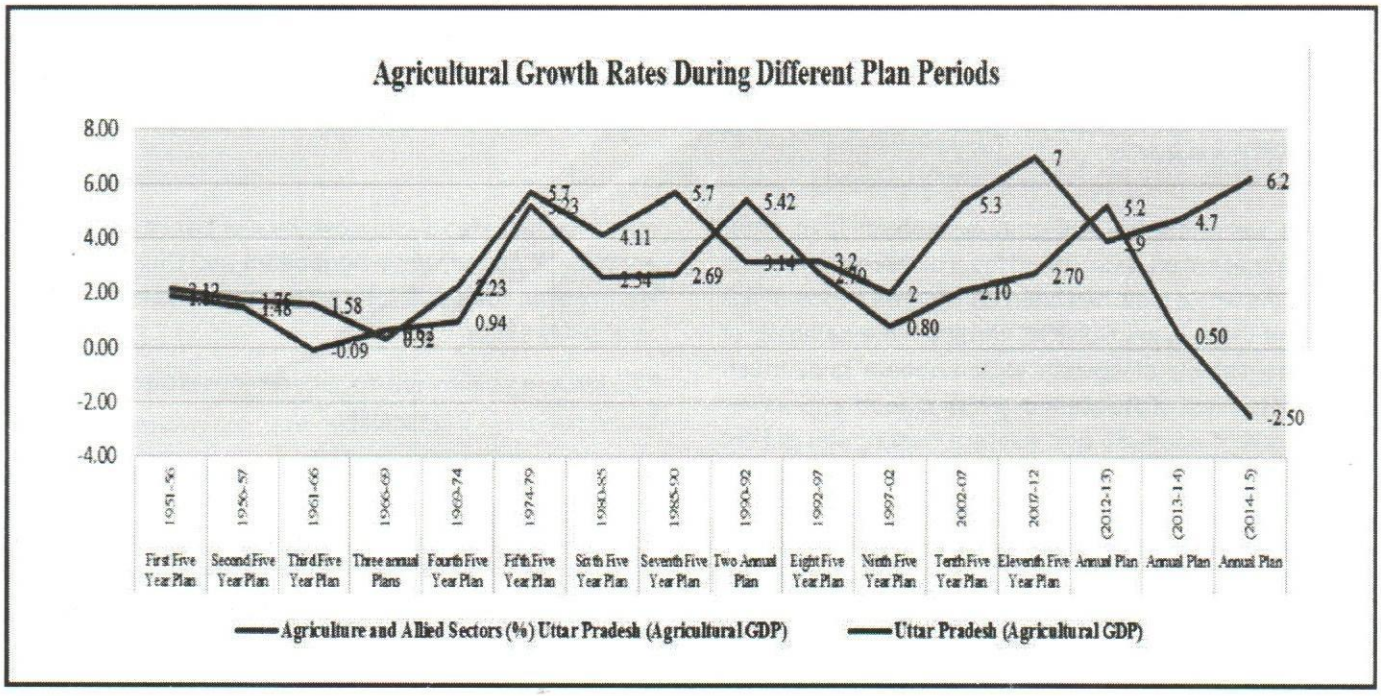
The following indicators have been chosen to determine a broad picture of food availability:

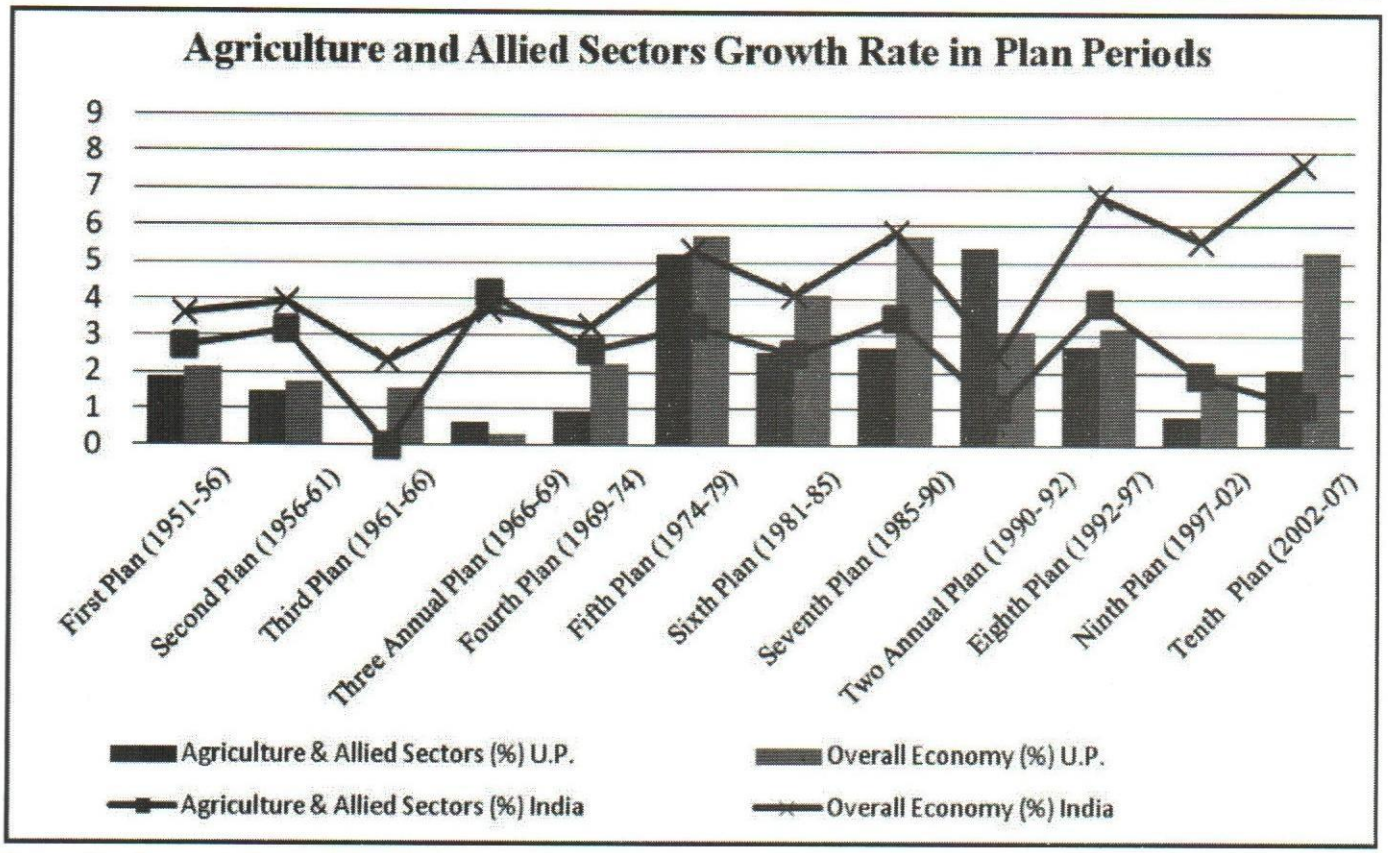
1. **Per Capita Value of Agricultural Production:** Agricultural output is an initial indicator of a district's rural production. To the extent that availability of food depends on the level of a district's production; per capita production can be taken as representing availability.

Table 3: Agriculture and Allied Sectors Growth Rate in Plan Periods

	Plan	Agriculture & Allied Sectors (per cent)		Overall Economy (per cent)	
		UP	India	UP	India
1	First Plan (1951–56)	1.86	2.71	2.12	3.60
2	Second Plan (1956–61)	1.48	3.15	1.75	3.95
3	Third Plan (1961–66)	(–) 0.09	(–) 0.73	1.58	2.32
4	Three Annual Plans (1966–69)	0.62	4.16	0.32	3.69
5	Fourth Plan (1969–74)	0.94	2.57	2.23	3.25
6	Fifth Plan (1974–79)	5.23	3.28	5.70	5.30
7	Sixth Plan (1981–85)	2.54	2.52	4.11	4.10
8	Seventh Plan (1985–90)	2.69	3.47	5.70	5.80
9	Two Annual Plans (1990–92)	5.42	1.01	3.14	2.47
10	Eighth Plan (1992–97)	2.70	3.90	3.20	6.80
11	Ninth Plan (1997–02)	0.80	1.90	2.00	5.60
12	Tenth Plan (2002–07)	2.10	1.10	5.30	7.70
13	Eleventh Five Year Plan (2007–12)	2.70	3.60	7.00	
14	Annual Plan (2012–13)	5.2	1.5	3.9	
15	Annual Plan (2013–14)	0.50	4.20	4.7	
16	Annual Plan (2014–15)	-2.50	–0.20	6.2	

Source: Plan Document, Chapter 1 Farm Sector.





Source: Plan Document, Chapter 1 Farm Sector

2. **Proportion of Forests:** Forests are a form of common property resource. Though usually claimed as state property and often ending up as an open access resource, there are both legal and geographical restrictions on developing production in forest areas. Thus, we assume that forest area is negatively associated with food security.

3. **Irrigation Extent:** Irrigation has a key role in both stabilizing agricultural production; through an increase in cropping intensity along with productivity can improve a district's food security position.

4. **Rural Connectivity:** Access to paved roads has a big role in development. It helps in reducing transport and transaction costs, with possible positive results on the prices realized by farmers. By improving communication, roads can increase the options for rural producers, connecting them with larger national, regional and even international markets. Studies of rural roads have shown that they raise the productivity and value of land for poor farmers (Jacoby, 2000). It has been found that government spending on rural infrastructure besides agricultural research and development, irrigation and rural development targeted to the rural poor, have all contributed to reductions in rural poverty and agricultural productivity. The marginal government expenditure on roads, in particular, has been found to be have the largest positive impact on productivity growth (Fan, et al., 1999).

4.2 Food Access

Accessibility to food or food distribution through self effort or other means has been regarded as the most important factor determining food security. A household's access to food depends on its own production of food and the food it can acquire through sale of labour or commodities produced by it. These are linked to what Amartya Sen calls endowment and exchange entitlements — 'A person starves either because he does not have the ability to command enough food, or because he does not use this ability to avoid starvation. The entitlement approach concentrates on the former, ignoring the latter possibilitiy' (Sen, 1981). The status of accessibility has been given in Table 5.

Table 4: Status of Districts in Food Availability Index

Food Available	Index Value	Moderately Food Available	Index Value	Moderately Insecure	Index Value	Severely Insecure	Index Value	Extremely Insecure	Index Value
Baghpat	0.945	Hathras (Mahamaya nagar)	0.795	Lucknow	0.698	Kanpur Dehat (Ramabai nagar)	0.593	Basti	0.497
Barabanki	0.926	Saharanpur	0.794	Bareilly	0.698	GB Nagar	0.590	Chandauli	0.497
Budaun	0.893	Meerut	0.793	Kushi Nagar	0.694	Kaushambi	0.589	Shravasti	0.382
Muzaffarnagar	0.862	Kannauj	0.760	Ambedkar Nagar	0.689	Hardoi	0.588	Mirzapur	0.362
Etah	0.857	Auraiya	0.753	Shahjahanpur	0.678	Allahabad	0.587	Bahraich	0.358
Mainpuri	0.836	Moradabad	0.753	Jalaun	0.675	Balia	0.569	Balrampur	0.340
Mathura	0.829	Firozabad	0.751	Kheri	0.674	Banda	0.539	Chitrakoot	0.231
Aligarh	0.814	Farrukhabad	0.736	Etawah	0.671	Deoria	0.538	Sonbhadra	0.054
Bulandshehar	0.814	Rampur	0.732	Faizabad	0.661	Siddharth Nagar	0.528		
Bijnor	0.808	Agra	0.711	Mau	0.658	Varanasi	0.524		
Sitapur	0.802	Pilibhit	0.709	Jaunpur	0.656	Sultanpur	0.513		
		Gonda	0.709	SR Nagar	0.655	Maharajganj	0.510		
		Ghaziabad	0.706	Unnao	0.655				
				JP Nagar	0.654				
				Rae Bareli	0.652				
				SK Nagar	0.646				
				Azamgarh	0.643				
				Fatehpur	0.635				
				Ghazipur	0.634				
				Gorakhpur	0.633				
				Jhansi	0.628				
				Kanpur	0.617				
				Nagar					
				Lalitpur	0.610				
				Mahoba	0.606				
				Hamirpur	0.604				
				Pratapgarh	0.604				

Source: Author's calculation.

Table 5: Status of Districts on Accessibility of Food Security

Highly Access	Index Value	Moderately Access	Index Value	Moderately Insecure	Index Value	Severely Insecure	Index Value	Extremely Insecure	Index Value
GB Nagar	0.847	Mainpuri	0.797	Lucknow	0.698	Kanpur Dehat (Ramabai Nagar)	0.593	Basti	0.497
Ghaziabad	0.843	JP Nagar	0.735	Bareilly	0.698	GB Nagar	0.590	Chandauli	0.497
Meerut	0.834	Bulandshehar	0.733	Kushi Nagar	0.694	Kaushambi	0.589	Shravasti	0.382
Baghpat	0.825	Firozabad	0.726	Ambedkar Nagar	0.689	Hardoi	0.588	Mirzapur	0.362
Muzaffarnagar	0.809	Mathura	0.723	Shahjahanpur	0.678	Allahabad	0.587	Bahraich	0.358
		Agra	0.722	Jalaun	0.675	Balia	0.569	Balrampur	0.340
		Etah	0.698	Kheri	0.674	Banda	0.539	Chitrakoot	0.231
		Aligarh	0.680	Etawah	0.671	Deoria	0.538	Sonbhadra	0.054
		Saharanpur	0.667	Faizabad	0.661	Siddharth Nagar	0.528		
		Hathras (Mahamaya nagar)	0.661	Mau	0.658	Varanasi	0.524		
		Kannauj	0.654	Jaunpur	0.656	Sultanpur	0.513		
		Moradabad	0.652	SR Nagar	0.655	Maharajganj	0.510		
		Bijnor	0.646	Unnao	0.655				
		Budaun	0.639	JP Nagar	0.654				
		Farrukha-bad	0.634	Rae Bareli	0.652				
		Varanasi	0.628	SK Nagar	0.646				
				Azamgarh	0.643				
				Fatehpur	0.635				
				Ghazipur	0.634				
				Gorakhpur	0.633				
				Jhansi	0.628				
				Kanpur Nagar	0.617				
				Lalitpur	0.610				
				Mahoba	0.606				
				Hamirpur	0.604				
				Pratapgarh	0.604				

Source: Author's calculation.

The indicators to capture food accessibility are as follows:

1. **Proportion of Agricultural Labourers:** The proportion of agricultural labourers is taken as an indicator to denote food insecurity of the district. The total number of agricultural workers in Uttar Pradesh has been estimated at 259 million as of 2011. The National Commission for Enterprises in the Unorganized Sector (NCEUS) has characterized the agricultural labourers as extremely poor in terms of physical and human capital and also bearing the brunt of poverty (NCEUS, 2007). Thus, it is expected that the proportion of agricultural labourers will be negatively related to food security, i.e., the more the agricultural labourers in a district the worse will be the food security situation.

2. **Proportion of Scheduled Tribes and Scheduled Castes:** The ST and SC households are known to generally be more food insecure, largely on account of their economic and social backwardness. The more the district consists of these marginalized groups, the more insecure it is in terms of food security.

3. **Proportion of Working Age Population:** The working age population is considered to be the 'demographic dividend', and if effectively harnessed, leads to prosperity and hence food security (Chandrasekhar et al., 2006).

4. **Rural Female Literacy:** It is well known that there are gender-based inequalities in food consumption within a household. Numerous case studies show the existence of this inequality in household consumption (see those reviewed in Bina Agarwal, 1994). Further, studies also reveal the existence of very high incidence of anaemia among women and girls even in households that are not otherwise poor or nutritionally deficient. We have used the rural female literacy rate as the variable to represent the gender-based inequality in household consumption. The argument is that a higher literacy rate for women is more likely to enable them to enhance their roles in family decision-making and increase their share of household consumption. At the same time, higher women's literacy is also likely to lead to better knowledge of nutritional systems and improved health practices in the household.

4.3 Food Absorption

The ability of the body to translate food intake into nutritional status is mediated by a number of factors, some genetic and others related to hygiene and morbidity:

1. **Access to Safe drinking Water:** Studies have shown that water and sanitation accounts for a substantial portion of the difference in infant and child mortality rates experienced by the rich and the poor (Leipziger et al., 2003). Drinking water is a key factor in the body's use of consumed food. Empirical studies have shown that water quality is a big problem in the rural areas (Krishnan et al., 2003).The availability and quality of potable water is a big factor that affects food insecurity. A UNICEF study has pointed out that almost two million children die each year because of lack of clean water and sanitation (UNICEF, 2007c).

2. **Access to Primary Health Services:** Public health services, which reduce a population's exposure to disease through such measures as sanitation and vector control, are an essential part of a country's development infrastructure. In rural areas, all the health services are pivoted around the primary health centres, hence we have taken access to the same as a major indicator determining absorption.

5. Food Insecurity Index (Districts)

The FSI is a composite index covering three dimensions — Availability, Access and Absorption factors. The district with a higher index value is considered as relatively more food secure, as compared to districts with lower index values. All variables included in the index are for rural areas only as the National Food Security Bill 2013 focuses more on rural areas covering 75 per cent of the population. Now having ranked districts on FSOI and FSI based on three contingent parameters, availability, access and absorption, we tried of figure out overlaps between the ranks of districts on the FSOI and the ranks on the FSI. To put it in other words, do the districts with poor outcome index also have low availability, access and absorption?

For each variable, component and index, districts have been divided into five classes — Secure to Moderately Secure, Moderately Insecure, Severely Insecure and Extremely Insecure. The method used for making class intervals is the 'equal intervals' method, i.e., difference between all upper and lower class intervals for an indicator is the same. This method takes into account the range of the indicator's values and divides the range

Table 6: Status of Districts in Food Absorption Index

Secure	Index Value	Moderately Access	Index Value	Moderately Insecure	Index Value	Severely Insecure	Index Value	Extremely Insecure	Index Value
Hamirpur	0.865	Banda	0.697	Bahraich	0.594	Moradabad	0.488	Mahrajganj	0.384
Shahjahanpur	0.716	Ballia	0.683	Auraiya*	0.593	Rae Bareli	0.483	Agra	0.372
Mainpuri	0.711	Baghpat*	0.682	Gonda	0.590	Meerut	0.472	Hathras*	0.372
Jalaun	0.707	Chitrakoot*	0.678	Basti	0.585	Unnao	0.470	Kanpur Nagar	0.371
Deoria	0.700	Kannauj*	0.668	Jyotiba Phule Nagar*	0.585	Sant Ravidas Nagar Bhadohi*	0.459	Lucknow	0.342
		Azamgarh	0.637	Mau	0.583	Rampur	0.458	Chandauli*	0.309
		Buland-shahar	0.623	Kushinagar*	0.582	Sultanpur	0.441	Varanasi	0.284
		Mahoba*	0.614	Etawah	0.579	Gautam Buddha Nagar*	0.431	Mirzapur	0.263
		Barabanki	0.613	Pratapgarh	0.574	Fatehpur	0.427	Sitapur	0.182
		Kaushambi*	0.605	Etah	0.568	Hardoi	0.423	Sonbhadra	0.148
				Budaun	0.567	Ghaziabad	0.418	Allahabad	0.142
				Muzaffar-nagar	0.555	Mathura	0.402		
				Gorakhpur	0.552				
				Farrukhabad	0.550				
				Ghazipur	0.546				
				Kheri	0.544				
				Lalitpur	0.540				
				Aligarh	0.539				
				Bareilly	0.531				
				Siddharth-nagar	0.531				
				Jhansi	0.528				
				Balrampur*	0.524				
				Firozabad	0.523				
				Jaunpur	0.523				
				Saharanpur	0.521				
				Kanpur Dehat	0.518				
				Bijnor	0.518				
				Faizabad	0.518				
				Ambedkar Nagar*	0.514				
				Shrawasti*	0.510				
				Sant Kabir Nagar*	0.506				
				Pilibhit	0.505				

Source: Author's calculation.

Table 7: Status of Districts in Food Security Index

Secure	Index Value	Moderately Secure	Index Value	Moderately Insecure	Index Value	Severely Insecure	Index Value	Extremely Insecure	Index Value
Baghpat*	0.817	Kannauj*	0.694	Shahjahanpur	0.600	Mahoba*	0.499	Mirzapur	0.337
Mainpuri	0.781	Aligarh	0.678	Rampur	0.594	Hardoi	0.494	Sonbhadra	0.299
Muzaffarnagar	0.742	Firozabad	0.667	Azamgarh	0.591	Fatehpur	0.492	Sitapur	0.221
Bulandshahar	0.723	Saharanpur	0.661	Deoria	0.586	Varanasi	0.479		
Etah	0.708	Jyotiba Phule Nagar*	0.658	Pilibhit	0.584	Kaushambi*	0.475		
Meerut	0.700	Bijnor	0.657	Ballia	0.583	Sultanpur	0.470		
Budaun	0.700	Ghaziabad	0.656	Gonda	0.578	Sant Ravidas Nagar Bhadohi*	0.455		
		Mathura	0.652	Mau	0.573	Mahrajganj	0.439		
		Barabanki	0.649	Jaunpur	0.570	Bahraich	0.430		
		Farrukhabad	0.640	Kushinagar*	0.561	Chitrakoot*	0.429		
		Moradabad	0.631	Ghazipur	0.561	Chandauli*	0.414		
		Hamirpur	0.626	Pratapgarh	0.560	Allahabad	0.412		
		Auraiya*	0.626	Kheri	0.560	Balrampur*	0.400		
		Gautam Buddha Nagar*	0.622	Ambedkar Nagar*	0.555				
		Hathras*	0.609	Faizabad	0.550				
		Jalaun	0.609	Gorakhpur	0.545				
		Etawah	0.607	Kanpur Dehat	0.544				
		Agra	0.601	Banda	0.544				
		Bareilly	0.601	Unnao	0.542				
				Shrawasti*	0.540				
				Lalitpur	0.529				
				Sant Kabir Nagar*	0.525				
				Siddharth nagar	0.521				
				Rae Bareli	0.519				
				Basti	0.518				
				Jhansi	0.515				
				Lucknow	0.505				
				Kanpur Nagar	0.503				

Source: Author's calculation.

Table 8: Status of Priority Districts in FSI and FSOI

Districts	Criteria	FSI	FSOI	Region	Districts	Criteria	FSI	FSOI	Region
Ballia	FSOI	32	46	Eastern	Ghaziabad	FSOI	14	64	Western
Ambedkar Nagar	FSOI	40	47	Eastern	Kanpur Nagar	FSOI	54	65	Central
Deoria	FSOI	30	48	Eastern	Mahoba	FSOI & FSI	55	66	Bundelkhand
Moradabad	FSOI	18	49	Western	Lucknow	FSOI	53	67	Central
Kanpur Dehat	FSOI	43	50	Central	Sultanpur	FSOI & FSI	60	68	Eastern
Muzaffarnagar	FSOI	3	51	Western	Hamirpur	FSOI	19	69	Bundelkhand
Azamgarh	FSOI	29	52	Eastern	Jhansi	FSOI	52	70	Bundelkhand
Gautam Buddha Nagar	FSOI	21	53	Western	Mirzapur	FSI	68	25	Eastern
Fatehpur	FSOI & FSI	57	54	Central	Sonbhadra	FSI	69	31	Eastern
Baghpat	FSOI	1	55	Western	Sitapur	FSI	70	13	Central
Jalaun	FSOI	23	56	Bundelkhand	Hardoi	FSI	56	5	Central
Rae Bareli	FSOI	50	57	Central	Varanasi	FSI	58	33	Eastern
Etawah	FSOI	24	58	Western	Kaushambi*	FSI	59	7	Eastern
Auraiya	FSOI	20	59	Western	Sant Ravidas Nagar Bhadohi*	FSI	61	2	Eastern
Gorakhpur	FSOI	42	60	Eastern	Mahrajganj	FSI	62	14	Eastern
Mathura	FSOI	15	61	Western	Bahraich	FSI	63	28	Eastern
Agra	FSOI	25	62	Western	Chitrakoot*	FSI	64	15	Bundelkhand
Meerut	FSOI	6	63	Western	Chandauli*	FSI	65	24	Eastern
Allahabad	FSI	66	17	Eastern	Balrampur*	FSI	67	12	Eastern

Source: Author's calculation.

into five equal classes. The number of districts in different classes can be different.

Table 7 shows the status of the districts in terms of FSI. Ranking of districts on all the parameters of availability, accessibility and absorption reveals that Bagpat (0.817), Mainpuri (0.781), Muzaffarnagar (0.742), Bulandshahr (0.723), Etah (0.708), Meerut (0.700), Budaun (0.700) are the food secure districts of the state. About 28 districts were found to be moderately secure, 13 districts are severely insecure and three, Mirzapur, Sonbhadra and Sitapur, are extremely insecure. Sonebhadra, which is fairly urbanized and hence moderately insecure in outcome, is extremely insecure in food availability, food absorption and food accessibility indices — thus reflecting upon the rural–urban inequalities.

6. Grouping of Districts on FSOI and FSI

As a measure to identify those districts that lie in the most critical state, it is imperative to analyze the relative ranking of the districts in both food insecurity outcome and food security indices (Table 8). It is expected that a

district that has a very high child mortality and under nutrition status, and at the same time ranks poorly in terms of availability, access and absorption indicators, should be identified as the district with topmost requirement of attention of the development planners. Based on this premise, this study identifies 38 districts that rank extremely low in both these indices and need urgent action.

Having earmarked the districts that require priority intervention, it would be pertinent to look for the priority areas of intervention. The correlation matrix of the availability, access, absorption, the FSI and FSOI indices shows that the access indicators are closely related to FSI and negatively associated to FSOI (Table 9). Of all the indicators, access to food is more closely and significantly related to the other two indicators of food insecurity, so the factors ensuring access should be taken up on a priority basis. In total, 16 districts belong to eastern region, seven to central region, 10 to western region and five to Bundelkhand region of the state.

The districts and social groups most beset by hunger and food insecurity are largely identified through this exercise and call for priority intervention by the State Government and other stakeholders, by formulating policies for enhancing availability by increasing production and productivity by launching various programmes. An attempt has been made to identify areas of interventions for priority districts of Uttar Pradesh. The FSOI and FSI have helped in identifying priority districts which need special attention from policy formulators and the State Government. As the unit of analysis is district and with one administrative unit where various programmes are launched, this effort would definitely help in sorting the food insecurity issue, and specific intervention can be framed in that particular district.

7. Conclusion and Policy Implications

The districts which suffer the most due to hunger and food insecurity have been identified in the analysis done in previous sections, or to put it differently these are districts which need priority attention from the policy interventionists of the State of Uttar Pradesh. Broadly speaking, one can find the causes of insecure districts and chalk plans to solve various problems beset through availability, accessibility or in the absorption process. If availability of food creates the problem, improvement in irrigation and agricultural productivity could solve it. Income from agriculture could be improved through better road connectivity. Access to food could be improved with better planning and providing better wages and enhancing the status of women through literacy and empowerment. The government schemes could also help in procuring food through various programmes, be it TPDS, ICDS and Mid-day Meal Scheme. Better provisioning of water and sanitation will help to deliver the required absorption capacity of humans.

Development Economists Dreze says 'under National Food Security Bill, Uttar Pradesh will see the maximum increase in food grain allocation, but the biggest challenge yet will be to confront vested interests'. However, if Uttar Pradesh adopts some of the reforms from Chhattisgarh

Table 9: Correlation between Availability Index, Access Index, Absorption Index, Food Insecurity Index and Food Security Outcome Index (Rank value)

	Availability	Access	Absorption	FSI	FS0
Availability	1	.498**	.215	.815**	–.104
Access		1	.091	.761**	–.075
Absorption			1	.567**	.019
FSI				1	–.078
FSOI					1

Note :
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

model of public distribution system, it could tackle the problem of leakages (*The Hindu*).

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Appendix I: Technical Notes

1. Food Security Indices

The indicators chosen for analyses have been aggregated into various indices. To remove the biasness of scale that characterizes each indicator, the Range Equalization (RE) method as adopted by the UNDP in computing Human Development Index (HDI) has been used. Maximum and minimum 'goalposts' have been determined based on the feasible upper and lower limits of the values. If the indicator chosen is a 'positive' indicator, i.e., positively related with food security (for instance, female literacy, irrigation extent, etc.), the minimum goal post is subtracted from the actual value of the indicator and divided by the range. Whereas, for 'negative' indicator, i.e., one that is inversely related with food security (for e.g., proportion of scheduled castes and tribes), actual value is subtracted from the maximum goalpost and divided by the range.

This can be illustrated as follows:

(a) For positive indicator: $$i = \frac{Xi - Min\ g}{Max\ g - Min\ g}$$

(b) For negative indicator: $$i = \frac{Max\ g - Xi}{Max\ g - Min\ g}$$

Where: Xi = actual value

Max g = maximum goalpost

Min g = minimum goalpost

2. Class Intervals

The indices and values of indicators have been divided into five classes based on Equal Intervals approach taking into account the range of the values of that indicator.

Appendix II: Indicators Used to Calculate Indic s

Table 10: Indicators used to Analyze Food Insecurity

	Indicator	Method of Calculation	Source
Food Availability	1. Per Capita Value of Agricultural Production(in Rs)	Total value of production of all crops has been calculated by multiplying the total production with constant 1993–94 all-India prices of the crop. Triennium averages of value of production have been used. Finally, the per capita value of production is taken out by dividing it by the mid-year rural population.	District-wise Development Indicators, UP, 2012
	2. Proportion of Forest Area to Total Geographical Area (in percentage)	This indicator has been used as a negative indicator in the indices. District-wise Development Indicators, UP, 2012	District-wise Development Indicators, UP, 2012
	3. Irrigation Extent (in percentage)	Proportion of net irrigated area to net sown area	District-wise Development Indicators, UP, 2012
	4. Rural Connectivity (in percentage)	Proportion of villages having access to paved road to total number of villages in the district	District-wise Development Indicators, UP, 2012
Food Access	1. Proportion of Agricultural Labourers (in percentage)	Sum of agricultural labourers (main and marginal) is divided by total workers. This has been used as a negative indicator in the index.	Census, 2011
	2. Proportion of ST and SC Population (in percentage)	Sum of rural ST and SC population is divided by rural population of the district. This has been used as a negative indicator in the index.	Census, 2011
	3. Proportion of Working-age Population (as ratio)	Rural population in the age group 15–59 years is divided by the sum of 0–14 years' population and 59+ years' population	NSSO, 2009–10
	4. Female Literacy (in percentage)	Proportion of literate females in rural areas (in 7+ age population) to rural female population in the same age group	Census, 2011
Food Absorption	1. Access to Safe Drinking Water (in percentage)	Proportion of rural households having access to safe drinking water	District-wise Development Indicators, UP, 2012
	2. Access to Primary Health Services (in percentage)	Primary Health Center (PHC) per lakh of Population	District-wise Development Indicators, UP, 2012

"If you can't feed a hundred people, then feed just one."

– Mother Teresa

Food and Nutrition Security: An Exercise in Locating Ground-truth Among Tribals

NITIN TAGADE AND R.S. DESHPANDE

Food security has been a singular concern in India for the last century. Policies were made, strategies were formulated to overcome food and nutrition deficiency, but with a marginal dent. Macro data, however, paints a rosy picture of a food-sufficient India. But even six decades after Independence, we cannot say that India is fairly comfortable in all its regions with regard to food availability. The strategies implemented thus far focused on food production, distribution, employment generation and emphasizing fair prices.

This paper is based on a field study to understand the issue of food insecurity/access in the tribal-dominated areas of Maharashtra, at micro level as against the comfortable situation shown by many. A comparison of food insecurity between the tribals and non-tribals reveals a higher incidence among the tribals as compared to non-tribals, and hence the former group will have to be carried to the very distant goal with an extra push. Their dependence for nutrition on the forest products to which the access is denied through state control needs to be understood as a deliberate policy to keep them away from food of their liking. State should build the capabilities of the tribal communities to overcome food insecurity, particularly in distress situations with the help of their own initiatives.

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1. Introduction

Food security has been the major concern and the central point of our agricultural policy since long. Our efforts on policy could be traced from the official documents beginning from Food grains Policy Committee of 1943 (Gregory, 1943), Maitra (1950), Mehta (1957), Venkatappaiah (1966) to the Report of the High Power Committee (GoI, 1990a & b) that made recommendations covering major sectors of the agricultural economy. A policy study by ASSOCHAM (1998), the Long Term Grain Policy Committee (Chair: Abhijit Sen, GoI, 2002) and Farmers' Commission headed by Dr Swaminathan (GoI, 2004) also focused on food security issues. These important documents flag some of the milestones in making India food-sufficient through their wide-ranging recommendations and the results obtained call for close scrutiny. The period after Independence witnessed broadly five important policy directions, namely (i) Food security, (ii) Institutions for food administration, (iii) Introduction and dissemination of technology to increase food production, (iv) Reaching food to the under-developed regions, classes, farmers (v) Enabling access to food both in physical and economic terms. However, we cannot deny the fact that India is notcomfortable on food security issues. In any case, India is far away from the Millennium Development Goals (MDG) mandated targets. The questions thrown at us include: Have we failed in policy frame? Have our policy documents stayed only in the shelves of the food ministry? Is the problem so enormous that we cannot grapple with it? Are the diversities posing a formidable challenge for us? We feel all these are striking a note about our failures and distance from MDGs.

India has significant regional diversity in its agriculture and that is also reflected in the availability and

access to food. There are regions coexisting with abundance of food and at the same time pockets with extreme shortages. It is no more surprising to hear reports of tons of grains rotting in the FCI godowns and at the same time some sections (usually the same spots) in the country are denied food or there are reports of starvation deaths. Unfortunately, even our definition of food grains is dominated only by wheat and rice (the food grains identified with high/middle income groups) and if these two are taken out of the total, we are extremely insufficient on the availability calculus. The often evaded issue in the food security analyses is the regional diversity and ethnic differences in tastes, access and availability of food. Surprisingly, the states or regions that depict good economic progress also have a hungry belly deep inside their forested regions. Any analysis across states reveals this. We looked into the cross-section of the states briefly and then zeroed on Maharashtra (a well-developed state), to study its march towards Sustainable Development Goals (SDGs). The choice was purposive as the 'advanced state' image of Maharashtra has a lot under its mask, only visible to a critical analyst.

Maharashtra has not only been proclaimed as one of the economically developed states, but has also remained at the top among the states in terms of some usual economic progress indicators. The Gross State Domestic Product (GSDP) and Per Capita Income (PCI) put the state among the top three economically developed states. The GSDP of Maharashtra for 2013–14 worked out to Rs 13.3 lakh crore at 2004–05 constant prices. In addition to this, PCI of the state has been consistently above the national average (GoI, 2006). Nevertheless there is another perspective, which we may call as the demand side perspective, wherein some social groups in the state suffer from perpetual poverty.

2. Sample and Design

The analysis is carried out using both primary and secondary information. The secondary sources include data from Central Statistics Office (CSO), National Sample Survey Office (NSSO), National Family Health Survey (NFHS) and Census of India for macro understanding. To comprehend the micro realities, primary-level information was collected from selected households, about their socio-economic conditions along with dietary specifications and anthropometric measures,from four tribal-dominated districts of Maharashtra in 2007–08. The sample survey covered 239 households in tribal-dominated areas of Maharashtra. The basic criterion for selecting households was three-stage stratified sampling method. Households with at least one child below six years of age were listed and the sample was drawn out of this group. To reach the households in the villages, we adopted a four-stage selection procedure. In the first stage, districts with tribal population higher than the state average were divided into four categories based on the level of poverty and child malnutrition — these two indicators attribute to food insecurity levels, first being a major cause and second being an outcome (Table 1). These four categories include High Poverty and Low Malnutrition (HPLM), Low Poverty and High Malnutrition (LPHM), High Poverty and High Malnutrition (HPHM) and Low Poverty and Low Malnutrition (LPLM).[1] These categories are necessarily made for the reason that each these regions are homogeneous in nature at the aggregate level, being tribal-dominated, however, geographical and economic heterogeneity differs across regions resulting in different levels of child undernutrition and poverty. In these four categories, one district each was selected for the survey, namely, Nagpur, Gadchiroli, Nandurbar and Raigarh. In the subsequent stage, 30 households with at least one child below six years of age were selected randomly from a list provided by the primary school in each selected village. Anthropometric data were collected from the households — the height and weight were measured for all children along with their actual date of birth. Based on this information, the nutritional status has been estimated for 342 children below six years of age born to 248 mothers in 239 households of both tribal and non-tribal communities using WHO method.

3. Macro Scene of Access to Food and Nutrition

3.1. Food Availability

The foodgrain availability is the initial step to ensure food security. In India, a number of steps have been taken to improve foodgrain production, such as use of high-yielding seeds, new technology, fertilizers and pesticides, intensive cropping patterns, irrigating and bringing larger areas under crop. The result of these initiatives is quite astonishing with increased foodgrains production leading to higher level of net availability of foodgrains. From 1951 to 2011 net foodgrain production increased from 52 MT to 203 MT with year to year variations (Figure 1). This is heralded as an exemplary achievement and we had the euphoria of having crossed the hurdle of food insecurity. The variations particularly increased from 1970s onward with higher production level, although foodgrain production in India is

largely dominated by cereals and pulses. It is observed that net availability increased from 1951 till 1972 and then demonstrated deceleration in growth till 1984. After that the CGR in net availability picked up till 1997, but later stagnated with an exception of one year when it showed a negligible peak in 2002.

Table 1: Poverty and Malnutrition in Districts with ST Population above State Average

Groups	High Malnutrition		Low Malnutrition	
High Poverty	Nandurbar	(65.5, 49, 67.4)	Nagpur	(10.9, 35.27, 46.2)
	Dhule	(26, 49, 52.4)		
	Nashik	(23.9, 35.44, 58.8)		
	Wardha	(12.5, 30.5, 52.5)		
	Chandrapur	(18.1, 33.02, 59.1)		
	Yavatmal	(19.3, 30.43, 60)		
	Amravati	(13.7, 31.11, 55.9)		
	Jalgaon	(11.8, 44.3, 51.4)		
Low Poverty	Gadchiroli	(38.3, 26.67, 61.9)	Raigarh	(12.2, 8.44, 39.4)
	Thane	(14.7, 13.11, 48.5)		

Note: 1. Figures in parentheses indicate the percentage of ST population (2001), poverty ratio during 1993–94 and the percentage of malnutrition among children below six years during 1999–2000 in the district, respectively.
2. The threshold taken in the above table for ST population (2001), poverty (1993–94) and proportion of malnourished children below six years (1999–2000) are 8.9, 28.4 and 47.7 per cent respectively.
3. Remaining districts with lower percentage of ST population than the state average with poverty and malnutrition is given in the Appendix.

Source: Based on RCH 2 (2002–04) and Planning Commission (2007)

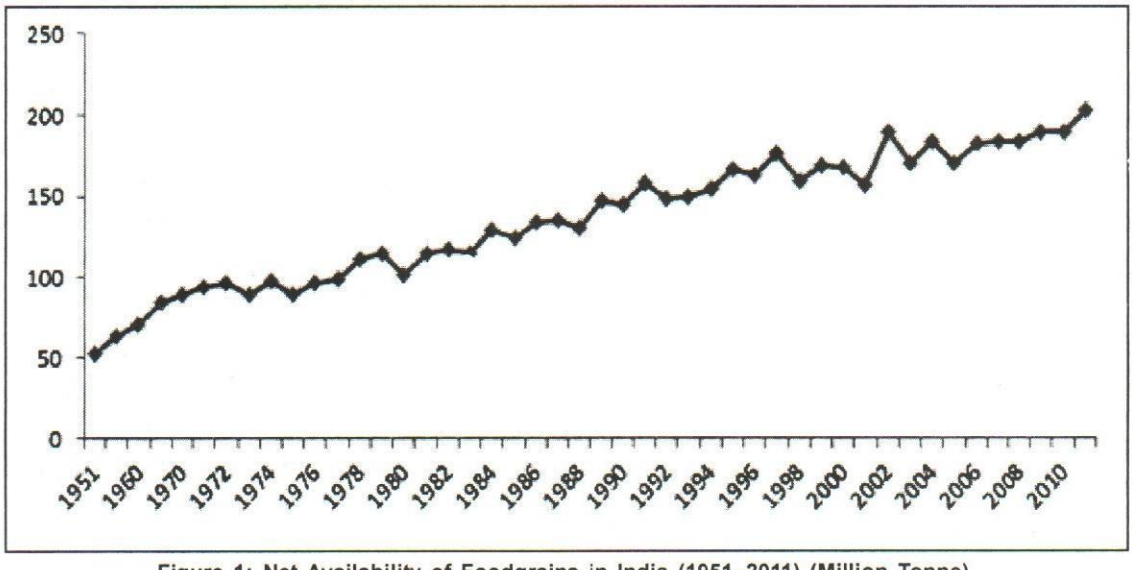

Figure 1: Net Availability of Foodgrains in India (1951–2011) (Million Tonne)

Note: Net availability of Foodgrains is the sum of Foodgrains produced and imported.
Source: Economic Survey (Various Years)

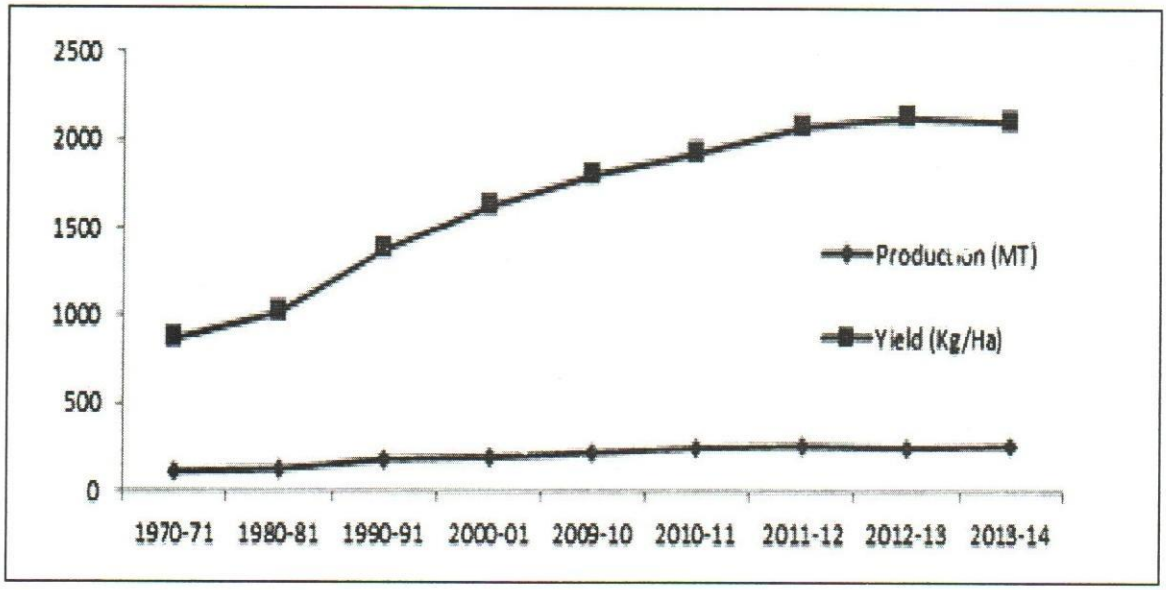

Figure 2: Per Capita Net Availability of Cereals and Pulses in India (1971–2013) (in gram)

Source: Economic Survey (Various Years).

The production of cereals was always higher than pulses and therefore the trend of cereals production determined the production of total food grain availability. The shortage of pulses and the stagnation of production of pulses was well observed in 1980s and 1990s. We continued to import and the import of pulses escalated during last two decades. The per capita net cereals production increased from 418 grams to 469 grams during 1971 to 2013, while the production of pulses declined from 51 grams to 41 grams during the same period (Figure 2).

3.2. Poverty

Poverty has been accepted in theory as one of the direct correlates of malnutrition and food insecurity. Most studies on poverty focus on the mundane measurement debates, statistical systems, small vs. large sample debates and the performance over time (decline or otherwise of head count ratios) (Subramanian, 1997; Deaton & Kozel, 2005). The underbelly of poverty remained on the margins of the analyses. The level of poverty between tribal and non-tribal populations is estimated based on the Tendulkar Method for 2011–12 (Figure 3). In India, poverty is 43 per cent among tribals and 20 per cent among non-tribals (the differences would have been even larger if poverty for Scheduled Castesis excluded from the non-tribal groups). The poverty numbers had come under severe scan and the debate about the reduction in poverty ratios, as also an apt rejoinder by Utsa Patnaik (2013), are fresh even now. Still accepting the official figures, the states with dominant tribal population continue to show high density of poverty. The difference in the poverty level between these two groups is 23 percent points, indicating higher level of poverty among tribals in India. Theoretically, we do not find significant answers for the higher poverty among Scheduled Tribes. Reason may lie in our definition of poverty or even the composition of food basket.

State-wise variations exist in terms of poverty level among tribals, with highest in Odisha — it is the state with highest poverty even among non-tribals, after Madhya Pradesh. Another way of looking at poverty among tribals could be through the differences between tribal and non-tribal communities (Figure 4). The state-wise differences are particularly higher in the states of central tribal region, ranging from 11 per cent points in Karnataka to 41 per cent points in Maharashtra. The differences in north-eastern regions are favourable for tribals in states like Mizoram, Nagaland, Sikkim, Arunachal Pradesh and Assam. It is clear that poverty among tribals is higher in Maharashtra and this can also be due to the NSSO approach in understanding what constitutes food. Tribal families largely depend on the fresh material available from forests, of which nutrition calculation is neither possible nor undertaken under NSSO household surveys. It is the barrier created by the state forest policy that is inhibiting the tribals to use the forest products as freely as they used to earlier.

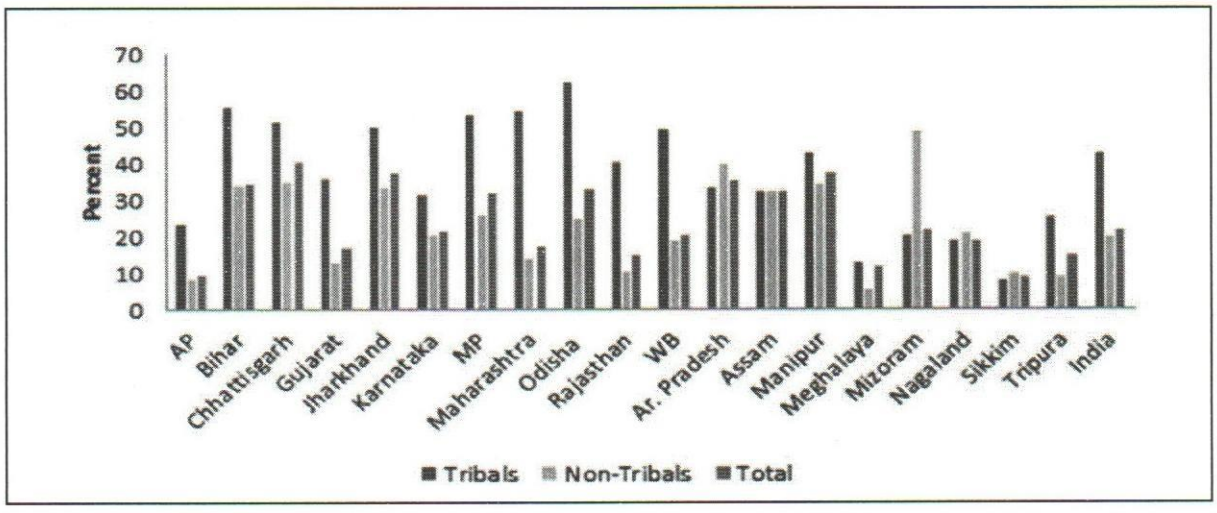

Figure 3: Poverty in India (2011–12) (in per cent)

Source: Author's estimates based on NSSO 68th Round on Consumption Expenditure

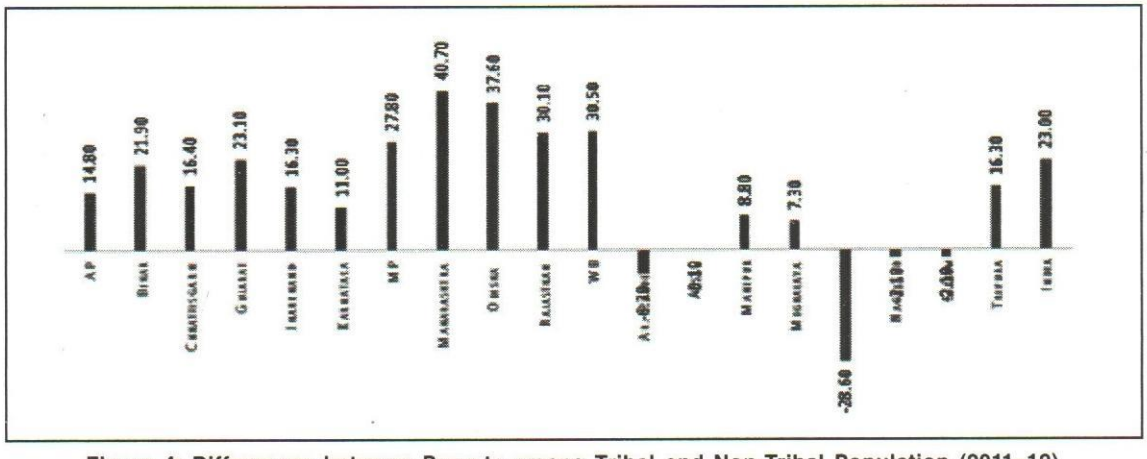

Figure 4: Differences between Poverty among Tribal and Non-Tribal Population (2011–12)

Source: Author's estimates based on NSSO 68th Round on Consumption Expenditure

3.3. Malnutrition

Malnutrition is also a specific feature and enemy of the children belonging to Scheduled Castes & Tribes. Malnutrition has always been a major issue in India because it decides the cognitive development in the early age. Undernutrition is measured with the help of three indicators, namely underweight, wasting and stunting. Underweight is a composite index of measuring acute and chronic undernutrition, which shows the low weight for a given age, while wasting measures acute undernutrition that shows low weight for a given height, and stunting measures chronic undernutrition indicated by low height for a given age. In India, undernutrition or malnutrition is a universal problem. In Table 2, the level of low weight among children below three years of age across states in India have been compared with the Gross State Domestic Products (GSDP) for three time periods, i.e., for 1991–92, 1998–99 and 2005–06, and classified as states with high GSDP, with low and high level of underweight and low GSDP with low and high level of underweight. From 1991–92 to 2005–06, the number of states have increased in both the groups. In this, Maharashtra is consistently in the group of high GSDP, but the state lost the low level of undernutrition in the next second period and recovered in the third period marginally. It is an irony that a state with high economic performance has a pathetic performance in ensuring food security for the most vulnerable group.

In 2005–06, about 46 per cent of the children below five years are malnourished, with relatively higher share in rural areas with socially and economically weaker sections

in Maharashtra. However, surprisingly the level of malnutrition is very high among tribals concentrated in certain pockets of the states (Figure 3).[2] About 57 per cent of children among tribals are underweight, 21 per cent wasting and 58 per cent are stunting; while this proportion among non-tribals is 34 per cent, 16 per cent and 44.6 per cent respectively. The differences between these two groups was more than 20 per cent points in 2005–06 and the concern over the issue of undernutrition further becomes intense when we read these results in the light of the fact that the non-tribals also include children belonging to Scheduled Castes and Other Backward Communities.

Table 2: Classification of States across the Levels of GSDP and Underweight

GSDP	1991–92		1998–99		2005–06	
	High Under-nutrition	Low Undernutrition	High Undernutrition	Low Undernutrition	High Undernutrition	Low Undernutrition
High GSDP	Bihar and West Bengal	Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, **Maharashtra**, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh	Madhya Pradesh, Uttar Pradesh, Rajasthan, **Maharashtra** and West Bengal	Andhra Pradesh, Delhi, Gujarat, Karnataka Kerala, Madhya Pradesh, Punjab, Rajasthan and Tamil Nadu	Gujarat, Madhya Pradesh, and Uttar Pradesh	Andhra Pradesh, Delhi, Haryana, Karnataka, Kerala, **Maharashtra**, Punjab, Rajasthan, Tamil Nadu, West Bengal
Low GSDP	Odisha	Tripura, Nagaland, Meghalaya, Manipur, Kerala, Himachal Pradesh, Haryana, Goa, Delhi, Assam, and Arunachal Pradesh	Odisha, Bihar	Arunachal Pradesh, Assam, Bihar, Goa, Haryana, Himachal Pradesh, Manipur, Meghalaya, Nagaland, Orissa, and Tripura	Bihar and Meghalaya	Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Manipur, Nagaland, Odisha, and Tripura

Source: Complied based on Nair (2007); IIPS (1994, 2000 and 2007); and CSO website

Notes: 1. Low and high levels of undernutrition and Gross State Domestic Product (GSDP) is the lower and higher level of undernourished children below three years.

2. Low and high levels of GSDP is the lower of higher GSDP than averages of all the states and UTs for the period of TE 1992–93, TE 1995–96, and TE 2005–06.

3. GSDP is at Constant Prices at 1993–94.

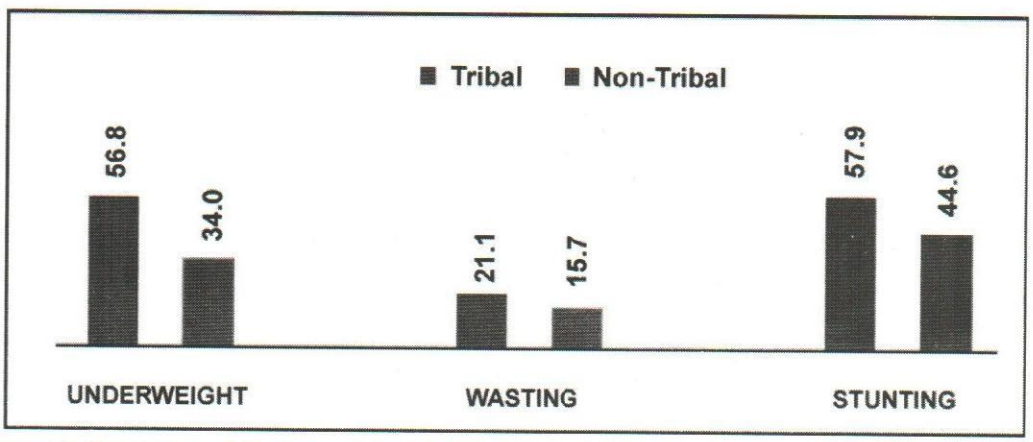

Figure 5: Proportion of Undernourished Children below 5 Years in Maharashtra (2005–06) (in per cent)

Source: Authors' estimates based on NFHS-3

The recent available information based on District Level Household Survey for 2011–12 presented in Figure 4 shows that Maharashtra has relatively higher proportion of underweight children (47.2 per cent) as compared to that in rest of India (41.2 per cent). The differences between tribal and non-tribal communities are much larger in the case of Maharashtra than in rest of India.

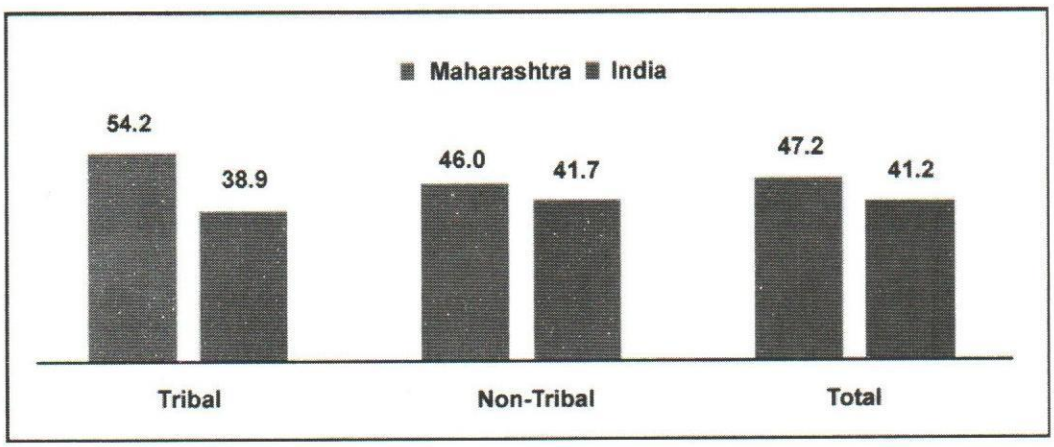

Figure 6: Proportion of Underweight Children below 5 Years in Maharashtra (2012–13) (in per cent)

Source: Author's estimates based on DLHS-4

3.4. Food Availability at Regional Level

Food availability has been estimated based on per adult food supply through agricultural foodgrain production, after reducing the wastages and seeds assuming that production is used only for consumption purpose.[3] Over time, food availability has not only been declining in the state but also across regions, as the per capita foodgrain production is declining.

Table 3: Per Capita Foodgrain Production and Population Growth across Regions of Maharashtra

(In Kg)

Regions	Per Capita Foodgrain Production (PCFP)					Percentage Change in PCF	Population Growth Rate
	1961	1971	1981	1991	2001	(1961 to 2001)	
Coastal*	102	104	90	65	91	–10.4	4.7
Inland Western	317	153	225	207	147	–53.5	3.3
Inland Northern	287	216	256	285	108	–62.0	3.4
Inland Central	452	187	311	328	282	–37.5	3.7
Inland Eastern	334	130	233	269	158	–52.5	3.2
Eastern	378	336	343	276	162	–56.9	2.9
Maharashtra	292	161	195	210	159	–45.3	3.6

Source: Based on Directorate of Economics and Statistics, GoM (Various years) and EPWRF (2004) and Maharashtra General Economic Tables, Census of India, GoI (Various years).

Note: 1. *indicates that the figures for coastal regions are estimated excluding Mumbai suburban and Gr. Bombay/Mumbai.

2. The 12.5 per cent of the total foodgrain production has been deducted inwastages and seeds

It is to be noted that on an average, per capita foodgrain production was found to be the lowest in the coastal region and highest in the inland central region. In 1961 as well as in 2001, per capita foodgrain production was found to be the highest in the inland central region, followed by the eastern region; whereas, it is the lowest in the coastal region followed by the inland northern region.

4. Micro Realities: The Primary Survey

4.1. Aggregate Scenario

Good economic growth and undernutrition should not coexist, but we noted that this cannot be a universal rule. We also observed that at the country level our per capita availability gives a somewhat satisfactory look, but has turned the corners around. Have we been able to reach the corners of the country predominated by undernutrition and malnutrition? The answers are not very satisfactory. The macro picture gets blurred as we try to understand the realities at the underbelly. It is stark when we compare tribal and non-tribal population. Therefore, further investigation is carried out to understand the micro realities from the information collected from the households in different tribal regions of Maharashtra.

Our initial understanding of poverty and malnutrition in the study area clearly indicates the operation of a vicious circle. A substantial non-food need is not met due to insufficient purchasing power, and as a result, a large proportion of income goes to meet food expenditure. The health care facilities, a major non-food item, is provided by the government in the study area, however, it is not efficiently accessible due to lack of infrastructure and trained health personnel on the supply side; while on the demand side, major hurdles are lack of awareness, dependence on traditional healers and low educational attainment.

A substantially high share of income spent on food is seldom associated with calorie intake, not only due to low quantum of food but also low quality of food. As a result, the proportion of the poor in the study area is remarkably high, at over 69 per cent, with mean calorie intake being far less than prescribed by ICMR norms (Table 4).[4] These together adversely influence the nutritional status among children below six years of age, as they are the most vulnerable to changes caused by variations in either food intake or environmental factors. Five children out of every six are underweight in some way or the other in the study area; 61 per cent children are moderately underweight and 21 per cent are severely underweight. The levels of chronic and acute undernutrition are not very different from the above. The total chronically undernourished (stunting) children account to about 75 per cent, while acute undernourished (wasting) are 58 per cent. A relatively higher level of poverty, higher number of malnourished children and lower mean calorie intake are more evident among tribal communities than non-tribals. Among tribal communities, poverty is as high as 88 per cent, underweight about 97 per cent, wasting over 65 per cent and stunting over 83 per cent (Table 4).

Table 4: Food Insecurity in the Area

Indicator of Food Insecurity		Tribal	Non-tribal	All	N
Poverty (percentage)	BPL	88.27	70.13	69.30	197
	APL	11.73	29.87	30.70	42
Calorie Intake (Kcal)	Mean	2,048	2,101	2,065	239
Stunting (percentage)	Severe	22.94	15.32	20.50	70
	Moderate	60.45	40.54	54.09	185
	Total	83.39	55.86	74.59	255
Wasting (percentage)	Severe	16.45	6.31	13.16	45
	Moderate	48.92	35.14	44.44	152
	Total	65.37	41.45	57.60	197

Underweight (percentage)	Severe	26.84	14.41	22.81	78
	Moderate	68.83	44.14	60.82	208
	Total	95.67	58.55	83.63	286

Source: Primary Survey

Note: 1. BPL and APL denotes Below Poverty Line and Above Poverty Line which has been estimated based on the Official Poverty Line provided by the Planning Commission of India.

2. The indicators of undernutrition are grouped as severe and moderate. It is to be noted that moderate undernutrition includes severe undernutrition.

4.2. Food Insecurity at Disaggregate Level

The vicious circle of high poverty, resulting in low calorie intake and high child undernutrition, further leading to perpetuated poverty in the study region, needs to be explored across regions. This is necessary mainly because each region differs from the other and represents differential levels of food insecurity areas, so the geographical advantages and disadvantages in terms of varying degrees of access to forest-based products may have a different impact on every region. The levels of undernutrition across regions are presented in Table 5. Based on the extent of undernutrition, different regions can be grouped into three broader categories. These three categories include high, medium and low levels of child undernutrition. The regions with the highest degree of severe and moderate undernutrition are included in the category of 'higher extent of undernutrition', and regions with a medium proportion of severe undernutrition but suffer from highest degree of moderate undernutrition are included in the second category, i.e., 'medium extent of undernutrition', whereas the third group, i.e., 'low extent of undernutrition', includes regions with low levels of both severe and moderate child undernutrition. The HPHM region falls under the first category while the LPHM region comes under the second category. The two regions, i.e., LPLM and HPLM, fall under the third category of lower extent of undernutrition.

The HPHM region falls under the first category of high degree of undernutrition because, on the one hand, it shares the highest proportion of severely wasted, stunted and underweight children accounting for 17 per cent, 29 per cent and 30 per cent, respectively. On the other hand, it has the highest proportion of moderately stunted children accounting for more than 69.8 per cent, along with about 41 per cent of moderately wasted children and over 58 per cent of underweight children. In the LPHM region under the second group, poverty is highest with low per capita calorie intake, in which the proportion of moderately wasted and underweight children is highest across regions, along with relatively low levels of severely undernourished children compared to the HPHM region. The percentage of moderately wasted and underweight children in this region constitute about 52 and 68 per cent, respectively; while 55 per cent are moderately stunted. The third group includes the HPLM and LPLM regions. In the HPLM region, the proportion of severely stunted and underweight children is lowest, whereas the proportion of severely wasted children is lowest in the LPLM region.

On the other hand, the level of moderately stunted children is lowest in the HPLM, while the proportion of moderately wasted is lowest in the LPLM region. It is interesting to note that LPLM region has the lowest poverty ratio while the second highest poverty ratio is in the HPLM region. Thus, the extent of undernutrition is high in those regions which are selected based on high level of child undernutrition, following the regions with high level of poverty. It needs further investigation to understand in what ways these three groups of regions differ from each other in terms of extent of undernutrition. Therefore, this issue has been further investigated in detail to understand whether it holds equally among tribal and non-tribal populations.

Prima facie the evidences on the basis of primary survey are corresponding with the criteria of sample selection, as the extent of undernutrition is high in the HPHM region, which declines in the LPHM, HPLM and LPLM regions. The macro-level information for each of these regions are presented in Table 5 for understanding how this information correlates with micro-level understanding. The HPHM region has the highest share of ST population

Table 5: Prevalence of Undernutrition across Regions (percentage)

Regions	Wasting			Stunting			Underweight		
	Tribal	Non-tribal	All	Tribal	Non-tribal	All	Tribal	Non-tribal	All
Severely Undernourished									
HPLM	19.1	9.1	13.9	23.8	9.1	16.3	20.9	11.6	16.3
LPHM	17.2	0.0	14.3	17.4	20.0	17.9	25.7	35.7	27.4
HPHM	24.5	6.1	17.4	32.1	24.2	29.1	39.6	15.2	30.2
LPLM	7.7	4.8	7.0	21.5	9.5	18.6	21.5	4.8	17.4
Moderately Undernourished									
HPLM	45.2	54.6	50.0	59.5	29.6	44.2	67.4	48.8	58.1
LPHM	52.2	53.3	52.4	58.0	40.0	54.8	72.9	42.9	67.9
HPHM	56.6	15.2	40.7	67.9	72.7	69.8	64.1	48.5	58.1
LPLM	40.0	19.1	34.9	56.9	19.1	47.7	69.2	28.6	59.3

Source: Primary Survey

Note: Abbreviations used are HPLM – High Poverty and Low Malnutrition; LPHM – Low Poverty and High Malnutrition; HPLM – High Poverty and Low Malnutrition; and LPLM – Low Poverty and Low Malnutrition.

Table 6: Basic Socio-economic Features

S. No.	Indicators	HPLM	LPHM	HPHM	LPLM
1	Income and Production Indicators				
1.1	Per Capita Net District Domestic Product (Rs) (TE 2008)	46,662	24,006	30,561	50,593
1.2	Share of district Population to Total State Population (2001)	4.27	1.02	1.38	2.3
1.3	Share of Tribal Population to Total District Population (2001)	10.9	38.3	65.5	12.2
1.4	Share of Forest Area (2002–03)	21.21	69.87	20.27	32.35
1.5	Average Foodgrain Production in TE 2000–06 in 00' MT	1,942	1,679	1,717	3,379
1.6	Per Capita Foodgrain Production in 2001 (kg)	303.7	882.1	668.9	996.9
1.7	Productivity Foodgrain Production (TE 2000–06) in kg/hectare	851	938	810	2099
2	Human Development Indicators				
2.1	Total Literacy Rate (2001)	84.03	77.42	55.78	77.03
2.2	Male Literacy Rate (2001)	90.18	71.86	66.16	86.15
2.3	Female Literacy Rate (2001)	77.42	48.07	45.18	67.75
2.4	Human Development Indicator Rank (2002)	5	35	32	6
2.5	Poverty (1993–94)	35.27	26.67	49.00	8.44
2.6	Child Underweight (2002–04)	46.2	61.9	67.4	39.4

Note: The information is compiled based on the districts

Source: Census of India, 2001; Directorate of Economics and Statistics, GoM (Various Years); GoM (Various Years); GoI, Economic Survey of India (Various Years); and RCH 2 (2002–04) (IIPS, 2007); and GoI (2002).

compared to that of the total in the district. In this region, production and productivity of foodgrains, as well as women literacy is lowest. The similar kinds of results are found in the case of LPHM regions; however, forest coverage is highest. The LPHM and HPHM regions differ mainly on two counts. The former region has advantage in terms of productivity and per capita foodgrain production, while it is in the disadvantageous position in terms of both male and female literacy rate as compared to the HPLM region (Table 6). Thus, the inferences drawn from macro level are corresponding with that of the household.

4.3. Determinants of Underweight

An attempt has been made to understand the factors affecting the nutritional status in the study area because it is the outcome indicator of deprivation or hardship, which would enable a broader understanding of scarcity in the society. Such an understanding of factors affecting the nutritional status would naturally hold larger implications for policymakers, and hence this attempt. For this purpose we used linear regression model, because the dependent variable, z-score of weight-for-age, is an anthropometry measure of underweight. The z-score is the standard normal random variable, which indicates how far values of weight-for-age differ from the international threshold given by the World Health Organization (WHO). The values range from the lowest (-) 6 to the highest (+) 6. The lowest value indicates a low nutritional status, while higher value indicates a high nutritional status. The explanatory variables include both linear and dummy variables (Table 7).[5] The linear variables are birth order of a child, Body Mass Index of mother (BMI) and birth order of children belonging to tribal communities (interaction between tribal and birth order). On the other hand, the dummy variables are regions, i.e., HPLM, LPHM and HPHM regions, mothers engaged in collecting Non-timber forest products (NTFPs), age group of children (age group 0–2, 3–4 and 5–6), literate mothers and proximity to market.

The results show that the nutritional status is the combined effect of non-economic factors that include social status, mother and child related factors and village and region-specific factors. The significance of non-economic factors in terms of determining the nutritional status, as revealed by the study, reaffirms our contention that deprivation has broader connotations than mere technical dimensions of poverty. In other words, factors such as mother being literate, proximity to market place, satisfactory BMI of mother, mother engaged in collecting NTFPs and birth order of children have a significantly positive impact on the nutritional status of children. On the other hand, being tribal, the HPHM region, birth order of children and age group of children (i.e., 3–4 years of age group) have a significantly negative impact on the nutritional status of children.

The regression results partly confirm the findings of earlier studies. The education level of mother has a significant impact on the dependent variable, indicating that the nutritional status improves in relation to her educational level. The studies have shown that the probability of mothers with primary/secondary/higher levels of education having underweight children is very low (Radhakrishna and Ravi, 2004). However, the results of the present analysis indicate a significantly negative impact for mothers with primary education, and a positive impact for mothers with middle school education on the nutritional status of their children. This significant negative impact could be because a larger proportion of the sample mothers surveyed had only primary education. In the study region it was observed that children do not attend school regularly.

The other mother-related factors — BMI of the mother and her engagement or non-engagement in the collection of NTFPs — have a positive impact on the nutritional status of children. The better the nutritional status of mothers, the better will be the nutritional status of children. Additionally, a mother's engagement in the collection of NTFPs from the forest areas has a positive impact on the nutritional status of children. This could be due to two factors: first, these mothers also collect food products from the forest areas that, in turn, might improve the nutritional status of their children, and second, it may be giving additional purchasing power to mothers in terms of ensuring nutritious food for their children.

On the other hand, there are other factors too that affect the nutritional status of children negatively. Studies have shown high malnourishment among children belonging to the tribal communities, as compared to non-tribal children, but the differences are not statistically significant. However, our results reveal that children belonging to tribal communities exhibit a significantly low nutritional status compared to non-tribal children. This could be attributed to the tribal communities' lack of awareness about healthcare facilities, lower educational attainments and higher number of children. It is also observed that region-specific characteristics and proximity to the market

Table 7: Linear Regression Results related to Undernutrition

Explanatory Variables and Variable information		Coeff.	Std. Err.	T
CONS	Intercept	–3.545	0.553	–6.41***
PRIMARY_EDU	Dummy for Primary Education of Mother (Primary Education=1; Other=0)	–0.340	0.183	–1.86*
MIDDLE_EDU	Dummy for Middle Education of Mother (Middle Education=1; Other=0)	0.339	0.134	2.53***
HIIGHER_EDU	Dummy for Higher Education of Mother (Higher Education=1; Other=0)	–0.251	0.261	-0.96
INTERIOR	Dummy for Interior Villages (Interior Village=1; Close to Market Place=0)	0.359	0.109	3.28***
TRIBE	Dummy for Tribal (Tribal=1; Non-tribal=0)	–0.727	0.212	–3.42***
HPLM	Dummy for HPLM Region (HPLM=1; other=0)	–0.219	0.151	–1.45
LPHM	Dummy for LPHM Region (LPHM=1; other=0)	–0.119	0.158	–0.75
HPHM	Dummy for HPHM Region (HPHM=1; other=0)	–0.375	0.159	–2.36**
B_ORD	Birth Order of the Child	–0.134	0.049	–2.74***
BMI_MO	Body Mass Index of Mother	0.092	0.023	3.92***
TRIBE_BO	Interaction between Tribal and Birth Order	0.202	0.073	2.75***
NTFP_MO	Dummy for mothers engaged in NTFPs (Yes=1; No=0)	0.359	0.136	2.64***
AGEGRP1	Dummy for age-group 3-4 (Age Group 3-4=1; other=0)	–0.296	0.142	–2.09**
AGEGRP2	Dummy for age-group 5-6 (Age Group 5-6=1; other=0)	-0.132	0.147	–0.89
N= 341, F (14, 326) = 6.08*, R-square = 0.19**				

Note : 1. ***, ** and * indicate p-value are significant at one per cent, five per cent and 10 per cent level, respectively.

2. HPLM, LPHM, HPLM and LPLM refer to High Poverty and Low Malnutrition, Low Poverty and High Malnutrition, High Poverty and High Malnutrition, and Low Poverty and Low Malnutrition regions, respectively.

3. z-score varies from -5.99 to 0.46.

place have a significant impact on the nutritional status of children. The HPHM region has a significantly higher proportion of underweight children as compared to the LPLM region. However, far-flung villages havea better nutritional status among its children, compared to villages closer to the market place. The reason could be the dependence on agriculture-based economy and access to natural forest resources in the villages far from the market place.

4. Conclusions

Our tryst with destiny at the time of independence began with a bundle of problems. India was one among the severe food deficit country and it always confronted shortages. The first decade after the independence the attention of the policy makers was more on making food available through a distribution system. Possibly it was believed then that food can be imported and we can meet the domestic demand. Our productivity was major concern as it was one among the lowest across the countries in the world. Food insecurity was the major policy concern during mid-60s and the nation survived from 'Ship to Mouth' strategy by importing foodgrains. The foodgrains policy committee reports made it very clear that India must make its own efforts to become food secure. These imports were accompanied with the domination of the world powers on India's international relations and came in the discussion on Politics of Aid. The technological change in mid-60s brought a significant improvement in the production of foodgrains and productivity improved substantially. With the 'Green Revolution' we seem to have turned the corner and celebrated by 1975 as a food secure nation. The arithmetic availability of foodgrains was showcased and at macro level Indian policy makers became a little complacent. We boasted as a food secure nation at macro level. But

these macro level statistics masked naked realities inside the belly. There are a large spots and regions that confronted severe food shortages. This is also true about some of the ethnic groups which traditionally had little access to food. The vulnerability of the tribals in many regions of India was well known and the food non-availability to these ethnic groups is always a matter of concern. We do not think we have really reached to the inclusivity in this context as far as food is concerned. This paper brings out vulnerability of tribal groups pertaining to nutrition insecurity in Maharashtra and this is a state which is economically far advanced as against others. The dependence of tribals on the forest products is also restricted to the state legislations. Therefore, they neither have access to the state sponsored supplies of food to ensure their nutrition security nor can they survive on the forest products. The macro picture of food security reflected in many of our documents therefore mask the naked reality of food and nutrition insecurity in the heartland of India and in many sports. With these handicaps can we dream to achieve the SDG goal as reflected in some of the policy documents?

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Notes:

[1] These four groups of regions, namely HPLM, LPHM, HPHM and LPLM, have been categorized on the basis of poverty levels in 1999–2000 (GoI, 2002) and child malnutrition in 2002–04 (IIPS, 2006). For identifying tribal dominated districts, we considered districts with more than 8.9 per cent of the tribal population. These tribal-dominated districts are Nandurbar, Dhule, Nashik, Wardha, Chandrapur, Yavatmal, Amravati, Jalgaon, Nagpur, Gadchiroli, Thane and Raigarh.

[2] The Factsheet of NFHS 4 for 2015–16 shows that 36 per cent of the children below five years are underweight in Maharashtra. These figures are 40 per cent in rural and 36 per cent in urban Maharashtra. However, proportion of malnourished children across social groups is not yet published.

[3] The availability of foodgrains has advantages over foodgrain production because it is measured based on the required food intake norm for the adult population. Adult population is the population of 15 years of age and above, whereas population below 15 years of age is the pre-adult or child population.

[4] Indian Council of Medical Research (1996) recommends 2400 kcal per day in rural areas for a healthy and active person.

[5] The specification used in this paper for linear regression model is $Y = a + bX + e$, where Y is dependent variable, i.e., weight-for-age (z-scores) for measuring underweight among children below age six years, a is intercept, b is coefficient of X explanatory variables and e is error term. The explanatory variables include both dummy as well as linear variables.

"Innovations that are guided by smallholder farmers, adapted to local circumstances, and sustainable for the economy and environment will be necessary to ensure food security in the future"

– Bill Gates

A Study of the Impact of Production Variables on Indian Food Grains Productivity

SHIKSHA AND PARUL MITTAL

Agriculture plays an essential role in the process of economic development of less developed countries like India. Besides providing food to the nation, agriculture employs labour, provides savings, contributes to market of industrial goods and earns foreign exchange. In India, agriculture was the main source of national income and occupation at the time of Independence. Agricultural sector occupies a key position in the Indian economy, mainly because of three reasons. First, it constitutes the largest share in the country's national income, though the share declined from 55 per cent in early 1950s to about 14.6 per cent by the turn of the century. Second, more than half of India's workforce is employed in the agriculture sector. Third, growth of other sectors and overall economy depends on performance of agriculture to a considerable extent. Because of these reasons agriculture continues to be the dominant sector in the Indian economy. Through this paper, we have tried to study the determinants of various food grain productions in India. In order to find out these determinants in pre- and post-economic reforms, the study adopted the Ordinary Least Square (OLS) regression model.

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1. Introduction

Agricultural development is treated as a precursor to industrial development in nations across the world; it passes through relatively definite phases of modernization. It is always worthwhile to understand these phases and their prime features, to learn from the experiences of the nations who have successfully passed these phases — the strategies they adopted to do away with the complications, tackle the challenges and exploit their resources. Agricultural development in nations passes through the following phases.

1.1. Traditional Agriculture

This is the initial and the most backward state of development of agriculture, which exists when the nation is in the primary state of development. In this phase, technique of production is not just obsolete, it is even primitive and labour intensive.

1.2. Technologically Dynamic Agriculture: Low Capital Technology

In this phase, agriculture remains the mainstay of the population with still more than 60 per cent of the population depending on it for their livelihood. Agriculture also contributes between one-third and one-half of the national income, though its contribution consistently falls. In this phase, capital for industrial development is particularly scarce and returns are rising. Unfavourable labour–capital cost relationship rules out the possibility of increased use of labour-saving mechanization in agriculture. The most distinguishing feature of the second phase is the constant generation and application of technology.

1.3. Technologically Dynamic Agriculture: High Capital Technology

This is the most advanced phase of agriculture that exists in mostly the advanced nations. The significance of agricultural sector in terms of dependence of the population on it as a source of livelihood and contribution to national income goes down; the secondary and tertiary sectors of food grains production occupy the most dominant position in India's agriculture, covering over 65 per cent of the gross cropped area. Since the beginning of the Green Revolution in the mid-1960s, the country has shown impressive growth in food grains production. Just after Independence, there was enough increase in production of food grains through expansion of cultivated area.

In this study, we mainly concentrated on rice, wheat, coarse cereals and pulses, because India contributes a major share of these food grains to the world, and its food security vitally depends upon wheat and rice production.

Rice, which is the predominant food crop in India, is extensively cultivated in almost all parts of the country. In India, rice cultivation has a long history marked by a series of technological breakthroughs and has the largest area under rice cultivation in the world. India ranks second, after China, and contributes to nearly 22 per cent of the global rice production. The principal rice-producing states in India are West Bengal, Uttar Pradesh and Punjab. Rice is the staple food of the people living in the eastern and southern parts of the country. In the context of wheat, India holds the second position among the wheat-producing countries of the world, next to China. Uttar Pradesh, Punjab, Haryana and Madhya Pradesh are the major wheat-producing states in India.

Coarse cereals are a group of six cereals, namely jawar, bajra, maize, ragi, barley and millets. In the production of coarse cereals, India holds the sixth position in the world, after US, China, Brazil, Russia and France. Coarse cereals are grown mainly in the rain-fed areas where the coverage of irrigation is only about 12 per cent. In context of pulses production, India ranks first in the world. The leading producer states of pulses in the country are Madhya Pradesh, Uttar Pradesh and Rajasthan. Sorghum and millets, the principal coarse grains, are dry land crops most frequently grown as staples in central and western India. Corn and barley are grown mainly in, and near, the Himalayan region. Because of increased yields, the production of coarse grains has doubled since 1950; though there was hardly any change in the cultivated area for these grains.

Pulses are an important source of protein in the vegetarian diet. However, even a small increase in production of pulses does not suffice as the population is increasing, which means reduced availability of pulses. Before the Green Revolution coarse grains showed satisfactory rates of growth, but they lost the cultivated areas to wheat and rice, and their growth declined.

2. An Introduction to Food Grains Production under Different Phases

The agricultural sector of India has passed thorough different stages of development. A comprehensive analysis of the process and stages requires great dedication and time from any researcher. The present study seeks to discuss the food grains production trends in Indian agriculture in the post-Independence era, that too in the planning period starting from 1951–52. This period has been considered as it was during this time that a transformation from the first stage, i.e., traditional agriculture, to the second stage, i.e., technologically dynamic agriculture, took place and the planning process in the country had started that aimed at planned and rapid development of the agricultural sector. It was only after the attainment of independence and launching of economic planning that India faced the food crisis. To take care of the constant need to import food grains to meet the domestic demand, the Government of India launched programmes for rapid development of agriculture, and in different plan periods adopted policies and strategies to boost agricultural production and regulate agricultural prices. The production of food grains was particularly dismal with modest growth in cultivated area; the performance was almost Malthusian in its mechanism with population pressing against production, with diminishing returns. The present study divides the entire period after the launch of economic planning in the country, i.e., a period of more than 58 years, into two broad phases:

- The first phase: prior to the launch of economic reforms (1951–52 to 1990–91)
- The second phase: after the launch of economic reforms (1991–92 to 2009–10).

3. Review of Literature

Hanumantha Rao (1968) in his study stated that inputs like fertilizers and improved seeds if used under conditions of assured irrigation may promote growth with stability,

but if used under conditions of uncertain rainfall may increase the range of fluctuations in output with growth. Since jowar, bajra and almost all the pulses crops are grown on marginal lands under rain-fed conditions, these crops have shown very high degree of instability/fluctuation in output with positive and high growth. The above statement undoubtedly holds good for Maharashtra.

A.S. Kahlan and H.K. Bal (1977) in their study implemented Cobb Douglas production functions at all-India level for two periods representing pre-Green Revolution (1960–61 to 1964–65) and post-Green Revolution (1967–68 to 1972–73) to compare factor shares. They took the value of agricultural production as dependent variables and net sown area, proportion of irrigated area, tractors, bullock labour, human labour, fertilizers, and rainfall as explanatory variables. Their study concludes that the highest contribution is made by human labour, followed by the net sown area, in both periods. The share of fertilizers, however, increased from 7.20 per cent in the first period to 15.56 per cent in the second period, while labour shares declined from 48.55 per cent to 46.03 per cent.

Singh and Singh (1991) in their study measured the changes in cropping and production patterns in agriculture in Haryana in the period 1966–89 based on secondary data. The study reveals that the area under rice and wheat cultivation has been increasing at the rate of 9.29 per cent and 6.34 per cent during 1966–67 and 1988–89, respectively. The area under food grains like jowar, bajra, maize, barley and the important pulses has been increasing at the rate of 11.60 per cent per annum during this period. The total production of jowar, maize, barley gram and other pulses has, however, been declining. According to a Ministry of Agriculture report (2000), fertilizer, quality seeds and better land preparation can raise cereal yields by about 85 per cent; the maximum would be for pearl millet (127 per cent) and the minimum for barley (32 per cent). Potential increases for sorghum and wheat can reach 100 per cent.

Sinha and Kumar (2003) studied the impact of agricultural price policy on production, productivity and cropping pattern in the state of Bihar. They pointed out that the analysis of production and productivity in sample districts shows that the yield of important crops is distressingly low and below the national average, with a few exceptions. The study also reveals that the area under paddy, wheat, pulses and oil seeds has increased, but has declined in the case of maize and jute crops. Besides, the rate of crop diversification is merging. This does not indicate an encouraging trend, and in this relation the authors address some policy measures which broadly suggest conversion of price policy into an approach for integration of production and distribution objectives.

Mathur and Das (2006) studied the determinants of agricultural growth at all-India level for the period 1990–91 to 2003–04. They suggested that government's investment in agriculture, subsidy, agriculture prices and usage of electricity are the significant factors that decide flows of production in Indian agriculture. Tupe and Kamat (2010) discussed the determinants of agricultural gross domestic production (AGDP) for the pre- and post-economic reforms period. They stated that institutional credit sources, consumption of fertilizer and net sown area are major determinants of AGDP in the pre-reforms period, whereas India's membership of World Trade Organization (WTO) is the significant determinant of AGDP in the post-reforms period. This study also reveals that the Indian agriculture sector witnessed a phase of decreasing returns to scale during the 1970s, 1980s and 1990s, and there is a need to increase the abundant and continuous flow of inputs so that problems such as food security, poverty reduction, unemployment and increasing price level of food grains can be minimized.

4. Objective of the Study

The main objective of this study is to accentuate the impact of production variables (inputs) on growth of food grains production in India.

5. Research Methodology

The present study is based on time series data (1951–52 to 2009–10) on production, area and yield of food grains production, such as rice, wheat, coarse cereals and pulses, available on the website of handbook of RBI, source of Ministry of Agriculture. The total time period is classified into four decades, namely pre-Green Revolution period (1951–52 to 1965–66), Green Revolution period (1966–67 to 1979–80), the maturing of Green Revolution period (1980–81 to 1990–91) and post-reforms period (1991–92 to 2009–10). In order to achieve the above objective, the study employs simple descriptive as well as some econometric techniques. It uses simple ordinary least square technique to find the determinants of food grains production in pre- and post-economic reforms. It adopts the following model:

$$Y = \beta_0+\beta_1 \log X_1+\beta 2 \log X_2+\beta_3 \log X_3+U \ldots\ldots\ldots \quad (1)$$

Where, Y is the log of Agricultural GDP

X_1 is the log of net sown areas

X_2 is the log Net Irrigated area

X_3 is the log Consumption of Fertilizer

Here, researcher used the Cobb-Douglas production function to find out the determinants of Indian Food grains production.

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3}$$

$$\text{Log}Y = \log \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3$$

$\beta_1 + \beta_2 + \beta_3$ (sum of the coefficients shows the returns to scale)

6. Data Analysis and Interpretation

In this section, an attempt has been made to accentuate the impact of production variables (inputs) on the growth of food grains production. In India, use of inputs in agriculture has been increasing since the Green Revolution in the late 1960s with increasing use of high-yielding seeds, synthetic fertilizers, improved irrigation, mechanical power and electricity in farm operations. The pattern and the rate of growth of demand for the major factors of production is influenced by a number of aspects, such as increasing population, growing urbanization, using household income, changing lifestyles and structural changes taking place in the economy. New agricultural technology demands higher input use in the form of seeds (high-yielding varieties), fertilizers, irrigation, electricity, tractor power tiller with diesel engine and electric motor for crop production and post-harvest operations, which are increasing in India, to achieve higher productivity and process increasing volumes of agricultural produce. The time series data in the study were obtained from various published sources. Here, Cobb Douglas production function was used to analyze the efficiency of various factors of production.

In this study, we took three main inputs of food grains production. These were net sown area, net irrigated area and consumption of fertilizers. Net area sown represents the total area sown with crops and orchards. Area with crops sowed more than once in the same year is counted only once. Net irrigated area is the area irrigated through any source once a year for a particular crop. Consumption of fertilizers is a key input in agriculture as they provide additional nitrogen, phosphorus and potassium to the crops. Use of fertilizers remains one of the principal determinants of crop yield. Modern agriculture largely depends on the use of fertilizers. The nitrogen, phosphorus and potassium fertilizers' consumption in India has increased from 0.05 (million tonnes) in 1963–64 to 18.1 (million tonnes) 2007–08. India has been the third largest consumer of fertilizers (Pasricha and Singh, 2005).

This section aims at analyzing the impact of production variables (inputs) on agricultural output growth in Indian agriculture from 1950–51 to 2007–08. For this purpose, we used Cobb Douglas production function methodology in order to find out the determinants of Indian food grains production gross for pre- and post-economic reforms. All variables' values are converted into natural log before running the regression. This model is linear in the parameter β_0, β_1, β_2, and β_3. Therefore, it is a linear regression model and all parameters are the respective elasticities. The sign of parameters shows the relationship between inputs and total production. This model is also known as linear model. The parameters give information about the returns to scale. The sum of (β_1, β_2, β_3) coefficients give information about the returns to scale, which is the response of output to a proportionate change in output. The response of output to a proportionate change in the inputs is measured in this model. If this sum of these parameters becomes 1, then it is understood that there is constant returns to scale, and if the sum is found as greater than 1, then there is increasing returns to scale, if the sum is less than 1, then there is return to scale.

6.1. Model 1 (1950–51 to 1965–66)

This model used only three variables for measuring production because we could not get complete data on the remaining variables. The results that appear from the model point out that net sown area and irrigated area shows positive impact on agricultural production. However, the consumption of fertilizers has a negative impact on the growth of agricultural production. The R^2 value of the model is 0.86, which can be concluded as about 86 per cent, which means that the variation in growth of food grains production is explained by the above variables. This model also shows that Indian agriculture had witnessed increasing return to scale for the covered period (1951–52 to 1965–66).

6.2. Model 2 (1966–67 to 1979–80)

The model reveals that the net sown area and net irrigated area exhibits positive sign of elasticity, but none of the variables is significant, expect the variable net sown area,

Table 1: Determinants of Agricultural Production in India (Cobb Douglas Production Function Methodology)

Period Model	(1) 1951–52 to 1965–66		(2) 1966– 67 to 1979– 80		(3) 1980-81 to 1990– 91		(4) 1991– 92 to 2007– 08	
	Coefficient	T	Coefficient	T	Coefficient	t	Coefficient	t
β_0	–196.20*	–4.094	–496.042*	–3.673	–125.519	–1339	–258.34*	-2.165
β_1	1.951*	2.628	3.734*	3.837	1.877*	3.553	1.831	1.942
β_2	.711	.213	2.139	1.749	–1.435	–.502	3.213	1.436
β_3	–1.259	–.830	–2.28	–.453	.836	2.427	.113	.417
$\bar{R}^2$	.82		.836		.948		.838	
F	22.66		23.011		55.956		22.356	
SE	4.168		5.94		3.70079		7.50246	
Phase	IRS		IRS		IRS		IRS	

Notes: *shows that 5 Per cent Significance of Level, Dependent variable Y, Independent variable β_1, β_2, β_3
Phases: IRS – Increasing Returns to Scale, CRS – Constant Returns to Scale, NRS – Negative Returns to Scale

which shows positive significance elasticity. However, the consumption of fertilizers shows negative elasticity, the R value 0.93, which can be concluded as about 93 per cent. Variation in the growth of agricultural production is explained by the above three variables.

6.3. Model 3 (1980–81 to 1990–91)

This model shows that net sown area and consumption of fertilizers show positive effect on the growth of agricultural production, but only net sown area shows positive significant elasticity, whereas net irrigated area shows negative elasticity. The value of R is 0.96, which shows that the variation in agricultural production is explained by these variables. The model was designed to examine the association between input and output before the 10 years of liberalization policy that was introduced in 1991. The result of this model shows that Indian agriculture sector has witnessed the increasing return to scale of production. The findings of the model match with the conclusion drawn by the earlier studies conducted in the 1980s.

6.4. Model 4 (1990–91 to 2007–08)

The model shows that the variables net shown area and irrigated area and consumption of fertilizers shows positive effect on the growth of food grains production, but they are not statistically significant. It can be interpreted from the findings emerging from this model that the Indian agricultural sector has witnessed decreasing return to scale after the introduction of new economic reforms and India joining the WTO. This was mainly because the Government of India had reduced the subsidy support given to agriculture in a move to reduce public expenditure under the pressure of WTO. Banking reforms have also forced the banks to collect old debts for reducing their NPA and sanction new credit to farmers on selective basis.

It is clear from the above discussion that the 4 models show the increasing return to scale since Independence. It can also be seen in the table that the net sown area has a positive impact on models 1, 2 and 3, and is statistically significant, while net irrigated area has a positive impact on food grains production in three phases but is not statistically significant. Consumption of fertilizers has a negative impact on the growth of food grains production in models 1 and 2, and has positive impact on models 3 and 4, but is not statistically significant. These models also show that Indian agriculture had witnessed increasing return to scale, which suggests that net irrigated area, net sown area and consumption of fertilizers are very vital input for food grains production. In order to maintain this level in future, due consideration should be given to these inputs.

7. Conclusion

In this study, we examined the impact of three agricultural inputs (net sown area, net irrigated area and consumption of fertilizers) on food grains production in four phases (1951–52 to 1965–66 [Pre-Green Revolution], 1966–67 to 1979–80 [Green Revolution], 1980–81 to 1990–91[Post-Green Revolution], 1991–1992 to 2007–08 [Post-economic reforms]). Results in this context reveal that in all the four phases food grains production has increasing return to scale because net sown area and net irrigated area are very vital inputs for food grains production. Finally, it can be stated that increase in growth rate of production was only due to increase in the growth rate of yield. It seems that the agricultural pricing policy, especially after economic reforms, ensuring remunerative prices to the farmers and supplying significant amount of inputs, especially fertilizers at subsidized prices, has been the most important factor in encouraging farmers to increase the production of agricultural crops.

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"It's clear that agriculture, done right, is the best means the world has today to simultaneously tackle food security, poverty and environmental degradation."

– Irene Rosenfeld

Feature

Performance Assessment of National Textile Corporation after Turnaround

J.R. DIKSHIT, P.C. BASAK AND KAMAL VAGRECHA

The textile industry occupies a unique place in our country as a self-reliant industry. A number of textile mills were declared sick and closed down in the 1960s. The Government of India established National Textile Corporation (NTC) to manage these mills. There were several reasons for the sickness of these mills. NTC was referred to Board for Financial and Industrial Reconstruction (BIFR), and the Corporation adopted turnaround strategies. The operating performance of the NTC has been compared with Alok Industries. The labour productivity, overhead productivity and total factor productivity for NTC is low as compared to Alok Industries. Only the material productivity of NTC is comparable with Alok Industries.

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1. Introduction

The textile industry occupies an important place in our country. It has a unique position as a self-reliant industry, from the production of raw materials, mainly cotton, to the delivery of finished products with substantial value-addition at each stage of processing. The Indian textile industry, thus, has a significant presence in the Indian economy — reflected in terms of its contribution to industrial production, employment generation and foreign exchange earnings — as well as in the international textile economy.

The period between post-Independence and expiry of Multi Fibre Arrangement (MFA), on 1 January 2005, has not been very encouraging for the organized mill sector. A number of mills have closed down during this period, blocking capital and adversely impacting the health of banks and financial institutions.

Till 1985, the main concerns of the government were centred on import substitution, protection of existing employment in the organized sector and support for decentralized sector (Textile & Beyond, 2008). These concerns were reflected in the government policies, such as imposition of quotas on yarn export, strong exit barriers even for unviable operations, general discouragement of automation, stringent licensing for organized sector and price regulations to handle the shortages resulting from the licensing restrictions.

Restrictions of such nature only resulted in increasing costs, declining productivity and loss of competitive edge. The textile industry had to be set free from these regulatory burdens so that it could evolve, grow and remain competitive in the global market.

A number of textile mills were declared sick during late-1960s. The National Textile Corporation (NTC) Limited

was set up by the Government of India to manage these sick textile mills. It is a Central Public Sector Undertaking (PSU) under the Ministry of Textiles. Some of the reasons that resulted in these textile mills turning sick are:

(i) Government regulations

Too many restrictions imposed on the organized mill sector did not allow the mills to adapt to the changing environment.

(ii) Lack of modernization

There were again several reasons for lack of modernization:

(i) Lack of financial resources (due to low profit margin).

(ii) High cost of capital needed for modernization (high rate of interest).

(iii) Government restrictions on import of technology with automation to reduce the labour-intensive character of the textile industry.

(iv) The cost of modernization incurred has to be recovered by reduced labour cost and higher value-addition.

(iii) Overstaffing

Quite a substantial number of mills had a large workforce and that too indirect labour; this type of labour has low productivity.

(iv) Fluctuation in Prices of Cotton

The raw material cost is major component of the total cost. Even a slight change in its cost affects the profit margin of the company.

(v) Change in Taste of the Consumer

The taste of the customer has also changed with time. Most of the lower middle class and weaker sections were using coarse white cotton cloth in the yester years. The narrow width cloth has also given way to large width cloth, which was only possible by changing the looms. The mills which could not adapt themselves to these changes could not survive in the new environment.

Out of five reasons stated above, lack of modernization and overstaffing are specific to NTC. These two factors result in:

(i) Increase in time required to produce the same quantity of goods

(ii) Increase in maintenance cost

(iii) Quality deterioration

(iv) Increase in waste

(v) Increase in labour cost

All the above factors bring down the productivity, thus making NTC uncompetitive among other market players.

The Government tried to modernize the mills in order to make them viable. Still most of the mills continued to incur losses and had to depend on budgetary support from the government to make up for the losses. In the early 1990s, with the introduction of new economic policy, the government stopped the reimbursement of losses. NTC as a result accumulated huge losses. In the meantime, Sick Industrial Companies Act (SICA) was amended to bring under its ambit the PSUs also. The net worth of NTC quickly eroded and it was referred to Board for Industrial and Financial Reconstruction (BIFR) as per provisions of SICA.

2. Turnaround Strategies adopted by NTC

After the reference of NTC to BIFR during 1992–93, the Board declared NTC as sick. Industrial Development Bank of India (IDBI) and Industrial Finance Corporation of India (IFCI), appointed as operating agencies by BIFR, were asked to submit a rehabilitation plan. The operating agencies in consultation with Textile Research associations prepared a rehabilitation scheme for the revival of NTC.

A draft rehabilitation scheme (DRS) prepared by IDBI and IFCI was submitted to BIFR. The scheme had the following salient features: The total cost of the rehabilitation plan was Rs 3,937.49 crore in 2002–03, which was mainly to be financed by sale of assets (Annual Report, National Textile Corporation, 2003–04). The scheme was further revised to Rs 5,267.56 crore in 2006 and finally to Rs 9120.72 crore in 2008. It was financed internally by the sale of assets (Annual Report, National Textile Corporation, 2007–08).

The rehabilitation scheme adopted the following strategies.

2.1 Modernization Strategy

NTC mills had mostly outdated machinery. Many of the machines were as old as 40 years. There was severe resource-crunch due to continuous losses or low profits. Even NTC could not replace the vital parts of machines

which were normally changed every five years, like rings, spindles, aprons and cots, etc. This resulted in reduced speed of the machines and hence low productivity. The quality of the products produced on these machines was also low, thus fetching lower rates in the market. These old machines were able to produce only cotton products. Whereas with the lowering of excise duty on polyester and viscose fibres, the polyester–viscose- and polyester–cotton-blended products became middle-class fabric. There was only one alternative available for NTC — modernization of its mills. The modernized mills should have machinery with state-of-the-art technology, so that the NTC mills come within top 15 to 20 per cent of all textile mills. Only then the mills would be able to face the period of recession without going into losses. Hence NTC has modernized 24 mills by itself and 4 mills through joint ventures.

2.2 Retrenchment Strategy

NTC (Holding Company) had engaged Textile Research Associations (TRAs) to prepare modernization scheme for NTC as a whole (Public Enterprise Survey, 1994–95) and it was found that only 53 mills out of total 119 mills could only be made viable, 66 unviable mills were to be closed down. The workers of these mills were to be paid off. Similarly, the employees of the mills identified for joint venture were also to be paid off. No private party was willing to continue with the old workers in the joint venture firm. NTC offered the mills for joint venture free of all past liabilities. The share of NTC in the form of land/building and plant/machinery was to be 51 per cent. Private partner would contribute its share of 49 per cent towards modernization of the mills.

2.3 Divestment Strategy

The total rehabilitation plan is based on working only the viable mills after modernization and closing down of the non-viable ones. The source of funds is the sale of surplus land and the land/building and machinery of the unviable mills. Initially 66 mills were identified for closure. The workers in these mills were offered to go under modified voluntary retirement scheme (MVRS). In the other viable mills if the workers wanted to avail the facility of MVRS, they were all given the option to do so. Thus, in all, 77 mills were closed under the Industrial Disputes Act. The machinery, debris of the building and the land were either sold or were in the process of being sold.

2.4 Organizational Restructuring

NTC at one time was managing 119 mills. It was able to have effective control over the working of these mills through nine subsidiary corporations in different regions. Now only 24 mills were proposed to be modernized, hence there was no need for such a large organizational structure. The 24 mills could be managed through only one company. Therefore, the organization of NTC has been restructured. All the nine subsidiary companies have been merged into one holding company — National Textile Corporation Ltd with its headquarters at New Delhi. Since most of the mills are concentrated in South India and Maharashtra, NTC has two regional offices — one at Coimbatore and another at Mumbai — to closely monitor the working of the mills situated in Southern India and Maharashtra regions, respectively.

2.5 Relocation Strategy

Out of 24 mills which NTC is modernizing on its own, 4 mills are to be moved to new locations:

(i) Finlay Mills Mumbai has been moved to the location of the closed mills at Achalpur (Maharashtra).

(ii) Rajnagar Textile Mills has been moved to the location of closed Rajnagar Mills at Ahmadabad (Gujarat).

(iii) Minerva Mills Bangalore has been relocated to the industrial area of Hassan (Karnataka).

(iv) Udaipur Cotton Mills has to be moved to the location of closed Mahalakshmi Mills Beawar (Rajasthan).

The ideas behind relocating the mills are:

(i) The mills had a name and good image in the industry and amongst the consumers.

(ii) The land at the original place was costly and could have fetched a good price if sold.

(iii) The land at the new location was cheap, and it would not have fetched a good price if it was sold after the closure of the mills.

Hence the relocation of the 4 mills was planned. The three mills, viz., Finlay Mills, Rajnagar Mills, and Minerva Mills have already been relocated and working satisfactorily. NTC is planning to set up technical textile mills at the fourth relocated mills, i.e., Udaipur Cotton Mills. It is in search of a consultant and a marketing partner for technical textiles.

2.6 Product Diversification

The NTC has adopted the strategy of product diversification as its survival drive. It has diversified to readymade garments by using NTC-produced cloth. These include shirts, trousers, bermudas, shorts, handkerchiefs, kurtas, pyjamas, woollen coats and jackets, and inner garments, as well as traditionally produced cotton cloth, bed sheets, etc. NTC also markets readymade items under the brand name FINLAY and ENTYCE all over India.

The turnaround of NTC has perhaps been the biggest single turnaround case involving more than 90,000 employees. It has so far closed 78 mills; 63,284 employees have gone under MVRS from April 2002 onwards and it has paid Rs 2,351.07 crore by way of compensation to these employees. NTC has reduced the manpower from 90,000 to about 8,152 employees. It has modernized 21 units fully and 2 units partially. The 24th unit is slated as a Technical Textile Unit (Annual Report, National Textile Corporation, 2013–14).

3. Turnaround Strategies and their Relationship with Productivity

The turnaround strategies adopted by NTC are focused on increasing productivity.

3.1 Modernization Strategy

The modernization strategy adopted by NTC has the following objectives:

(i) Producing more goods in same time

(ii) Lower maintenance cost

(iii) Quality improvement

(iv) Decrease in waste

3.2 Retrenchment Strategy and Organizational Restructuring

The retrenchment strategy and organizational restructuring adopted by NTC has the following objectives:

(i) Decrease the wage cost

(ii) Decrease the welfare and other benefits costs

(iii) Decrease in the duplicity of hierarchy and structure

(iv) Increase in overall efficiency

3.3 Divestment Strategy

The divestment strategy adopted by NTC has the following objectives:

(i) Divestment of low productivity mills decreases the burden of NTC

(ii) All the factors that bring down the productivity are offloaded at once

(iii) Reduce the number of unviable mills which cannot be revived even after a lot of modernization

3.4 Product Diversification

Product diversification has the following objectives:

(i) Increase the value of the existing products

(ii) Unlock the benefit of value chain by introducing readymade garments

(iii) Synchronise products with latest trends and taste of the buyers

(iv) Increase sales

Turnaround of a company and its path to increasing profitability is linked with growth and productivity. According to P.L. Chauhan (2010), 'Productivity is at the heart of economic growth and development'. All above factors/ objectives of each strategy are aligned to increase productivity.

4. Assessing the performance of NTC

Measurement of profitability is as essential as earning for the business concern. Some managerial decisions like increasing additional finance, further expansion, problems of bonus and dividend payments rest upon this measurement. It can be measured for short-term and as well as long-term. The relation to sales is a good short-term indicator of successful growth, while profitability in relation to investment is healthy for long-term growth of the business (Zala, 2010).

To gauge the after-effects and assess the success of the Turnaround Strategy of NTC, an analysis of its performance after the implementation of the modernization scheme has been done in comparison with the data of Alok Industries — one of the top ten textile companies in India. The data regarding operating performance has been obtained from the annual reports of the National Textile Corporation and Alok Industries, from 2008–09 to 2014–15.

Productivity can be defined as the amount of output produced divided by the amount of input used. (Martimich, Joseph S., 1997, p. 42).

Productivity is defined as the ratio of output produced to the input used in its production (Bedi, Kanishka, 2004, p. 515)

Productivity is the ratio of the outputs achieved from an activity to the inputs consumed to make those outputs (Kachru, Upendra, 2007, p. 491)

As mentioned, the performance of NTC has been assessed with the help of productivities, utilizing the data collected from various sources as well as factors of production. Productivity has been defined as the ratio of output produced per unit of resource consumed by the process. Data collected from profit and loss statements has also been analysed to get some useful information. This analysis helps to arrive at some logical conclusion regarding the state of affairs of the company. The performance assessment has been categorized under the following productivity ratios:

(i) Overall Labour Productivity: It is the overall labour productivity of the unit or company expressed as a ratio of turnover (output in Rupees) to labour cost in Rupees.

(ii) Overall Material Productivity: It is the overall material productivity of the unit or company expressed as a ratio of turnover (output in Rupees) to material cost in Rupees.

(iii) Overall Overhead Productivity: It is the overhead productivity of the unit or company expressed as a ratio of turnover (output in Rupees) to overhead cost in Rupees.

(iv) Total Factor Productivity (General Electric Formula): It is the overall productivity of the unit or company expressed as a ratio of turnover (output in Rupees) to total cost in Rupees.

4.1. Overall Labour Productivity

The turnover and salary/wages cost of NTC and Alok Industries are shown in Table 1. The Table exhibits the overall labour productivity for seven years from 2008–09 to 2014–15. In all these years, NTC has maintained a very low level — 2.29 to 4.81 — although it has gradually increased over the years. The overall labour productivity for Alok Industries is at a very high level and has increased in recent years.

4.2. Overall Labour Productivity (ANOVA Test)

Null hypothesis: There is no significant difference in overall labour productivities of NTC and Alok Industries.

Alternative hypothesis: There is a significant difference in overall labour productivities of NTC and Alok Industries.

Level of significance: 5 per cent

Critical value: 4.75

Degree of freedom between groups: 1

Degree of freedom within groups: 12

Table 1: Overall Labour Productivity of NTC and Alok Industries

Year	NTC (Rs in Crore)			Alok Industries (Rs in Crore)		
	Turnover	Salary/ Wages Cost	Labour Productivity	Turnover	Salary/ Wages Cost	Labour Productivity
2008–09	523.66	228.41	2.29	3,383.41	110.25	30.69
2009–10	540.94	229.4	2.36	4,709.01	153.73	30.63
2010–11	713.85	260.54	2.74	6,617.42	199.76	33.13
2011–12	893.38	228.87	3.9	8,966.46	267.28	33.55
2012–13	1,232.69	267.61	4.61	13,506.44	289.79	45.96
2013–14	1,262.15	282.18	4.47	14,205.07	282.42	50.3
2014–15	1,368.59	284.49	4.81	14,903.69	275.06	54.18
Average			3.60	Average		39.78

Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

Table 2 indicates that the calculated value of 'F' is higher than critical value; so, null hypothesis is rejected and alternative hypothesis is accepted. It can be concluded that there is a significant difference in overall labour productivities of NTC and Alok Industries under period of study.

4.3. Overall Material Productivity

The turnover and material cost of NTC and Alok Industries are shown in Table 3. The Table exhibits the overall material productivity for seven years from 2008–09 to 2014–15. In all these years, NTC has maintained a level of overall material productivity ranging from 1.75 to 2.57, although it has fluctuated over the years. The overall material productivity for Alok Industries is at a low level (1.29 to 2.43) and has decreased gradually over the years.

4.4. Overall Material Productivity (ANOVA Test)

Null Hypothesis: There is no significant difference in overall material productivities of NTC and Alok Industries.

Alternative hypothesis: There is a significant difference in overall material productivities of NTC and Alok Industries.

Level of Significance: 5 per cent

Critical value: 4.75

Degree of freedom between groups: 1

Degree of freedom within groups: 12

Table 4 indicates that the calculated value of 'F' is lower than critical value; so, null hypothesis is accepted and alternative hypothesis is rejected. It can be concluded that there is *no significant difference* in overall material productivities of NTC and Alok Industries under period of study.

4.5 Overhead Productivity for NTC and Alok Industries

The turnover and overhead cost of NTC and Alok Industries are shown in Table 5. The Table exhibits the overhead productivity for seven years from 2008–09 to 2014–15. In

Table 2: Overall Labour Productivity (ANOVA Table)

Source of variation	Sum of Squares	Df	Mean Square	F	F Critical
Between Groups	4,581.473	1	4,581.473	89.70	4.75
Within Groups	6,12.933	12	51.078		
Total	5,194.406	13			

Table 3: Overall Material Productivity of NTC and Alok Industries

Year	NTC (Rs in Crore)			Alok Industries (Rs in Crore)		
	Turnover	Raw Materia Cost	Material Productivity	Turnover	Raw Material Cost	Material Productivity
2008–09	523.66	203.71	2.57	3,383.41	1,740.58	1.94
2009–10	540.94	240.17	2.25	4,709.01	1,940.35	2.43
2010–11	713.85	408.95	1.75	6,617.42	3,224.04	2.05
2011–12	893.38	467.24	1.91	8,966.46	4,393.13	2.04
2012–13	1,232.69	524.32	2.35	13,506.44	9,272.58	1.46
2013–14	1,262.15	667.99	1.89	14,205.07	10,430.03	1.36
2014–15	1,368.59	662.66	2.06	14,903.69	11,587.48	1.29
Average			2.11	Average		1.80

Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

all these years, NTC has a level of overhead productivity ranging from 1.81 to 2.58, although it has slightly increased over the years. The overhead productivity for Alok Industries is at a high level and has increased to a level of 5 to 5.58 in recent years.

4.6 Overhead Productivity (ANOVA Test)

Null Hypothesis: There is no significant difference in overhead productivities of NTC and Alok Industries.

Alternative hypothesis: There is a significant difference in overhead productivities of NTC and Alok Industries.

Level of Significance: 5 per cent

Critical value: 4.75

Degree of freedom between groups: 1

Degree of freedom within groups: 12

Table 6 indicates that the calculated value of 'F' is higher than critical value; so, null hypothesis is rejected and alternative hypothesis is accepted. It can be concluded that there is a significant difference in overhead

Table 4: Material Productivity (ANOVA Table)

Source of variation	Sum of Squares	Df	Mean Square	F	F Critical
Between Groups	0.349	1	0.349	2.592	4.75
Within Groups	1.615	12	0.135		
Total	1.964	13			

Table 5: Overhead Productivity of NTC and Alok Industries

Year	NTC (Rs in Crore)			Alok Industries (Rs in Crore)		
	Turnover	Overhead Cost	Overhead Productivity	Turnover	Overhead Cost	Overhead Productivity
2008–09	523.66	289.31	1.81	3,383.41	1,274.59	2.65
2009–10	540.94	278.96	1.94	4,709.01	2,250.14	2.09
2010–11	713.85	356.05	2.00	6,617.42	2,610.43	2.53
2011–12	893.38	383.81	2.33	8,966.46	3,544.28	2.53
2012–13	1,232.69	503.84	2.44	13,506.44	2,701.64	5.00
2013–14	1,262.15	488.45	2.58	14,205.07	2,685.39	5.29
2014–15	1,368.59	686.52	1.99	14,903.69	2,669.13	5.58
Average			2.16	Average		3.67

Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

Table 6: Overhead Productivity (ANOVA Table)

Source of variation	Sum of Squares	Df	Mean Square	F	F Critical
Between Groups	7.995	1	7.995	6.533	4.75
Within Groups	14.686	12	1.224		
Total	22.682	13			

productivities of NTC and Alok Industries under period of study.

4.7. Total Factor Productivity for NTC and Alok Industries

The turnover and total cost of NTC and Alok Industries are shown in Table 7. The Table exhibits the total factor productivity for seven years from 2008–09 to 2014–15. In all these years, NTC has maintained a level of total factor productivity ranging from 0.70 to 0.95, although it has fluctuated over the years. The total factor productivity for Alok Industries is at a higher level ranging from 1.02 to 1.1.

4.8. Total Factor Productivity (ANOVA Test)

Null Hypothesis: There is no significant difference in total factor productivities of NTC and Alok Industries.

Alternative hypothesis: There is a significant difference in total factor productivities of NTC and Alok Industries.

Level of Significance: 5 per cent

Critical value: 4.75

Degree of freedom between groups: 1

Degree of freedom within groups: 12

Table 8 indicates that the calculated value of 'F' is higher than critical value; so, null hypothesis is rejected and alternative hypothesis is accepted. It can be concluded that there is a significant difference in total factor productivities of NTC and Alok Industries under period of study.

4.9. Observations

Various productivities were calculated for NTC and Alok Industries. These productivities for NTC were compared with those of Alok Industries during the period 2008–09 to 2014–15. The period is considered after 2008–09 for NTC because the implementation of the rehabilitation scheme was started from 2006–07, and it took about two years for

Table 7: Total Factor Productivity of NTC and Alok Industries

Year	NTC (Rs in Crore)			Alok Industries (Rs in Crore)		
	Turnover	Total Cost	Total Factor Productivity	Turnover	Total Cost	Total Factor Productivity
2008–09	523.66	289.31	1.81	3,383.41	1,274.59	2.65
2008–09	523.66	720.89	0.73	3,383.41	3,098.42	1.09
2009–10	540.94	748.53	0.72	4,709.01	4,344.22	1.08
2010–11	713.85	1,025.54	0.7	6,617.42	6,034.23	1.1
2011–12	893.38	1,079.92	0.83	8,966.46	8,204.69	1.09
2012–13	1,232.69	1,295.77	0.95	13,506.44	12,264.010	1.1
2013–14	1,262.15	1,438.62	0.88	14,205.07	13,397.84	1.06
2014–15	1,368.59	1,633.67	0.84	14,903.69	14,531.67	1.02
Average			0.81	Average		1.08

Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

Table 8: Total Factor Productivity (ANOVA Table)

Source of variation	Sum of Squares	Df	Mean Square	F	F Critical
Between Groups	0.255	1	0.255	53.45	4.75
Within Groups	0.057	12	0.005		
Total	0.312	13			

the effects of rehabilitation to show. The source for the data used to calculate various ratios has been Annual Reports of NTC and Alok Industries from 2008–09 to 2014–15. Following are the observations made:

(i) Overall labour productivity for NTC is very low as compared to Alok Industries.

(ii) Overall material productivity for NTC is comparable with that of Alok Industries.

(iii) Overhead productivity of NTC was comparable with Alok Industries in the initial years but has gradually gone down, whereas it has gone up for Alok Industries.

(iv) Total factor productivity (turnover/ total cost) is low for NTC as compared to that of Alok Industries.

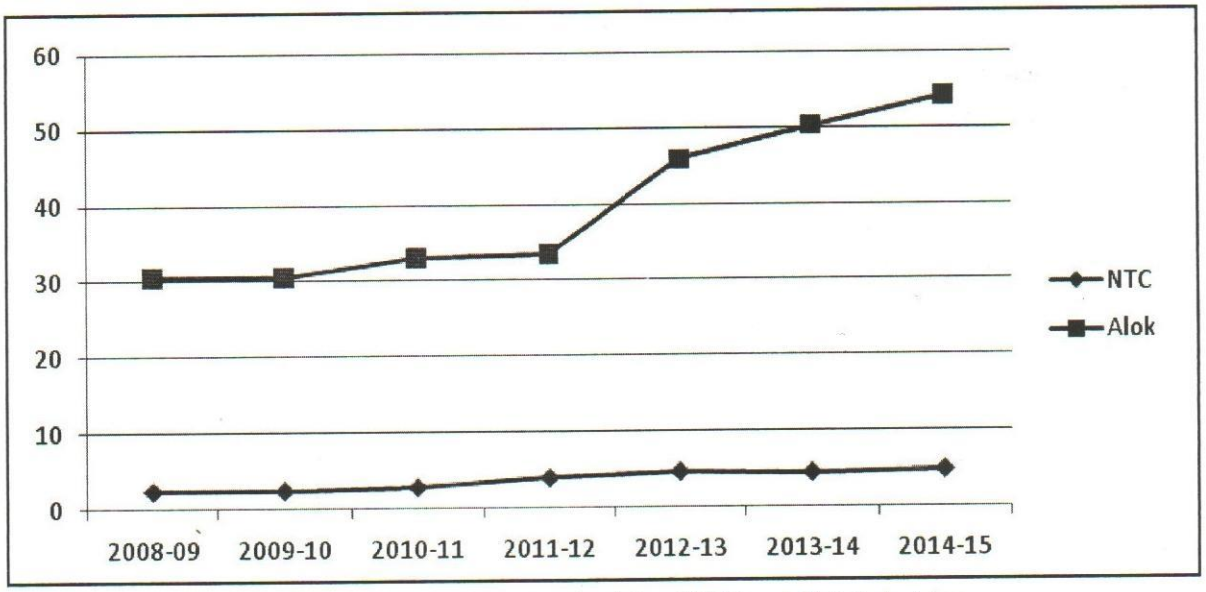

Figure 1: Overall Labour Productivity of NTC and Alok Industries

X axis: Years
Y axis: Overall Labour productivity (Turnover/employees cost ratio)
Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

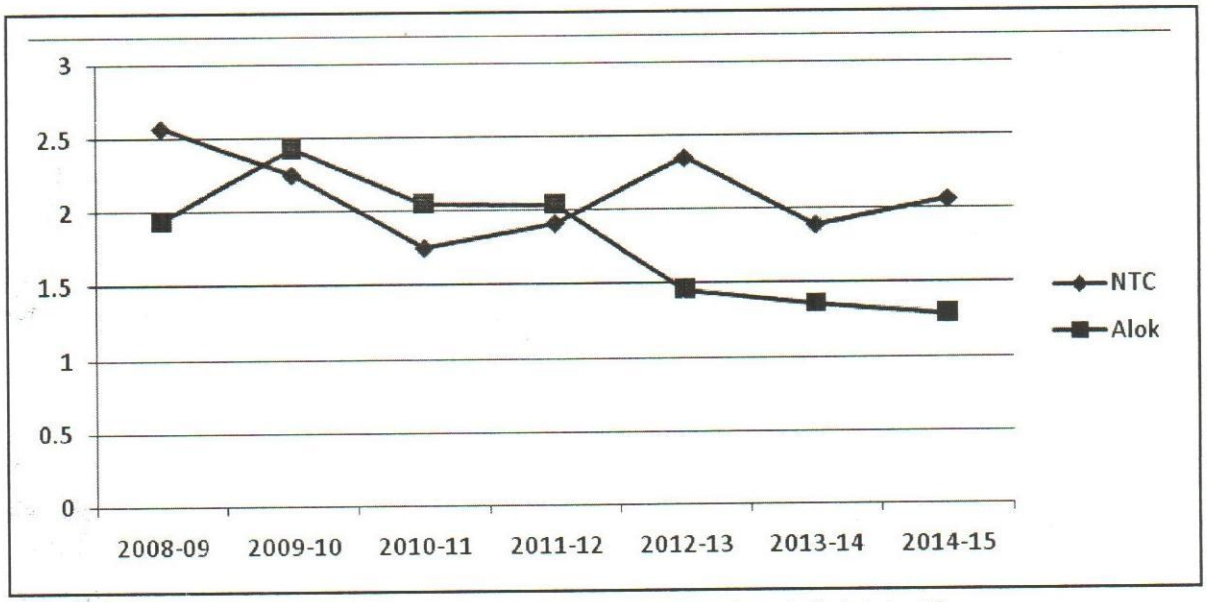

Figure 2: Overall Material Productivity of NTC and Alok Industries

X axis: Years
Y axis: Overall material productivity (Turnover/employees cost ratio)
Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

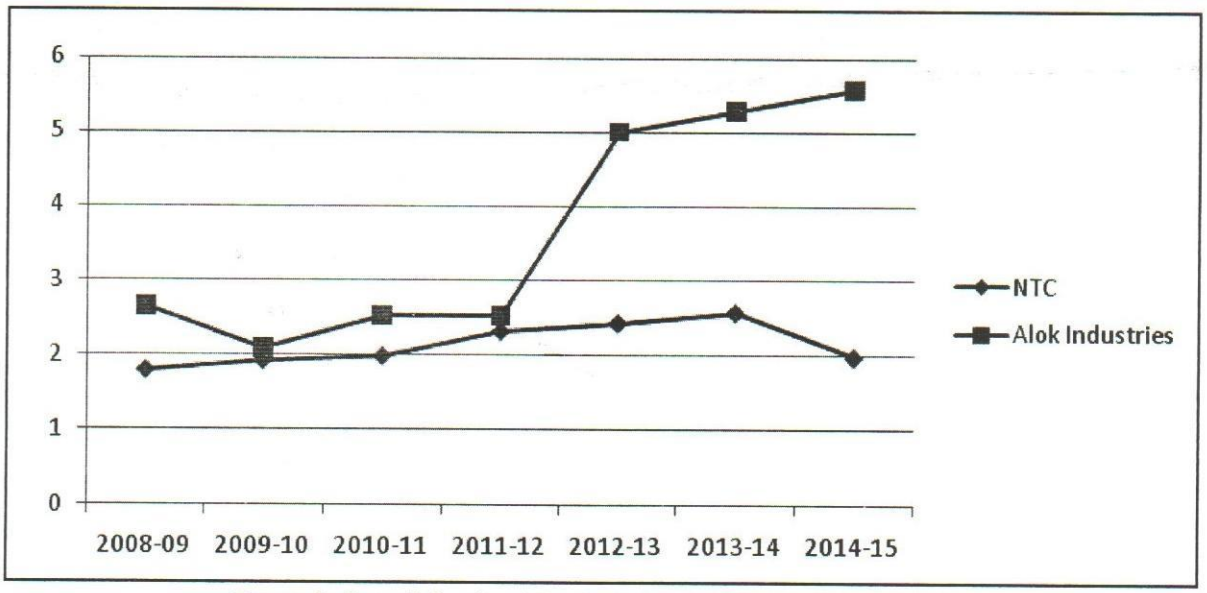

Figure 3: Overall Overhead Productivity of NTC and Alok Industries

X axis: Years
Y axis: Overhead productivity
Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

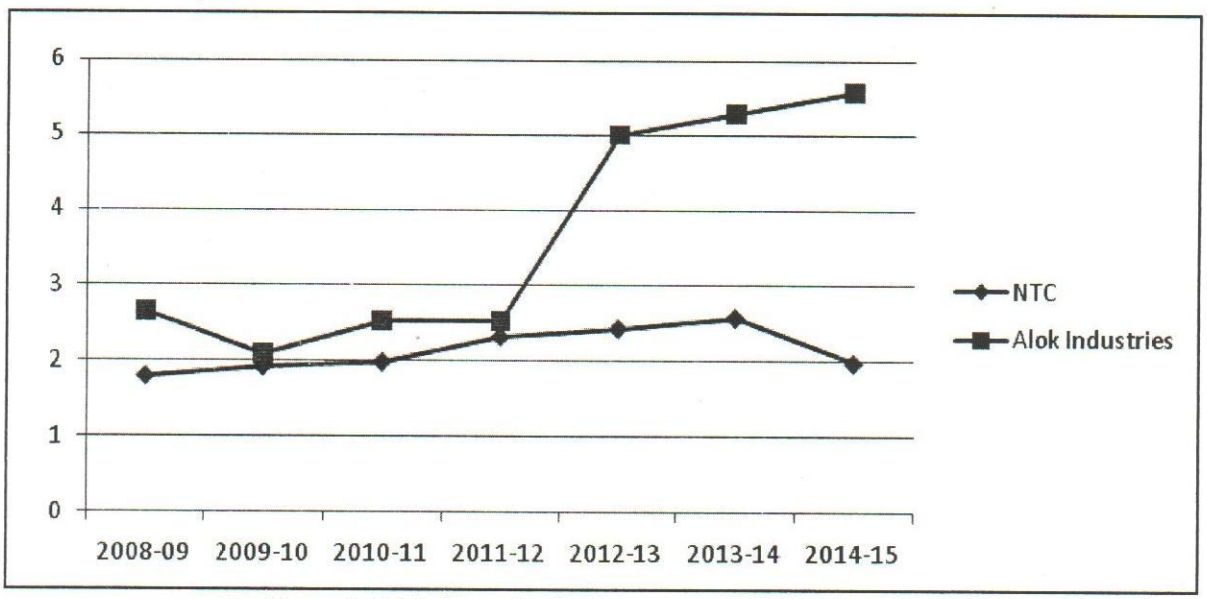

Figure 4: Total Factor Productivity of NTC and Alok Industries

X axis: Years
Y axis: Total Factor productivity
Source: Annual Reports of NTC and Alok Industries (2008–09 to 2014–15).

5. Major outcomes of the Study

5.1. Interpretations and Significance

We conclude that there is:

- a difference between two ratios of salary/wages cost and turnover, one for NTC (3.60) and another for Alok Industries (39.78).
- no difference between two ratios of overall raw material cost and turnover, one for NTC (2.11) and another for Alok Industries (1.80).
- a difference between two ratios of overhead cost and turnover, one for NTC (2.16) and another for Alok Industries (3.67).
- a difference between two ratios of total cost and

turnover, one for NTC (0.81) and another for Alok Industries (1.08).

- The salary/wages cost of the NTC is very high (i.e., 34.8 per cent, refer to Table 5) and it is eating into the profit margin. This alone is the major factor for poor operating performance of NTC. It will have to take some drastic measures to reduce the workforce so that the salary/wages cost comes down and matches the industry average (7 per cent). The salary/wages cost figures for Alok Industries is 2.9 per cent.
- The overhead cost of NTC is high and this is also contributing towards low/negative profitability.
- NTC should further look for the option of diversification into readymade garments and made ups.

The turnaround of NTC has been unique in the sense that it is not supported by external financial help and it involved a large number of textile mills, and more than 90,000 employees — it had a pan-India presence. It is also true that this turnaround would not have been possible but for the support and co-operation of all the stakeholders, promoters (i.e., Government of India), financial institutions, employees and the society.

5.2. Suggested Future Strategies

The following strategies should further be adopted to sustain the growth:

(a) Retrenchment Strategy: NTC should go in for further retrenchment strategy, as the number of employees is still very high. NTC should bring down its salary/ wages cost to the tune of 7 per cent from present level of 21 per cent of the turnover.

(b) Joint Venture along with Diversification Strategy: NTC should further look for the option of diversification into readymade garments and made-ups. It could have a tie up in the form of a joint venture preferably with any private partner with a brand name.

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"Sustainable global food security is attainable if we have open minds on technology and focus on high productivity and efficiency. We cannot feed tomorrow's world with yesterday's technology."

– Aalt Dijkhuizen

DATABASE

Food Security Scenario: India *vis-a-vis* Select Countries

RAJESH SUND

Introduction

Through Food security has improved around the globe over the past five years, but hunger and food insecurity still persist. Governments, multilaterals and the private sector are proactively addressing food-security challenges around the world.

The Global Food Security Index (GFSI) is designed and constructed by the Economist Intelligence Unit, London, spanning a set of 113 countries. The index, constructed from 28 unique indicators measuring drivers of food security across both developing and developed countries, is a dynamic quantitative benchmarking model considering three core issues of affordability, availability, and quality and safety. More than three-fourths (89) of the 113 countries in the 2016 GFSI have shown food-security improvements over the past five years. These positive developments have largely been driven by rising incomes in most countries and general improvements in the global economy. Falling food prices have also positively impacted food security. But weather and climate change-related risks, as well as market-distorting government food policies, pose risks to food prices and food availability in the future.

For the year 2016, India ranks 75 in GFSI (see Table 1). In all the three core issues of affordability, availability, and quality & safety, there has been very minor improvement during the last four years (see Table 2). India has shown remarkable improvement in the areas of nutritional standards, urban absorption capacity, volatility of agricultural production, food loss, food safety, political stability risk and access to financing for farmers. A lot of efforts are required in the areas of food consumption as a share of household expenditure, presence of food safety net programmes, agricultural import tariffs, agricultural infrastructure, sufficiency of supply, proportion of population under global poverty line, diet diversification, micronutrient availability and corruption. Whereas areas like protein quality, Gross Domestic Product (GDP) per capita (US$

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PPP), public expenditure on agricultural R&D are greatest challenges requiring insistent attention.

The Food Security Portal, facilitated by IFPRI, aims to provide improved food security for the world's poor and increased resilience of global food systems against food and financial crises.The Global Hunger Index (GHI) is a tool designed to comprehensively measure and track hunger globally, regionally, and by country. Each year, the International Food Policy Research Institute (IFPRI) calculates GHI scores in order to assess progress, or the lack thereof, in decreasing hunger. The GHI is designed to raise awareness and understanding of regional and country differences in the struggle against hunger.

India's GFSI ranking is worse today than it was 15 years ago. India was ranked 83 in 2000 and 102 in 2008 with GHI scores of 38.2 and 36 respectively. This implies that, while hunger levels in India have diminished somewhat, the improvement has been outstripped by several other countries. In fact, Bangladesh was ranked 84 with a score of 38.5 in 2000, just below India. India has been ranked low 97th among the 118 countries surveyed in 2016 Global Hunger Index (GHI). In 2016 GHI, India has scored low 28.5 on a 0–100 point scale of the index. It describes India's hunger situation as 'serious'.

Table 1: India Food Security Index 2016

	India		
	Rank / 113	**Score / 100**	**YoY Growth**
Overall Score	75	49.4	+0.5
Affordability	78	42.0	-0.5
Availability	58	57.1	+1.6
Quality and safety	80	46.7	0.0

Source: The Global Food Security Index

Table 2: Food Security Indicator wise Index of India

Overall Score		Score 0–100 where 100 = best			
		2013	2014	2015	2016
		48.2	47.9	48.9	49.4
1) AFFORDABILITY		**43.1**	**42.7**	**42.5**	**42**
1.1) Food consumption as a share of household expenditure	Percentage of total household expenditure	63.5	62.5	61.1	61.1
1.2) Proportion of population under global poverty line	Percentage of population living under $3.10/day 2011 PPP	37.6	37.6	37.6	37.6
1.3) Gross domestic product per capita (US$ PPP)	US$ at PPP / capita	3.1	3.3	3.5	3.8
1.4) Agricultural import tariffs	Percentage	52.8	50.7	50.7	45.7
1.5) Presence of food safety net programmes	Qualitative assessment (0–4)	50	50	50	50
1.6) Access to financing for farmers	Qualitative assessment (0–4)	75	75	75	75
2) AVAILABILITY		**53.9**	**53.6**	**55.5**	**57.1**
2.1) Sufficiency of supply	Rating 0–100	37.3	37.3	42	40.4
2.1.1) Average food supply	kcal/capita/day	32.7	32.7	39.1	36.9
2.1.2) Dependency on chronic food aid	Qualitative assessment (–2)	50	50	50	50
2.2) Public expenditure on agricultural R&D	Rating 1–9	0	0	0	0
2.3) Agricultural infrastructure	Rating 0–100	50.9	50.9	41.7	41.7
2.3.1) Existence of adequate crop storage facilities	Qualitative assessment (0–1)	100	100	100	100
2.3.2) Road infrastructure	Qualitative assessment (0–4)	25	25	25	25
2.3.3) Port infrastructure	Qualitative assessment (0–4)	50	50	50	50
2.4) Volatility of agricultural production	standard deviations	91.4	90.9	88.1	87.9
2.5) Political stability risk	Rating 0–100; 100=highest risk	72.2	72.2	77.8	77.8
2.6) Corruption	Rating 0–4; 4=highest risk	25	25	25	25
2.7) Urban absorption capacity	GDP (Percentage of real change) minus the urban growth rate	69.9	66.9	73.6	95.5
2.8) Food loss	Total waste/total domestic supply quantity (tonnes)	78.2	78.2	87.1	86.1
3) QUALITY AND SAFETY		**44.9**	**45.1**	**46.7**	**46.7**
3.1) Diet diversification	Percentage	33.3	32.1	37.5	37.5
3.2) Nutritional standards	Rating 0–100	100	100	100	100
3.2.1) National dietary guidelines	Qualitative assessment (0–1)	100	100	100	100
3.2.2) National nutrition plan or strategy	Qualitative assessment (0–1)	100	100	100	100
3.2.3) Nutrition monitoring and surveillance	Qualitative assessment (0–1)	100	100	100	100
3.3) Micronutrient availability	Rating 0-100	26.5	26.5	26.5	26.5
3.3.1) Dietary availability of vitamin A	Qualitative assessment (0–2)	50	50	50	50
3.3.2) Dietary availability of animal iron	mg/person/day	2.4	2.4	2.4	2.4
3.3.3) Dietary availability of vegetal iron	mg/person/day	27.2	27.2	27.2	27.2
3.4) Protein quality	Grams	17.2	18.8	20	20
3.5) Food safety	Rating 0–100	81.1	81.8	82.6	82.5
3.5.1) Agency to ensure the safety and health of food	Qualitative assessment (0–1)	100	100	100	100
3.5.2) Percentage of population with access to potable water	Percentage	85.1	86.7	88.5	88.4
3.5.3) Presence of formal grocery sector	Qualitative assessment (0–2)	50	50	50	50

Source: Global Food Security Index

Table 3: Global Hunger Index for India

Country	1992	2000	2008	2016
Index	46.4	38.2	36	28.5
Rank	76	83	102	97
Total Countries	96	115	118	118

Source: Global Hunger Index

Table 4: GHI India and neighbouring countries

Country	Rank	GHI score	Percentage of Malnourished
China	29	7.7	8.8
Nepal	72	21.9	7.8
Myanmar	75	22	14.2
Srilanka	84	25.5	22
Bangladesh	90	27.1	16.4
India	97	28.5	15.2
Pakistan	107	33.4	22

Source: Global Hunger Index

Table 5: GHI comparison with select countries

Country	1992	2000	2008	2016
Bangladesh	52.4	38.5	32.4	27.1
Brazil	16.1	11.8	5.4	< 5
China	26.4	15.9	11.5	7.7
India	46.4	38.2	36	28.5
Indonesia	35.8	25.3	28.6	21.9
Malaysia	20.1	15.5	13.4	9.7
Nepal	43.1	36.8	29.2	21.9
Thailand	26.1	18.3	11.9	11.8
Philippines	30.8	26.2	20.4	19.9
South Africa	18.5	18.7	16.3	11.8
Viet Nam	41.5	30.2	22.1	14.5

Source: World Development Indicators

Table 6: Agriculture, Value Added (as percentage of GDP)

Country	1990	2000	2010	2015
Bangladesh	32.75	23.77	17.81	15.51
Brazil	8.10	5.52	4.84	5.21
China	26.58	14.68	9.53	8.88
India	29.02	23.02	18.88	17.05
Indonesia	20.93	15.60	13.93	13.52
Malaysia	15.22	8.60	10.09	8.45
Nepal	51.63	40.82	36.53	33.00
Thailand	12.50	8.50	10.53	9.14
Philippines	21.90	13.97	12.31	10.27
South Africa	4.63	3.29	2.63	2.37
Viet Nam	38.74	22.73	18.38	16.99

Source: Food Security Portal

Table 7: Agricultural land (as percentage of land area)

Country	1990	2000	2010	2014
Bangladesh	79.79	72.21	70.99	69.90
Brazil	28.91	31.28	32.72	33.81
China	53.86	55.60	54.81	54.81
India	61.02	60.87	60.40	60.41
Indonesia	24.89	26.04	30.69	31.46
Malaysia	20.84	21.37	22.72	23.86
Nepal	28.98	29.64	28.78	28.75
Thailand	41.85	38.82	41.22	43.28
Philippines	37.36	37.68	40.58	41.72
South Africa	78.81	80.89	79.87	79.83
Sri Lanka	37.30	37.47	41.78	43.69
Vietnam	20.66	28.23	34.70	35.07
Italy	57.26	53.17	48.71	44.75
Japan	15.61	14.43	12.60	12.40
United Kingdom	75.24	70.12	71.19	71.23
United States	46.62	45.23	44.65	44.63
Denmark	65.77	62.39	61.89	62.21
France	55.87	54.44	52.83	52.54
Germany	51.65	48.91	47.91	47.94

Source: World Development Indicators

Table 8: Cereal yield per hectare (kg)

Country Name	1990	2000	2010	2014
Bangladesh	2,490.6	3,384.4	4,288.3	4,618.4
Brazil	1,755.1	2,660.8	4,040.6	4,640.4
China	4,320.9	4,752.6	5,526.7	5,886.4
India	1,891.2	2,294.2	2,676.4	2,984.1
Indonesia	3,800.2	4,026.4	4,877.6	5,095.5
Japan	5,846.3	6,256.7	5,853.6	6,080.5
Malaysia	2,740.3	3,039.5	3,659.9	3,866.4
Nepal	1,920.1	2,136.3	2,289.9	2,747.9
Sri Lanka	2,965	3,338.2	3,974.3	3,801.9
Philippines	2,099.5	2,580.8	3,231.9	3,637.4
South Africa	1,877.3	2,762.2	4,149.1	4,893.5
Thailand	2,009.2	2,719	2,976.2	3,144.4
Vietnam	3,072.9	4,112.4	5,177.55	5,77.8
Switzerland	5,983.9	6,601.1	6,093.8	6,725
United Kingdom	6,170.9	7,164.7	6,953	7,696.5
United States	4,755.1	5,854.3	6,987.7	7,638.1
Germany	5411.1	6,452.9	6,718.4	8,050.3

Source: World Development Indicators

Source: 1. Food Security Portal
2. World Development Indicators
3. The Global Food Security Index
4. Global Hunger Index

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