Vegetable Consumption in India: Supply Chain and Prices

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I Introduction

Vegetables are important element of food basket around the world and in India. Although vegetables consumption/intake may not contribute at large to calories required but they are critical micronutrient rich. It is scientifically established fact that fruits and vegetables are essential sources of phytonutrients and provide range of health benefits (Mukherjee *et al*., 2016). World Health Organization (WHO) observed that lower levels of intake of fruits and vegetables, is one among the 10 high risk factors of mortality (WHO, 2003; ICMR and NIN, 2019). Around 14 percent of all gastrointestinal cancer deaths, 11 percent of ischaemic heart disease deaths and about 9 per cent of stroke deaths are associated with insufficient intake of fruit and vegetables (*ibid*).

In this regard, to prevent diet-related chronic diseases and micronutrient deficiencies, WHO has recommended a daily of intake at least 400 grams fruits and vegetables[1] with an average serving size of 80grams five times a day. However, their lower intake continued to prevail in different parts of the world due to different factors. The vegetable consumption across the globe on an average is lower than WHO recommended levels. Such incidence of low consumption of vegetable is very high in developing countries including India. Obviously, factors associated with production and supply along with prices of vegetables definitely have their impact on their demand and hence the vegetable intake or consumption.

In this backdrop, the present note looks into production, supply and consumption of vegetables in India and impact of prices in its consumption. The analysis of the note is based on FAOStats, National Sample Survey Office's (NSSO) Consumer Expenditure Survey (CES) and Private Final Consumption Expenditure (PFCE) of National Accounts Statistics (NAS), Government of India along with surveys conducted by National Nutrition Monitoring Board (NNMB) of National Institute of Nutrition (NIN), Government of India.

II Vegetable Production and Supply

Vegetable production in India has grown remarkably since 1960s. The acreage harvested vegetables in India has been trebled from 2.9 million hectares in 1961-63 to 8.6 million hectares in 2017-18 (Table-1). The vegetables production in India has increased 6 times from 19.1 million tonnes in 1961-63 to 126.6 million tonnes in 2017-18. Considerably a large part of vegetable production growth is due to increase in yield rate which is also doubled in India during the same period.

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[1]It must be noted that it is excluding potatoes, cassava and other starchy tubers.

Table-1: Vegetable Production in India

Country	1961-63	1971-73	1981-83	1991-93	2001-03	2011-13	2016-18
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Acreage Harvested (Million Hectares)							
World	20.9	20.8	24.2	30.0	44.3	53.7	57.4
Asia	10.9	10.7	13.5	18.3	30.9	38.1	41.1
South Asia	3.5	4.3	5.3	5.7	7.5	9.8	10.6
India	2.9	3.7	4.5	4.6	6.2	8.0	8.6
Production (in Million Tonnes)							
World	197.3	237.5	317.6	441.2	726.4	979.3	1081.9
Asia	96.1	111.5	162.2	269.5	519.5	739.0	825.7
South Asia	22.0	32.6	45.9	63.0	93.7	140.6	157.5
India	19.1	27.7	38.4	50.3	75.1	112.7	126.6
Yield Rate of Vegetable (Tonnes per Hectares)							
World	9.4	11.4	13.1	14.7	16.4	18.3	18.8
Asia	8.8	10.4	12.0	14.8	16.8	19.4	20.1
South Asia	6.4	7.6	8.6	11.1	12.5	14.4	14.9
India	6.5	7.6	8.5	10.9	12.2	14.1	14.7

***Source**: FAOSTAT*

***Note**: Three-Year Average.*

The increase in global average of acreage harvested vegetable also almost doubled during the same period (1961-63 and 2017-18) but the production increased by five times with doubled yield rate (Table-1). The Asian average of acreage vegetables harvested during the period is increased by four times and production by eight times with doubling of the yield rate. Whereas the change in south Asia average during the period indicate that with 2.5 times increase in yield rate and three times increase in acreage, its production has increased by seven times. Change in Asia's average is influenced by changes in this regard in China and other East Asian countries.

Table-2: Vegetable Supply in India

Country	1961-63	1971-73	1981-83	1991-93	2001-03	2011-13	2016-18
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Vegetable Supply Quantity (Million Tonnes)							
World	194.6	231.3	308.4	431.6	728.3	959.3	1199.5
Asia	98.2	112.1	161.3	268.9	528.3	730.1	926.4
South Asia	21.3	31.7	45.7	61.6	90.2	137.7	157.4
India	17.7	25.9	36.0	47.3	69.7	104.7	121.3
Per Capita Vegetable Supply Quantity (Kg/capita/Year)							
World	62.7	60.9	67.8	79.8	118.1	138.6	141.1
Asia	57.1	51.6	60.5	81.8	139.7	173.0	177.7
South Asia	34.3	40.7	46.2	49.5	60.3	79.8	72.4
India	37.7	44.5	49.2	52.3	64.8	85.3	94.1
Per Capita Vegetable Supply Quantity (grams/capita/day)							
World	171.7	167.0	185.9	218.5	323.6	379.7	386.6
Asia	156.5	141.3	165.7	224.1	382.7	474.0	486.8
South Asia	94.0	111.6	126.6	135.7	165.1	218.5	198.4
India	103.3	122.0	134.7	143.3	177.5	233.8	257.7

***Source**: FAOSTAT*

***Note**: Three-Year Average.*

Although better than change (increase) in global average, the production increase in India during the period is less than the change (increase) in average of Asia in general and south Asia in particular (Table-1). In terms of vegetable supply, it increased by nearly seven times in India from 17.7 million tonnes in 1961-63 to 121.3 million tonnes in 2017-18 (Table-2). The change

(increase) in global average in this regard is six times. While, south Asia witnessed a 7.4 times increase in vegetable supply during the period, the change in average of whole Asia is more than nine times (Table-2). Although India's performance in this regard is on par with global average it is no better than that of average of all-Asia or south Asia.

The domestic supply of vegetable is made up of the domestic production, less exports, plus imports. For agricultural food commodities produced, the quantity available or supplied is excluding the quantity retained by the producer for own consumption, seed, feed and wastage. Again, ***as is the case of most of the agricultural crops, vegetable production as well consists of post-harvest losses***. Different stages of post-harvest losses in vegetables are: harvesting, grading & packing, handling, transportation, storage and marketing (Sharma and Singh, 2011). They are at the producer or grower level as well as wholesaler and retailers level. Hence, all that vegetables harvested or produced may not come to market (part of quantity retained by producer) and that meant for market may not reach the end consumer's kitchen (due to post-harvest losses including wastage throughout the supply chain).

The per capita vegetable supply is affected by the population size and growth during the period, it is so all across the globe. Although vegetables supply in India is increased by seven times during period between 1961-63 and 2017-18, trebling of its population during the same period reduced the increase in per capita supply of vegetables (Kgs. per person per year). Annual per capita supply of vegetables in India is increased by only 2.5 times from 37.7 Kgs. to 94.1 Kgs. during the same period (Table-2). While the change in global and south Asian average in this regard indicate a doubling the vegetables supply per capita, the all-Asia average is increased by three times during the period.

Notwithstanding the increase in acreage, yield, production and supply, the vegetable supply per capita in India is still less than what is recommended by WHO (Table-2). It needs further increase in the production and supply which is possible through further increasing in acreage and/or yield rate with the help of technological advancements.

III Vegetable Consumption

As the estimates based on National Sample Survey Office's (NSSO) Consumer Expenditure Survey (CES) 68 round in 2011-12, indicates the annual average quantity of vegetable consumption per capita (Kgs. per person per year) in rural areas was 82.2 Kgs. and 83.2 Kgs. in urban areas[2] (Table-3). The estimates of annual per capita quantity of vegetable consumption based on NSSO-CES appears to be nearly matching with FAOStat estimate (rural-urban combined) for the relevant year(s), it was 80.5 Kgs. in 2011 and 84.7 Kgs. in 2012.

As the household consumption expenditure survey (NSSO-CES) estimates has shown nearly 99 percent of the rural households and 92.6 percent of those in urban areas have consumed vegetables during the survey period 2011-12. The annual per capita expenditure on vegetables in rural areas was Rs. 1151.2/- and Rs. 1480.7/- in urban areas.

[2] *It includes potato but WHO recommended quantity is excluding potato and other starchy tubers.*

Table-3: Expenditure and Quantity of Vegetable Consumption in India: NSS-CES, 2011-12

Sector	% of Households consumed Vegetables	Per Capita Per Year				% of Vegetables in	
		Quantity of Vegetables Consumed (Kgs.)	Expenditure on Vegetables (Rs)	Expenditure on Food (Rs.)	Total Consumption Expenditure - Total (Rs.)	Food Expenditure (%)	Total Expenditure (%)
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Rural	98.7	82.2	1151.2	9198.0	17398.3	12.5	6.6
Urban	92.6	83.2	1480.7	13638.8	31998.3	10.9	4.6

***Note**: **1**. Monthly quantity and expenditure reported by the NSS-CES are re-calculated per year; **2**. NSS-CES – National Sample Survey (Office) Consumption Expenditure Survey; **3**. Estimates presented are based on Modified Mixed Reference Period (MMRP) of the NSS-CES 68th Round; 4. Estimates include potato as well but WHO recommended intake quantity of vegetables is excluding potato and other starchy tubers.*

***Source**: Author's Calculations based on NSSO Consumption Expenditure Survey 68th Round (2011-12) Report.*

Along with NSSO-CES based estimates, the National Accounts Statistics (NAS) also provides estimates of only expenditure incurred (not quantity) on vegetables in the country as a whole (not at any disaggregated level, not even a state level estimate). Vegetables is one of the individual food item in its Private Final Consumption Expenditure (PFCE) estimates of NAS. While the household consumption expenditure survey (NSSO-CES) covers only the households, the NAS-PFCE accounts for all the expenditure including that of vegetables incurred by the resident households and non-profit institutions serving households (NPISH). Secondly, NAS-PFCE expenditure estimates are based on commodity flow while applying the farm harvesting prices or retail prices depending on point of consumption (own or market consumption). Knowing such methodological differences, it is not unthinkable to have differences in these two sources of estimates on consumption expenditure. Without going deep into such differences, what one can note is that annual per capita expenditure on vegetables according to NAS-PFCE has increased in current prices from Rs. 1438/- in 2011-12 to Rs. 2871/- in 2017-18 (Table-4).

Table-4: Per Capita Private Final Consumption Expenditure (Rs.0.0 in Current Prices) in India

Item	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Total	39202	44324	50478	55725	61796	68738	75278
Food-All	11681	13507	15712	16918	17727	20424	20669
Vegetables	1438	1640	2008	2287	2334	2404	2871

***Source:** National Accounts Statistics (NAS), Government of India.*

What is more important to bring it here is that the price impact on the consumption expenditure for vegetable. As one could observe the although there appears to be considerably high growth in annual per capita expenditure incurred on vegetables at 10.7 percent in current prices during period between 2011-12 and 2017-18, it is largely due to growth in prices of vegetables (Table-5). The growth in constant prices for the same is merely 3.3 percent during the same period.

The growth in constant prices is lower for vegetables when compared to that of average of food items and that of all-PFCE (Table-5). Conversely, the growth in prices is high for vegetables as compared to that of average for food items and all-PFCE.

Table-5: Growth of Vegetable Prices in India: Per Capita Private Final Consumption Expenditure (PC-PFCE) in Current and Constant Prices during 2011-12 and 2017-18

	Growth (in %) between 2011-12 and 2017-18		
Item	Current Prices	Constant (2011-12) Prices	Difference (Price Effect)
1	*2*	*3*	*4*
Total	10.8	5.9	5.0
Food	9.5	3.4	6.1
Vegetables	10.7	3.3	7.4

***Note**: Log-linear (Semi-log) model.*

***Source**: Author's Calculation Based on National Accounts Statistics (NAS) data.*

The income and price elasticity of demand for food items in general and vegetables in particular vary across economic classes. In this regard, as a study (Kumar *et al.*, 2011) estimated the income and price elasticity of demand for vegetables varied by economic classes where the elasticity is high among the very poor and moderately poor, it is relatively lower among the non-poor (see Table-6). Increase in prices lowers the demand for vegetables and its consumption and vice versa. Further, Noble Laureate economist Angus Deaton has shown that demand for each good depends on the prices of all goods and on individual incomes (Deaton and Muelbauer, 1980).Hence, increase in prices of vegetables may also affects demand for the other commodities in the consumption basket. Food prices including vegetables are important factors affecting nutritional levels (including micronutrients) of population especially the poor.

Table-6: Income and Prices Elasticity for Vegetables in India based on Food Characteristics Demand System (FCDS) using NSSO-CES 1983 - 2004/05

Income Class	Income Elasticity	Price Elasticity
1	*2*	*3*
Very poor	0.693	-0.769
Moderately poor	0.518	-0.730
Non-poor lower	0.370	-0.600
Non-poor higher	0.174	-0.453
All	0.259	-0.515

Notes: It is based on Bouis's (1996) Food Characteristic Demand System (FCDS) model; 2. Income Classes are categorised using the poverty line as the reference point.

Source: Kumar *et al.*, 2011.

Vegetables are marketed in different forms (fresh, frozen, processed or chopped) and formats (organic and inorganic as well as branded and non-branded) through retail chains as well as usual standalone groceries and hawkers (Mukherjee *et al.*, 2016). Prices of vegetables at farm gate and that of the end consumer purchase have huge differences. Supply chain is accountable for such difference and rise in the prices at the final purchase for consumption. Farm-gate prices are added with costs and margins throughout the supply chain including retailers. Costs in the supply chain include costs of transportation, storage and handling along with costs of commodity wastage involved with the commodity movement throughout supply chain (farm-gate to the consumer). Supply chain transfers the burden of wastage cost to producer or consumer. Non-durable nature of commodity (vegetables) requires immediate transportation and appropriate storage system. Although organised retail chains with single intermediary contact point (farm-gate to consumer directly) are emerging, vegetable marketing is largely unorganised ones with multiple contact points in the supply chain. Many retail chains are yet rely full or partially on at least one other intermediary in meeting their supply. The *Rythubazar* (producer directly

marketing vegetables to end consumers) experiment of Andhra Pradesh, Telangana and Tamil Nadu is sporadic and accounts for very small part of the total vegetable market, also not sure about actual producer occupying such designated market meant for them. In this regard, it requires an appropriate policy intervention in straitening vegetable marketing supply chain and controlling the vegetable prices so that the demand and consumption can be improved.

IV Concluding Remarks

Vegetables, although contribute very minimal in calories but rich in micronutrient, are important element of food basket around the world and in India. Vegetables emerged as an important agricultural commodity. Over period there is a considerable increase in acreage cultivated, yield rate and production and hence the supply of it. The increase in supply more than the increase in population has resulted in increase in vegetable supply per capita. But the average supply of vegetables quantity per capita in India is less than what is recommended by WHO experts, 300 grams per person per day.

On the supply-side, the production and supply of vegetables requires further increase in acreage and yield rate along with minimising the post-harvest losses throughout the supply chain till the end consumption point. On the demand side it is the price of vegetable which is accumulated on margin throughout the supply chain. Too long a supply chain is, too high would be the prices. Appropriate policy intervention required to regulate, support and strengthen the supply chain.

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