

CHALLENGES OF FOOD SECURITY IN INDIA

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During the neo-liberal policy regime, agricultural production has largely been demand-driven, mainly due to gradual shift in the dietary pattern towards high value horticulture and livestock products. It is generally argued that, as the dietary pattern of people is changing due to increase in per capita income, urbanization, convergence of food habits, and more availability of horticulture and livestock products, food security should not be confined to mere availability of food grains but to the overall availability of edibles. Assuming no leakages in the distribution system, we can argue that at least 50 percent of the demand-side constraints in the food accessibility of the intended beneficiaries would be removed. However, supply-side constraints may have serious implications for maintaining the food security. This paper, therefore, focuses on the supply-side challenges of food security in India.

INTRODUCTION

Removal of hunger and malnutrition among masses is not only socially desirable but also necessary for improving overall development of the country, as healthy people contribute more to the economy with their relatively higher level of productivity and efficiency. UN post-2015 development agenda on sustainable development goals (SDGs) aims to end all forms of hunger and malnutrition by 2030. In this context, three interconnected issues--water, food and livelihood--need to be addressed in an integrated manner. Food security is not to be viewed only in terms of procurement and distribution of food, but also in terms of food production, people's livelihood and overall management of food economy. It may be noted that the green revolution technology in India, in spite of its severe criticism on equity, ecology and environment grounds, has made significant contribution in transforming India from food-deficit to food-surplus country. Food production during the green revolution period was largely supply-driven, resulted by the policy support, agriculture R&D, and hard work of farmers. By contrast, during the neo-liberal policy regime, agricultural production has largely been demand-driven, mainly due to gradual shift in the dietary pattern towards high value horticulture and livestock products. It is generally argued that, as the dietary pattern of people is changing due to increase in per capita income, urbanization, convergence of food habits, and more availability of horticulture and livestock products, food security should not be confined to mere availability of food grains but to the overall availability of edibles. But, at the same time, a large number of poor households, especially living in rural areas and in urban slums, are not able to get adequate quantity of food and thus suffer from malnutrition.

Various survey reports indicate that in spite of relatively higher GDP growth achieved during the last two decades, hunger and malnutrition among a majority of Indian population still persists. FAO study reveals that during 2009-2011, India was home to 190 million undernourished people (FAO, IFAD, and WFP 2014). National Family Health Survey (2005-06) indicates that the percentage of anemic ever-married women in the age group 15-49 has increased from 53.9 in 1998-99 to 58.2 in 2005-06 in rural areas and from 45.7 to 51.5 in urban area. Similarly, percentage of anemic children has also increased from 75.3 to 81.2 in rural areas and 70.8 to 72.7 in urban area between the same periods. The International Food Policy Research Institute latest report (IFPRI, 2014) on hunger ranks India at 55 out of 76 countries, slightly above Bangladesh and Pakistan and below Sri Lanka

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and Nepal. Global Food Security Index 2015 ranks India 68 out of 109 countries. It is in this context that the National Food Security Act (NFSA) assumes significance as it gives legal right to subsidised food grain to 67% of India's population (75% of rural and 50% of urban households) and also makes provision for nutritious meal to pregnant and lactating mothers and children. Assuming no leakages in the distribution system, we can argue that at least 50 percent of the demand-side constraints in the food accessibility of the intended beneficiaries would be removed. However, supply-side constraints may have serious implications for maintaining the food security. This paper, therefore, focuses on the supply-side challenges of food security in India.

STATE OF HUNGER AND MALNUTRITION

According to FAO, "Food security 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". Food security has three dimensions: availability, affordability and food absorption. Availability can be improved through raising domestic production, more import and better distribution system. Affordability refers to the ability of a person/household to buy sufficient quantity of nutritious food required for healthy life. It can be ensured by providing better income and employment opportunities to the workforce. Food absorption depends on people's access to safe drinking water, sanitation and hygiene facilities. Poor quality of water and sanitation generate negative externality and affect the food absorption. This dimension of food security is crucial because food absorption not only depends on individual household's water and sanitation conditions but also on the other households' water and sanitation status and overall environment of that place. Inadequate and inefficient delivery of these basic amenities put enormous burden of diseases on households, especially the poor households who cannot afford to have costly water-purifying system (Singh 2013). As per the NSS 69th round (GOI, 2013a), only 32.3 percent rural and 54.4 percent urban households treat water before its use. Further, 59.4 percent rural and 8.8 percent urban households do not have toilet facilities within house; 68.3 percent rural and 17.5 percent urban households do not have improved drainage facilities; and 68 percent rural households and 24.2 percent urban household do not have garbage disposal system. Contaminated water, open defecation, lack of personal and food hygiene and improper disposal of solid and liquid wastes are key factors responsible for morbidity among masses. Therefore, economic, social and environmental aspects need serious attention for ensuring an effective food security system.

FAO study shows that there has been significant improvement in the nutrition status of India. The number of undernourished persons in the country has come down from 210.8 million (20.78% share in the world) during 1990-92 to 190.7 million (23.61% share in the world) during 2012-14. Although, absolute number of undernourished population has declined during the period, but percentage share of India in the world's undernourished population has increased. Still about 16 percent of India's population is undernourished (FAO, IFAD, and WFP 2014).

According to FAO, a person will be considered undernourished if his/her per day calorie consumption is less than 1,800 kcl. In India, on an average, in both rural and urban areas, average calorie consumption has been more than this minimum requirement. Table 1 shows that in 2011-12, an average person consumed 2233 calories in rural areas and 2206 calories in urban areas. The table also indicates that between 2004-05 and 2011-12, nutritional status of both rural and urban households has improved, as consumption of calories, protein and fats show an increase during this period. Global Hunger Index (GHI) prepared by the IFPRI (2014) also indicates that the intensity of hunger and malnutrition in India has declined over the period. The value of GHI for India has gradually declined from 31.2 in 1990 to 25.5 in 2000 and further to 17.8 in 2014. Still, India's hunger index is under serious category.

Table 1: Average Per Capita Consumption Of Calorie, Protein And Fats For Rural And Urban Households In India

Year	Calorie (Kcl)		Protein (gms)		Fats (gms)	
	Rural	Urban	Rural	Urban	Rural	Urban
1993-94	2151	2071	60.2	57.2	31.4	42.0
1999-00	2149	2156	59.1	58.5	36.1	49.6
2004-5	2047	2020	57.0	57.0	35.5	47.5
2011-12	2233	2206	60.7	60.3	46.1	58.0

Source: GOI (2014 a)

As per the NSS consumption surveys, per capita consumption of cereals has declined from 12.72 kgs in 1999-00 to 11.22 kgs in 2011-12 in rural areas and from 10.42 kgs to 9.28 kgs in urban areas. Further, share of pulses has also declined from 0.94 kgs to 0.78 kgs in rural and from 1.0 kgs to 0.90 kgs in urban areas during the same period. Share of food grains in the total food consumption has also decelerated from 38.73 percent in 2004-05 to 31.69 percent in 2011-12 in rural areas and from 28.94 percent to 24.68 percent in urban areas; whereas share of dairy products, eggs, meat, fish and fruits & vegetables has gone up from 36 percent to 39.92 percent in rural and from 40.47 percent to 44.42 percent in urban areas. Although overall share of food in total consumption has declined during this period; the share of fruits & vegetables and dairy & meat products show an increase. This makes a strong argument that the food security should not be limited to the accessibility of food grains but it should be extended to the availability of livestock and horticultural commodities. In this regards, two points may be taken into consideration. First, poor households get more calories from cereals than non-cereal food items. Second, diversification of dietary pattern towards meat, poultry, milk and other livestock products would increase the indirect demand for cereals for feed grains. Since 67 percent of population is entitled to have subsidized food from PDS; the direct or indirect consumption of cereals may likely to increase in future, raising further demand for cereals and consequently their prices.

Table 2: Average Calorie, Protein And Fats Intake Per Capita Across Mpce Fractile Classes In 2011-12

MPCE Fractile Class	Rural			Urban		
	Calorie (Kcl)	Protein (mg)	Fats (mg)	Calorie (Kcl)	Protein (mg)	Fats (mg)
0-5	1633 (70.4)	42.8 (72)	20.8	1637 (65.5)	44.0 (68)	26.5
5-10	1816 (67.4)	48.0 (69)	26.0	1754 (60.4)	47.5 (63)	34.4
10-20	1933 (65.2)	51.5 (67)	30.4	1856 (58.1)	50.6 (60)	39.5
20-30	2010 (63.5)	53.8(65)	33.8	1942 (55.5)	53.3(57)	44.9
30-40	2083 (61.0)	56.2 (62)	38.2	2041 (52.8)	55.9(54)	50.2
40-50	2158 (59.3)	58.3 (61)	42.3	2117 (50.0)	57.7(51)	54.7
50-60	2228 (58.1)	60.5 (59)	45.6	2199 (49.4)	60.2 (51)	58.6
60-70	2291(56.3)	62.5 (57)	49.9	2265 (46.3)	62.1(47)	63.4
70-80	2399 (54.4)	65.8 (55)	54.7	2410 (44.0)	66.0(45)	69.8
80-90	2540 (51.8)	70.3 (52)	61.6	2538 (41.1)	69.6(42)	75.3
90-95	2667 (48.2)	74.1 (48)	69.5	2805 (36.9)	77.2(38)	86.7
95-100	3263 (42.1)	90.9 (42)	92.2	3190 (29.4)	86.5 (31)	99.7
All	2233(57.4)	60.7 (58)	46.1	2206 (48.0)	60.3 (49)	58.0

Source: GOI (2014 a)

Note: Figures in parentheses are % share of cereals in calorie and protein intakes, respectively.

Table 2 shows per capita average calorie, protein and fats intake across MPCE fractile classes in 2011-12. It is significant to note that bottom 5 percent rural and urban households in India in 2011-12 met respectively 70.4 percent and 65.5 percent of their calorie requirement from cereals, while the corresponding percentages for the top 5 percent households were 42.1 and 29.4 in rural and urban areas respectively. The table shows that there is wide difference between rich and poor in regard of the per capita calories consumption. For example, bottom 5% households in rural and urban areas consume only 1633 and 1637 calories, respectively, while the corresponding calories intakes in case of top 5 percent households are 3263 and 3190, respectively. This implies that poor households consume much less calories than the minimum prescribed norms.

About 40 percent of households of India consume less than 2100 calories per day. It is observed that consumption of calories, protein and fats increases with the increase in MPCE fractile classes, indicating that relatively richer households consume more protein, fats and calories than their poorer counterparts. It may also be noted that poor households get large proportion of their calorie and protein intakes from cereals, while rich people get these intakes more from non-cereal food items. This implies that increase in food grains prices affect poor households more than the other households. Recently, there has been significant improvement in the public distribution system, which is evident from the increasing share of PDS rice and wheat in the total consumption of cereals (Table 3). Although, over the period, per capita consumption of cereals, on an average, has declined in both rural and urban areas, the share of PDS quantity has increased. Since, NFSA now covers 75 percent rural and 50 percent urban households, efficiency in the PDS system is likely to improve and leakages would be minimised.

Table 3: Per Capita Monthly Consumption Of Pds And Non-Pds Quantity Of Rice And Wheat In India (Kgs)

Items	Year	Rural			Urban		
		PDS	Non-PDS	Total	PDS	Non-PDS	Total
Rice	2004-05	0.84 (13.2%)	5.54	6.38	0.53 (12.7%)	4.18	4.71
	2011-12	1.67 (28.5%)	4.18	5.85	0.88 (19.6%)	3.61	4.49
Wheat	2004-05	0.31 (7.4%)	3.89	4.20	0.17 (4.0%)	4.19	4.36
	2011-12	0.74 (17.3%)	3.54	4.28	0.41 (9.4%)	3.61	4.02
Rice+ wheat	2004-05	1.15 (10.9%)	9.43	10.58	0.70 (7.7%)	8.37	9.07
	2011-12	2.41(23.7%)	7.72	10.17	1.29 (15.2%)	7.22	8.51

Source: GOI (2014a).

Figure in Parentheses are %e share of PDS rice and wheat in total *consumption of rice* and wheat respectively

Table 3 shows that share of PDS rice in total rice quantity consumed has increased from 13.2 percent in 2004-05 to 28.5 percent in 2011-12 in rural areas and from 12.7 percent in 2004-05 to 19.6 percent in urban areas. Similarly, the share of PDS in total wheat quantity consumed has increased from 7.4 percent to 17.3 percent in rural and from 4.0 percent to 9.4 percent in urban areas during the same period.

During 2004-05 to 2011-12, share of cereals in total consumer expenditure has declined in both rural and urban areas (Table 4). However, rural households spend relatively more on cereals than their urban counterparts. Except for beverages and fruits, percentage share of all other food items in the total MPCE was higher for rural than the urban households. In 2011-12, food shared 48.6

percent of total consumer expenditure in rural areas, while the corresponding share in urban areas was only 38.5 percent. The ratio of urban to rural MPCE on non-food is 2.30, while in case of food items, it is only 1.52. Since, poor households spend relatively large share of their income on food, food inflation affects them more. If we compare the share of different non-food items in the total expenditure in 2004-05 and 2011-12, we find that both in rural and urban areas, the percentage shares of clothing and footwear, conveyance, education, healthcare, and other misc. items have increased, while percentage shares of pan and tobacco, fuel & light have declined. It is interesting to note that rural households spend relatively more on healthcare, while their urban counterparts spend more on education.

Table 4: Trends In The Composition Of Mpce On Food And Non-Food Items (In %)

Item Group	sector	Food		Item Group	Non-Food	
		2004-05	2011-12		2004-05	2011-12
Cereals & Cereal substitutes	Rural	18.2	12.3	Pan, tobacco & intoxicants	2.7	2.4
	urban	10.2	7.4		1.6	1.4
Pulses & products	Rural	3.1	3.1	Fuel & light	10.2	9.2
	urban	2.1	2.1		9.9	7.6
Milk & products	Rural	8.5	9.1	Clothing & footwear	5.3	7.6
	urban	7.9	7.8		4.7	6.5
Edible oils	Rural	4.6	3.8	Education	2.7	3.1
	urban	3.5	2.7		5.0	5.7
Eggs, meat & fish	Rural	3.3	3.6	Medical Care	6.6	6.9
	urban	2.7	2.8		5.2	5.5
Vegetables	Rural	6.1	4.8	Conveyance	3.8	4.5
	urban	4.5	3.4		5.5	7.5
Fruits & Nuts	Rural	1.9	1.9	Consumer Services	3.8	4.5
	urban	2.1	2.3	excl. Conveyance	7.0	6.5
Sugar	Rural	2.4	1.8	Rent	0.5	0.5
	urban	1.5	1.2		5.6	7.0
Salt & spices	Rural	2.5	2.4	Entertainment	0.6	1.1
	urban	1.7	1.7		1.9	1.8
Beverages, etc.	Rural	4.5	5.8	Other items*	8.8	11.6
	urban	6.2	7.1		11.1	12.0
Total Food	Rural	55.0	48.6	Total non-food	45.0	51.4
	urban	42.5	38.5		57.5	61.5

Source: Government of India (2013b)

* Include toilets articles, other hhs consumables, durable goods, taxes & cesses, other Misc. goods and services.

SUPPLY-SIDE CHALLENGES

In India, enforcement of right to employment and right to food has significantly improved the food affordability for the poor households. NFSA provides guarantee to 75 percent of rural and 50 percent of urban households to have 300 kgs of cereals (rice/wheat/millet at the rate of Rs 3/2/1 per kg) at the very subsidized prices and MGNREGS ensures 100 days of manual employment annually

to each willing rural household. If a rural worker works only two days under the MGNREGS, he/she can easily purchase 300 kgs cereals from the wages. This indicates that 50 percent of food demand can easily be met through these two rights. We can address the demand-side constraints related to food security through legal entitlements, improvement in livelihood options and better food management system. However, major concerns are how to ensure food availability and food absorption. It is in this context that this paper examines the key supply-side challenges of food security in India. We examine major supply-side challenges in the following points.

Trade off between Food and Fuel

Energy prices affect the food prices in two ways: First, rising prices of petroleum products motivates the government and corporate sector to go for producing bio-fuels. Although, in India, grains are not being used to produce ethanol, however, its possibility in future cannot be ruled out. If you look at the trends in developed countries, you will find that indirect demand for cereals (feed-grains and fuel-grains) is much higher than the direct demand. The increasing production of bio-fuel reduces the global availability of food grains for consumption and thus raises the food prices. For instance, one ton of barley/sorghum/rice/wheat can produce 434 liters of bio-ethanol, while one ton of maize, potato, and sugarcane can generate 428, 131 and 99 liters of ethanol, respectively. Whenever global energy prices increases, conversion of food grains into fuel becomes more profitable. About one-fifth of US maize production is used to produce ethanol. Brazil uses sugarcane to produce bio-energy. Since land and water resources are limited, a diversion of these resources towards energy production may have serious implications for global food security. In India, ethanol is produced from molasses. However, now voices are being raised in favour of allowing sugar mills to produce ethanol directly from sugarcane juice so that ongoing crisis in the sugar industry may be alleviated and farmers' income be augmented. However, such move may not only jeopardize the food security but also stress more on already scarce water resources as sugarcane is a water guzzling crop.

Second, increasing energy prices makes agricultural production more expensive via raising the cost of mechanical cultivation, pumping of ground water for irrigation, inputs like fertilizers and pesticides, and transportation of inputs and outputs. It may be relevant to note that the share of mechanical and electrical power in the total power consumption has significantly increased from 39.63 percent in 1972-73 to 86.6 percent in 2005-06, while corresponding shares of human and animal powers have come down from 60.37 percent to 13.4 percent during the same period. Energy intensification in agriculture has increased the external inputs' cost. Therefore, if domestic food prices are controlled by banning export and reducing import duties, farmers would get disincentives to grow more food.

Trade off between Food and Feed

Urbanization, rising income, and changing demographic pattern have raised the demand for high income-elastic and more water-intensive dairy and meat products. Analysis of consumption data done in the preceding section shows that direct consumption of food grains in India has been constantly declining over the period; while consumption of dairy and meat products has increased at the same time. This indicates that more land, water and other resources are moving towards these high value food products. In regard of implication of this dietary diversification on the food security, two points may be relevant to mention. First, more consumption of meat and dairy products means more indirect demand for food grains for animal feed, thus affecting their availability for direct human consumption and raising their prices. Since, 60-70 percent of calories

requirement of poor households are met from cereals, the diversion of cereals to feed livestock rather than human being may contribute to food insecurity among the poor households. Moreover, rising food grains prices also affect the other needs of poor households. Poor households have to spend a large proportion of their income to buy food and therefore, they may have less money to spend on healthcare and education. Thus, it may not only affect their nutrition level by way of reducing quality and quantity of food but also their non-food essential needs. A high share of food in the total budget of a household makes it highly vulnerable to food insecurity, as price volatility in domestic and global markets affect such households more than those who spend less proportion of their budget on food.

Second, we can also argue that rising demand for dairy and meat products also help the poor rural households as livestock rearing is the main source of livelihood of a majority of rural households. Moreover, being rich in protein and fats, dairy and meat consumption also improves the nutrition status of consumers. However, a high growth in horticulture and livestock products may not necessarily improve the nutritional status of the common masses, especially urban poor, as they have little or no access to these products. It is significant to note that the NFSA is expected to increase both direct and indirect demands for cereals. Since, this act covers 75 percent of rural households, there is possibility that cheap cereals available through the PDS may be used by the entitled farmer households for cattle feed because market prices of cattle feed are much higher than the price paid by the consumers for the PDS grains. This would raise the market price of cereals. Another possibility is that some small farmers may diversify from cereals to non-cereal crops, as at least 50 percent of their monthly cereal requirement can be met through PDS. Apart from farmers' decision to diversify their crops, technology, market, and monsoon failures may also lead to create volatility and instability in food production system and consequently the food security. In such situations, if India enters in the world market as a bulk importer of food, international prices would increase to a greater extent, thus jeopardizing our food security. Therefore, these issues are required to be addressed through appropriate policy actions.

Trade off between Food and Wood

Another most critical issue in context of food security is diversion of cultivated land towards wood farming. High GDP growth is leading to increase consumption of wood and wood products like furniture, timber, pulp & paper. Recently, some farmers of Punjab, Haryana, Western Uttar Pradesh, Himachal Pradesh, and plains of Uttarakhand have been gradually shifting towards cultivation of poplar trees, which is turned out to be more remunerative than the crop husbandry. It is expected that in future more land would be brought under cultivation of poplar trees due to various reasons, including labour shortage, low profitability in crop husbandry, and increasing absentee land owners. This may be the big challenge for food security in future because, as the NSS situation assessment surveys on farmers indicate, a number of farmers want to abandon agriculture but they may not sell their land holdings. During 2004-05 and 2011-12, about 27 million workers have left agriculture job. The gradual shift of farm workers from agriculture to non-agricultural activities may increase more land area under plantation, thus creating supply-side constraint to the food security. Increasing indirect demand for cereals and declining areas under cultivation can create mismatch between supply and demand and generate inflationary pressure and consequently the fiscal burden of food security on the government. Food subsidy bill in India has significantly increased after the NFSA (currently more than 1.0 lakh crore rupees).

Virtual Water and Food Security

Water and land both are the key drivers of food and other agricultural production. These two inputs are unevenly distributed across Indian states. In some states, there is sufficient area of arable land but acute shortage of water (for instance western region) and therefore per hectare productivity is quite low. On the other hand, in some regions, there is sufficient quantity of water, but size of operational holding is too small to introduce modern farm practices (for example eastern region). Government of India has special focus on agriculture development of eastern states and wants to make this region as a future “food bowl” of the country. There is no physical scarcity of water in this region; however economic scarcity of water along with natural factors, such as, flood limits the scope of potential increase in food production. On the other hand, in northern states, which supply both wheat and rice to central pool, water has become a scarce input due to its overexploitation. For example, about 21 billion M³ virtual water goes out every year from Punjab through agricultural trade. Ground water comprises 76 percent of the total virtual water transfer.

Table 5: Water Use, Virtual Water Flows And Net Import By State (1997-2001) In Million M³

State	Water Use	Virtual water export		Virtual water import		Net VW Import
		Inter-state	International	Inter-state	International	
AP	66652	4952	1711	569	774	-5319
Assam	17812	4	0	2304	155	2455
Bihar	38283	149	1	14469	983	15302
Chhattisgarh	27912	2835	699	2544	558	-431
Gujarat	42678	3847	3120	9186	941	3160
Haryana	31956	13006	2105	638	339	-14134
Jharkhand	11593	0	0	8853	430	9283
Karnataka	43358	3130	365	3699	214	418
Kerala	2897	0	2	10180	891	11069
MP	64863	7671	8254	4933	162	-10831
Maharashtra	80390	5788	3949	11836	1461	3560
Orissa	37801	149	21	4552	416	4797
Punjab	43036	19351	4095	1658	914	-20874
Rajasthan	60169	9852	388	5504	512	-4224
Tamil Nadu	35496	4293	285	1397	967	-2214
UP	127855	24542	2988	4777	1953	-20800
WB	47141	4447	1094	6238	749	1445
Total	792321	105516	29203	105516	13953	-15250

Source: Kampman (2007).

In Punjab, Haryana and Western Uttar Pradesh, groundwater, the main source of irrigation, has been becoming scarce and water table is depleting at a faster rate. Environmental and ecological consequences of groundwater intensive farming system in these states have now become quite obvious and serious. As per the Central Groundwater Commission report, percentages of groundwater development in Punjab and Haryana have reached to 145 and 109 respectively. Out of 137 assessed blocks of Punjab, 75 are overexploited. In Haryana also, out of 113 assessed blocks, 49 are overexploited (Singh 2008). These two states provide maximum cereals to the central pool for PDS and also bear huge environmental and ecological cost of nation's food security, which is also a

matter of concern. It is significant to note that virtual water is traded through the export of agricultural commodities. Table 5 shows that annual net outflow of water is highest in Punjab, closely followed by Uttar Pradesh and Haryana, while net inflow of water is highest in Bihar, followed by Kerala, and Jharkhand. Among the net exporter states, the percentage share of export of virtual water in the total water use in agriculture is observed highest in Punjab (54.5%), followed by Haryana (47.29%), MP (24.55%), UP (21.53%), Rajasthan (17.01) and AP (10%). Contrary to this, among the net importer states, percentage of import to the total water use is found highest in Kerala (382.15%), followed by Jharkhand, (80%), Bihar (40.36%), Gujarat (23.7%) and Maharashtra (16.5%).

Water saving can take place when food exporter is more water-efficient than the food importer. For example, water savings occur if exporter produces in rain-fed condition, while importer would have used irrigation water. For example, transfer of food from Punjab to water-abundant region (say Bihar) means transfer of water from water-stressed region to water-abundant region, which may not be considered economically and environmentally sustainable. From the above discussion, it can be inferred that real supply-side challenge of food security in India is regional variation in the availability of land and water endowments.

Shrinking Land and Water Resources

Increasing use of land and water resources for non-agricultural purposes is also one the key challenges for the future food security of India. Due to urbanization, industrialization and rising per capita GDP, demand for land and water for non-agricultural uses have been constantly increasing. As per the NSS report on key indicators of land and livestock holdings in India (GOI, 2014b), area under operational holdings has declined from 107.65 million hectares in 2002-03 to 94.48 million hectare in 2012-13. Consequently size of operational holdings also went down from 1.06 ha to 0.91 ha. Land area owned by the farmers has also decelerated from 107.23 million hectares to 92.37 million hectares during the same period. This implies that 13-15 million hectares of agricultural land might have converted into non-agricultural uses during this period. Expansion of cities and towns means shrinking of agricultural land, water and other natural resources, thus having serious implications for future food security. Government of India envisages to create 100 smart cities over a period of 10 years in different parts of India, equipped with all modern infrastructure, including smart buildings, roads, sanitation, sewerage, power back up, information technology and responsive public and private institutions. These initiatives would increase more demand for land and water. Moreover, there is increasing water demand for maintaining environmental flows in rivers and also for various cultural and ecosystem services. Since agriculture is the largest consumer of water (about 87% of total water use), rising water demand for domestic, industrial and ecosystem services can only be met by reducing water consumption in agriculture. This implies that if irrigation efficiency is not improved through better technology, management practices, and changing cropping pattern from more water intensive to less water intensive food crops; water reduction in agriculture may jeopardize the future food security of the country.

Food Productivity, Quality and Waste

As discussed above, direct demand for food grains has declined over the period due to gradual shift of consumers' dietary pattern from food grains to dairy, meat and horticultural products. If this trend continues in future, then indirect demand for cereals will increase. Since, scope for bringing more land under cultivation is quite limited, more production can only be achieved by raising productivity of land, water, labour and other resources. One of the major problems in this context is the knowledge-deficit in agriculture. Due to it, there is a huge productivity gap between what the

technologist gets in the experimental farm and what a farmer gets on his farm. As per the NSS survey, about 60 percent farmers did not have access to any source of information for advanced agricultural technologies (GOI, 2005). Due to lack of education, skills, and timely availability of resources, technology transferred to the farmers' fields fails to provide the desired yield (GOI, 2007). It may be noted that educated farmers are better able to respond new technology, market opportunities, and risks, therefore how to improve human capital base of agriculture is a serious concern. The National Food Security Mission targeted to increase the production of rice, wheat and pulses by 10, 8 and 2 million tons by the end of the 11th Plan (GOI, 2015). India is in a position to increase production of wheat by about 40 per cent, and double paddy production by bridging the existing yield gaps. For instance, four States—Uttar Pradesh, Bihar, Madhya Pradesh and Rajasthan—together have potential of 25.04 million tons of additional wheat production. How to attract educated youths in farming activities, especially in doing innovations in agricultural practices, is a major supply-side concern. Productivity growth in food production helps to achieve food security in two ways: making food affordable and generating additional income and employment opportunities, as nearly 50 percent of India's population still draw their livelihood from agriculture.

The NFSA ensures quality food to the eligible households. Increasing chemicalization of farming has adversely affected the quality of food we eat. We have to promote sustainable agricultural practices, including organic farming, to provide safe and quality food and maintain soil health, water quality, and reduce non-point sources of pollution of water bodies. At least one-third of agricultural subsidies can be directed towards promotion of organic farming. Keeping in view the negative externalities associated with the conventional farming in terms of soil and water pollution and public health cost, environmentally sustainable farm practices would be more cost-effective than the conventional one. Improvement in food quality is not only essential for making accessible healthy food to citizens of the country but also boosting the food export. However, inadequate food safety laws, poor food standards, and insufficient quality-testing infrastructure are the major issues in regard of food quality and safety. India's horticulture and livestock products have no or little market in European countries because of high food quality and safety standards. The need of hour is to enhance public investment on upgrading the existing quality and safety management system, education and training of staff, and quality assurance measures. The effective enforcement of food safety laws is required for both domestic use and export of food products.

Huge post harvest losses of food production are also a concern. Estimate of losses varies from about 6 percent in cereals to more than 30 percent in horticulture and livestock products. India ranks first in milk and second in fruits and vegetable production in the world and number one in cattle and poultry population. However, due to lack of efficient transport, handling and storage infrastructure and inadequate processing facilities, large quantity of fruits, vegetables and other food commodities go on waste years. About Rs. 2.0 lakh crores of fruits and vegetables go on waste every year due to inadequate cold storage and processing facilities. Post-harvest losses in food grains range between 12-16 million tons (NABCONSE, undated). If even 50 percent of this waste is reduced, food security can be improved in a greater way and some land can be released for other purposes.

ACTIONABLE POINTS

In order to remove the supply-side constraints in food security, the following actionable points can be taken into account.

1. Cost-effective supply of food to the end-users is as critical as its cost-effective production. Therefore, existing delivery mechanism needs to be reformed. Academicians and experts

have suggested several measures, including direct cash transfer and food stamps to improve the PDS system. These measures may be attempted on pilot basis to examine their efficacy. Decentralization of procurement and distribution could be another option. Gram panchayats may be involved to locally procure and distribute food grains to the entitled households twice in a year (Rabi and Kharif seasons). Computerization of records and the issue of smart cards to PDS beneficiaries may improve accountability and transparency in the PDS system.

2. There is need to boost investment in agriculture innovation systems, including technology transfer and farm extension services, rural infrastructure, post-harvesting R&D to reduce waste, etc. Price stability, crop insurance, reform in tenancy and lease laws, promotion of contract farming and incentives to food processing industries are some of the policy-driven factors that may be considered.
3. Water would be the key issue for future food security. Its demand would increase in non-agricultural uses, including household, industry and environmental flow. It is, therefore, necessary to reduce water consumption in agriculture through better technology, management practices and change in cropping pattern. New technologies such as laser land leveling, zero tillage and sprinkler and drip irrigation, etc can be promoted to improve irrigation efficiency. Water credit system in agriculture may be introduced and water literacy among farmers needs to be promoted.
4. Encourage corporate sector to use a part of its CSR funds towards training, skill formation and capacity building of farmers so that they may adopt water efficient, cost-effective and sustainable farming system, including organic farming. Agricultural subsidies be rationalized and at least, one-third of these subsidies can be transferred from chemical fertilizers to bio-fertilizers and organic nutrients. Moreover, there is need to reorient agriculture R&D, extension and training system towards development and transfer of technology suited to the sustainable agriculture.
5. Invest in drinking water, sanitation, and other public services would help to improve food absorption.

SUMMING UP

Given the current trend in the productivity levels with growing pressure on water and land, it would be a difficult proposition for the public agencies to ensure food security on sustainable basis. Among others, there are three key supply-side challenges in regard of food security. First is a trade-off between food and fuel. Rising energy prices in the world market may motivate the corporate sector to produce bio-fuels from cereals. The second trade-off is between food and feed. Increasing demand for high-income elastic dairy, poultry and meat products may increase cereal demand for livestock feed and as a result, would affect the food security of poor people who cannot afford to buy costly dairy and meat products. However, small and marginal farmers and landless workers, who supplement their income from livestock activities, may gain from this diversification. Third challenge is the trade-off between food and wood. Gradual shift of cultivated land towards wood farming may have some impact on the food security. Apart from these challenges, increasing land demand for non-agricultural uses and near stagnant or decline in productivity of land, water and other resources are other supply-side challenges which are to be properly addressed. Since possibility of bringing additional area under cultivation is quite limited, future demand for food can only be met by enhancing productivity and efficiency of agricultural resources. As, food security is not less than the national security; food security system cannot be made vulnerable to the production and price volatilities of global food market. Therefore, policy focus must be on removing the supply-

side bottlenecks by raising investment in agricultural infrastructure, R&D, human capital, roads, markets, storage, and processing, along with support to organic farming and reform in tenancy and lease laws.

References

- FOA, IFAD and WFP (2014), The State of Food Insecurity in the World
<http://www.fao.org/3/a-i4030e.pdf>
- Government of India (2005), *Some Aspects of Farming, Situation Assessment Survey of Farmers*, NSS 59th Round, Report No 496, Ministry of Statistics and Programme Implementation, Government of India, New Delhi
- Government of India (2007), Recommendations of Working Group on Agricultural Extension for Formulation of Eleventh Five-Year Plan (2007-12), Planning Commission.
- Government of India (2015) National Food Security Mission: Retrospect and Prospects (2012-14), Ministry of Agriculture, Department of Agriculture and Cooperation, Krishi Bhawan, New Delhi.
- Government of India (2013a), NSS 68th Round: Key Indicators of Household Consumer Expenditure in India, 2011-12.
- Government of India (2013b), Key Indicators of Drinking Water, Sanitation, Hygiene and Housing condition in India, NSS 69th Round, July 2012-December 2012.
- Government of India (2014a), Nutritional Intake in India, 2011-12, NSS 68th Round, July 2011-June 2012.
- Government of India (2014b), Key Indicators of Land and Livestock Holdings in India, NSS 70th Round, January-December 2013
- IFPRI (2014), Global Hunger Index, The Challenge of Hidden Hunger, International Food Policy Research Institute, <https://www.ifpri.org/>
- Kampman, D.A. (2007), The water Footprint of India, Master Thesis, University of Twente http://essay.utwente.nl/537/1/scriptie_Kampman.pdf
- NABCONSE (undated), Valuation and Impact Assessment of Plan Scheme “Post Harvest Technology and Management” implemented during XI Five Year Plan (2007-2012), by NABARD Consultancy Services (P) Ltd. <http://agricoop.nic.in/imagedefault/posthar.pdf>
- Singh S P. (2008) ‘Policy Interplay and Trade off: Some Issues for Groundwater Policy in India’, in Kumar D (ed.), *Managing Water in the Face of Growing Scarcity, Inequity and Declining Returns: Exploring Fresh Approaches*, Proceedings of the 7th Annual Partners, meet, IWMI-Tata Water Policy Program, ICRISAT, Hyderabad, April 2-4.
- Singh, S.P. (2013), Water and Sanitation for Quality Life in Rural India, *Kurukshetra*, 61 (12).
- The Economist Intelligence Unit (2015), Global Food Security Index 2015, An Annual Measure of the State of Global Food Security, <http://foodsecurityindex.eiu.com/>