

Research Paper

# Supply-Demand Projection and Gap Analysis for Fruits in Assam

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## ABSTRACT

Assam state is endowed with exotic fruits due to its diverse agro-climatic condition and can be considered as the hub of various indigenous fruits. The present study was conducted with an objective of analysing the supply - demand projection and supply-demand gap of fruits in the state. It was found that the projected supply is much higher than the projected demand and the surplus continues up to 2050. However, the projected demand was found to be more than the projected supply in the later years when ICMR recommendation of consumption of fruits was taken into account. In addition to that it was also observed that the consumption of fruits is about 60 percent less than the ICMR recommendation. It is imperative to take appropriate action from the supply demand gap and to channelize towards export and value-addition of fruits through various schemes like Mission for Integrated development of Horticulture (MIDH), Rashtriya Krishi Vikas Yojana (RKVY) and Mega Food Park scheme of Ministry of Food Processing Industries.

## HIGHLIGHTS

- ① The supply of fruits is much higher than the actual demand.
- ① The area, production and productivity of fruits are significantly increasing.
- ① Consumption of fruits per person per day is less than ICMR recommendation.
- ① Appropriate post-harvest management practices should be adopted.

**Keywords:** Supply, demand, projection, gap, fruits, Assam

Assam, the north eastern state of India has been blessed with rich diversity in fruit crops due to its diverse topography, natural flora and fauna, ecological and agro-climatic conditions. People of the tropical indigenous and temperate fruits have still remained underexploited due to the lack of awareness of their potential, market demand and low and erratic bearing in many cases (Barua *et al.* 2019). Though wild and domesticated diversity is composed of nearly 3000 tropical fruit species, only a few are cultivated on a large scale (Pareek *et al.* 1998). Despite having genetic diversity in fruits only some fruits are grown commercially in the state i.e., banana, pineapple, papaya, orange, guava, Assam lemon, litchi, jackfruit, mango,

coconut, green coconut, etc. New generation farmers and farm women are now focussing and venturing more into commercial cultivation of fruits and are garnering skills for value-addition of fruits. During the last decade it was observed that there has been significantly a good growth in area, production and productivity of fruits. Area under fresh fruits in Assam was reported to be around 1.45 lakh hectares with a production of 21.46 lakh million tonnes and an average productivity of 14729 kg/ha in the year 2018-19 that presents a

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promising picture (Directorate of Horticulture and Food Processing, Assam, 2019). The horticulture sector as a whole in Assam is exploring new horizons and is approaching towards the status of a surplus state if determined on the basis of per capita requirement of fruits, vegetables and spices recommended by the Indian Council of Medical Research (ICMR). Estimates of the demand for fruits and vegetables were made taking into account the state's recommended daily intake of fruits (100g) and vegetables (150g) (Majumder and Deka, 2018). In the neighboring state of Tripura in 2013–14, fruits and vegetables accounted for the majority of horticulture output (48.6% and 48.3%, respectively) (Majumder and Deka, 2018). In this paper an attempt has been made to estimate the supply and demand projection of fruits in Assam up to the year 2050 and also to analyse the gap that exists between it that are likely to help in suggesting and adopting appropriate strategies and to unveil the plentiful avenues that are yet to be explored.

## MATERIALS AND METHODS

The temporal data regarding area, production and productivity of fruits were procured from Directorate of Horticulture and Food Processing, Assam. The data on consumer expenditure on fruits for consumers for both rural and urban population were compiled from 68<sup>th</sup> round of National Sample Survey (NSS, 2011-12). The adult population was projected up to the year 2050 after acquiring the population data from Statistical Handbook of Assam. The supply of fruits was projected up to the year 2050 which was computed using the production of fruits in the base year (2011-12). For the estimation of growth in income the data on per capita Net State Domestic Product at constant prices in the base year (2011-12) was collected from Ministry of Statistics and Programme Implementation (MoSPI). Compound growth rate was computed to assess the growth rate at which the area, production and productivity of fruits changed over the subsequent years. The expenditure elasticity for both rural and urban population was computed and was used for demand projection. The total demand of the state was computed by taking into consideration the adult population, base period consumption, combined expenditure elasticity and growth rate of NSDP and the demand was projected up to the year 2050.

## ANALYTICAL TECHNIQUES

### Estimation of growth rates in different indicators

Growth rates for area, production and productivity of fruits and per capita net state domestic product (NSDP) were computed using Cobb-Douglas production function and was obtained by fitting in the following equation

$$Y = ab^t$$

$$\ln Y = \ln a + t \ln b$$

Where,  $Y$  = area/ production/ productivity of the fruits and per capita NSDP.

$a$  = constant,  $t$  = time period and  $b$  = coefficient to be estimated.

Then CGR (%) was obtained as follows:

$$r = \{ \text{Antilog}(b) - 1 \} \times 100$$

The significance of ' $r$ ' was tested by working out  $t$ - value,

$$t' = b / SE(b)$$

Where, ' $t$ ' follows student's  $t$ - distribution with  $(n-2)$  degrees of freedom.

The growth of NSDP was taken as substitute for income growth in Assam.

### Estimation of co-efficient of variation

Coefficient of variation was used to determine the instability in area, production and productivity of fruits from the year 2009-10 to 2018-19.

$$CV = SD/mean * 100$$

Where,  $SD$  = standard deviation of area, production and productivity of fruits

Mean = average of  $A/P/Y$  of different fruits.

### Estimation of demand

#### (i) Projection of Population and supply

Projection of Population is computed by using the formula,

$$P_t = P_0(1 + r)^t$$

Where,

$P_t$  = Projected population (adult/ rural/ urban) and projected supply

$P_0$  = base period population (adult/ rural/ urban) and base period supply

$r$  = Population growth rate and supply growth rate

$t$  = number of years

### (ii) Expenditure elasticity of demand

Logarithmic form is used to estimate the expenditure elasticity of demand for different fruits. The expenditure elasticity was calculated by using NSS data from the 68<sup>th</sup> round (2011-12).

$$Q_i = aE_{it}^b$$

$$\ln Q_i = \ln a + b \ln E_{it}$$

Where,

$Q_i$  = Expenditure on fruit consumed by  $i^{\text{th}}$  household

$E_{it}$  = Total expenditure on food of the  $i^{\text{th}}$  household at time period  $t$

$a$  = intercept and  $b$  = coefficient

The elasticity thus obtained was used for demand projections with the assumptions that the consumer expenditure is insensitive to price changes and the expenditure elasticity do not change over time or with price.

By taking all the above parameters into consideration the future demand for fruits is estimated by the following formula,

$$Q_{it} = P_t \{q_{i0} (1 + g)^{net}\}$$

Where,

$Q_{it}$  = Quantity demanded of the commodity

$P_t$  = Projected adult population

$q_{i0}$  = Base period consumption of fruits

$g$  = Growth rate of per capita NSDP

$n$  = number of years

$e_{it}$  = expenditure elasticity

## RESULTS AND DISCUSSION

The compound growth rate of area (0.83\*), production (3.20\*\*) and productivity (2.28\*\*\*) of fruits in Assam was found to be positively significant and showed an increasing trend for all the three parameters indicating that there was significant increase in area, production and productivity of fruits. It has been witnessed that increase in area and productivity of fruits in the states, attributed towards higher production of fruits. Implementation of programs like Mission for Integrated Development of Horticulture (MIDH), 2014-15 contributed to both increase in area and productivity. Adoption of recommended package of practices along with the use of high yielding varieties instead of traditional varieties also attributed to the increase in productivity.

**Table 1:** Compound growth rates and coefficient of variation of area, production and productivity of Fruits in Assam (2009-10 to 2018-19).

Year	Area (in lakh hectares)	Production (in lakh M.T.)	Productivity (kg/ha)
2009-10	1.30	15.47	11855
2010-11	1.37	16.56	12085
2011-12	1.37	17.74	12885
2012-13	1.50	20.73	13760
2013-14	1.42	20.25	14219
2014-15	1.44	20.12	13956
2015-16	1.44	20.56	14247
2016-17	1.41	20.06	14144
2017-18	1.44	21.03	14390
2018-19	1.45	21.46	14729
C.G.R (%)	0.83*	3.20**	2.28***
C.V (%)	4	10.59	7.34

Source: Statistical Handbook of Assam.

In addition to positive and significant compound growth rate, considerable instability in area (4%), production (10.59%) and productivity (7.34%) was also observed owing to various factors like low area and low yield during the initial years and during the later years the area under fruits increased gradually resulting in higher productivity. The area, production and productivity has been increased from 1.3 lakh hectare, 15.47 lakh MT and 11855 kg/ha in 2009-2010 to 1.45 lakh hectare, 21.46 lakh MT and 14729 kg/ha in 2018-19. Dutta (2010) in his study on growth of area, production and productivity of

fruits and vegetables in West Bengal found that the area under all the major fruits crops was positively significant except for mandarin orange as this crop is specifically grown in the Darjeeling district and the area expansion under the crop is specifically restricted to that district only. Likewise, Majumder and Deka (2018) observed positive growth rates among all the major fruit crops cultivated in Tripura state. The production of fruits and vegetables has increased significantly over the last decades.

### Per capita income growth

The compound growth rate of per capita income was found to be positively significant (6.32<sup>\*\*</sup>) and also the percent growth over previous years is gradually increasing thereby indicating that per capita income in the state is showing an increasing trend. Per capita income projection depends on the rate of growth in population and the overall growth in the state (Kumari and Singh, 2016).

**Table 2:** Per Capita Net State Domestic Product (Constant Prices)

Year	Per Capita NSDP- Constant price (in Rupees)	% Growth Over Previous Year
2011-12	41142	—
2012-13	41609	1.14
2013-14	43002	3.35
2014-15	44809	4.2
2015-16	50642	13.02
2016-17	53575	5.79
2017-18	57835	2.72
2018-19	60695	4.94
C.G.R (%)	6.32	

*Source:* Ministry of Statistics and Programme Implementation (mospi).

### Per Capita Consumption

According to Indian Council Medical Research (ICMR) recommendation the minimum requirement of fruits per person per day is 100g (Majumder and Deka, 2018). In Assam the actual average consumption of fruits for rural and urban population is found to be 40.04 g/day and 43.27g/day, respectively based on 68<sup>th</sup> round of National Sample Survey (NSS, 2011-12). Therefore, it can be inferred that actual average consumption of fruits is about 60 percent less than the ICMR recommendation.

### Expenditure elasticity of fruits in Assam

Expenditure elasticity for rural and urban population for the state was calculated to be 0.41 and 0.45 resulting in average expenditure elasticity for fruit in the state as 0.44. Kumar *et al.* (2016) in their study found that the expenditure elasticity for high-value food commodities i.e., livestock and horticultural products was much higher. With economic growth the demand for high-value food commodities will accelerate at a faster rate as compared to the cereals. Kumar and Mruthyunjaya (1995) reported that the average demand elasticity of fruits is estimated to be 0.41 for India. Kumari and Singh (2016) reported that the expenditure elasticity value of fruits for the state of Bihar is estimated to be 0.54 based on the information obtained from the 66<sup>th</sup> round of data on consumer expenditure.

### Projected adult population and demand for fruits in Assam

Population projection was carried out up to the year 2050 with the help of population data of the state published by the Census of India for 2001 and 2011 then 80 percent of the projected population was taken to obtain the projected adult population. It was estimated that by the year 2050 the projected adult population in Assam would be 48.11 lakh with actual demand of 36.31 lakh million tonnes as per NSS data and the normative demand of 89.66 lakh million tonnes as per ICMR data depicted in Table 3. Mittal (2008) had conducted a study on demand and supply trends and projection of food in India and observed that increasing demand in food has been mainly attributed to growth in population and income. Several studies have been conducted by researchers on demand projection of food items in India (Kumar, 1998; Kumar *et al.* 2009).

**Table 3:** Projected adult population and demand for fruits in Assam

Year	Projected Adult population (Lakh)	Demand (lakh MT)	
		(NSSO)	(ICMR)
2021-22	31.05	3.96	9.78
2022-23	31.54	4.28	10.56
2023-24	32.04	4.62	11.41
2024-25	32.55	4.99	12.33
2025-26	33.07	5.39	13.31
2026-27	33.59	5.82	14.38
2027-28	34.13	6.29	15.53

(Contd...)

2028-29	34.67	6.79	16.78
2029-30	35.22	7.34	18.12
2030-31	35.78	7.92	19.57
2031-32	36.35	8.56	21.14
2032-33	36.93	9.24	22.83
2033-34	37.48	9.98	24.64
2034-35	38.04	10.77	26.59
2035-36	38.48	11.58	28.60
2036-37	39.06	12.50	30.86
2037-38	39.64	13.49	33.31
2038-39	40.24	14.55	35.94
2039-40	40.84	15.71	38.79
2040-41	41.46	16.95	41.86
2041-42	42.08	18.29	45.17
2042-43	42.71	19.74	48.75
2043-44	43.35	21.30	52.61
2044-45	44	22.99	56.77
2045-46	44.66	24.81	61.26
2046-47	45.33	26.77	66.11
2047-48	46.01	28.89	71.35
2048-49	46.70	31.18	76.99
2049-50	47.40	33.65	83.09
2050-51	48.11	36.31	89.66

### Supply and demand gap analysis for fruits

As fruits are highly perishable in nature, assuming an amount of 20 percent as post-harvest loss, the projected supply is estimated (Majumder and Deka, 2018). Post-harvest losses prevail at various stages of marketing that ranges from 15 to 50 percent (FAO, 1981; Roy, 1989). The post-harvest losses can be minimised by putting more emphasis into processing of different value-added products, extending the shelf life of horticultural produce thereby facilitating proper storage conditions (Nath *et al.* 2018). It was found that in Assam, the supply of fruits is more than the required demand calculated as per NSS but in case of ICMR recommendation the demand is more than the supply as depicted in Table 4. Increasing supply of fruits might be due to various reasons such as suitable agro-climatic and ecological conditions congenial for the production of fruits, using the recommended package of practices, using modern technology, controlling incidence of pest and disease, expansion of area

**Table 4:** Supply-demand gap of fruits in Assam

Year	Supply after 20% post-harvest loss (Lakh MT)	Demand (Lakh MT)		Gap (Lakh MT)	
		(NSSO)	(ICMR)	(NSSO)	(ICMR)
2021-22	20.07	3.96	9.78	16.11	10.29
2022-23	20.71	4.28	10.56	16.43	10.14
2023-24	21.81	4.62	11.41	16.75	9.96
2024-25	22.06	4.99	12.33	17.07	9.73
2025-26	22.77	5.39	13.31	17.37	9.45
2026-27	23.50	5.82	14.38	17.67	9.11
2027-28	24.25	6.29	15.53	17.96	8.71
2028-29	25.02	6.79	16.78	18.23	8.24
2029-30	25.82	7.34	18.12	18.48	7.70
2030-31	26.65	7.92	19.57	18.72	7.07
2031-32	27.50	8.56	21.14	18.94	6.36
2032-33	28.38	9.24	22.83	19.14	5.55
2033-34	29.29	9.98	24.64	19.31	4.65
2034-35	30.23	10.77	26.59	19.46	3.63
2035-36	31.20	11.58	28.60	19.61	2.59
2036-37	32.20	12.50	30.86	19.70	1.33
2037-38	33.23	13.49	33.31	19.74	-7860
2038-39	34.29	14.55	35.94	19.73	-1.65
2039-40	35.39	15.71	38.79	19.68	-3.39
2040-41	36.52	16.95	41.86	19.57	-5.33
2041-42	37.69	18.29	45.17	19.39	-7.48
2042-43	38.90	19.74	48.75	19.15	-9.85
2043-44	40.14	21.30	52.61	18.83	-12.46
2044-45	41.43	22.99	56.77	18.43	-15.34
2045-46	42.75	24.81	61.26	17.94	-18.51
2046-47	44.12	26.77	66.11	17.34	-21.99
2047-48	45.53	28.89	71.35	16.63	-25.81
2048-49	46.99	31.18	76.99	15.80	-30
2049-50	48.49	33.65	83.09	14.84	-34.59
2050-51	50.04	36.31	89.66	13.73	-39.61

under fruits *etc.* The Tripura state's overall supply of fruits and vegetables exceeds the level of demand (Majumder and Deka, 2018). Kumari and Panda (2020) conducted a study on analysis on demand supply and production constraints in major fruits and vegetables in Bihar and found that Bihar is not self-sufficient in case of fruits and vegetables production and over-all a deficit state which might be owing to various factors like lack of availability of suitable varieties of fruits and vegetables, inadequate management of orchards, lack of provision of subsidies and agricultural inputs to farmers from government, lack of initiatives being taken by the Government to boost the productivity *etc.*

### Strategies for effective utilization of surplus fruits in the state

Emphasis should be laid upon increasing the consumption of fruits among the people of state, as fruits are a vital source of vitamins, minerals, and antioxidants and are necessary for the well-being of human health. Proper arrangements should be made so that the fruits produced in surplus quantities are marketed in other deficit neighbouring states or countries, which will generate a healthy profit. There are ample opportunities in utilising the potential of excess fruit production in the form of value-added products. The fruits can be processed into various products like jam, jelly, squash, juices, wine, frozen, canned, pulp *etc.* Under the initiative of 'Vocal for Local' and 'Self-reliant India' the state needs to put emphasis on the export of organic fruits and encourage sales in domestic as well as international market, which will eventually lead to generation of employment opportunities to many, thus realizing the horticulture potential of the state. The government has taken appropriate steps by launching scheme SAMPADA (Scheme for Agro-marine Processing and Development of Agro-processing clusters) in 2019-20 which aims at expansion of food processing and preservation capacities. In order to realise the enormous potential of the state, the North-East Mega Food Park Ltd. (NEMFPL), Nalbari was established as part of the Mega Food Park Scheme with the goal of providing the necessary infrastructural facilities for the food processing industry as well as an effective value-chain from the farm to the market.

## CONCLUSION

It can be inferred from the study that Assam is a self-sufficient state in the case of fruits production. The projected supply of fruits is exceedingly higher than the projected demand (NSSO). The excess production of fruits can be utilized in many effective ways like imparting skills to people regarding value-addition of fruits which will extend the shelf-life of fruits, generate employment opportunities and raise the standard of living for the people. The fruits can be marketed at a global platform and cater to the requirement of large number of consumers and can earn good foreign exchange in return if domestic marketing system is well organised and efficient. Appropriate post-harvest management practices should be undertaken so that post-harvest loss can be minimised this is imperative for the success of fruit production. It was found from the study that the projected demand in case of ICMR recommendation will exceed the supply during the later years as consumption of fruits according to ICMR recommendation is 60 per cent more than the actual consumption. It is possible to harness the unexplored potential of the state through the adoption of scientific technologies which enables the processing of fruits to be structured, efficient and cost-effective. Facilitating efficient post-harvest management and establishment of adequate marketing infrastructure from the perspective of export are taken up by the Central and State Government by implementing various schemes like MIDH, Mega Food Park Scheme which has the ability to change the entire spectrum of the region. The formation of fruit producers' organization for better production, processing and marketing is expected to enhance their income.

## REFERENCES

- Barua, U., Das, R.P., Gogoi, B. and Baruah, S.R. 2019. Underutilised fruits of Assam for livelihood and nutritional security. *Agril. Rev.*, **40**(3): 175-184.
- Directorate of Horticulture and Food Processing. 2019. Department of Agriculture and Horticulture. Government of Assam.
- Dutta, J. 2010. Growth of Area, Production and Productivity of Fruits and Vegetables in West Bengal. *The Hort. J.*, **23**(2): 53-58.
- FAO 1981. Food Loss Prevention in Perishable Crops. *Agricultural Service Bulletin* 43, Rome.

- Kumar P. 1998. Food Demand and Supply Projection for India. *Agricultural Economics policy paper* 98-01. Indian Agricultural Research Institute, New Delhi.
- Kumar, P. and Mruthyunjaya 1995. Demand for Fruits and Vegetables in India. *Agric. Econ. Res. Rev.*, **8**(2): 7-17.
- Kumar, P., Joshi, P.K. and Birthal, S.P. 2009. Demand projection for food grains in India, *Agric. Econ. Res. Rev.*, **22**(2): 237-243.
- Kumar, P., Joshi, P.K. and Mittal, S. 2016. Demand vs Supply of Food in India - Futuristic Projection. *Proceedings of the Indian National Science Academy*, **82**(5): 1579-1586.
- Kumari, M. and Panda, C.K. 2020. Analysis of demand supply and production constraints in major fruits and vegetables in Bihar. *Econ. Aff.*, **65**(2): 225-232
- Kumari, M. and Singh, G.R. 2016. Demand, Supply & Trade Prospects of Major Fruits and Vegetables in Bihar. *Int. J. Agril. Sci. and Res. (IJASR)*, **6**(2): 269-278.
- Majumder, S.H. and Deka, N. 2018. Exploring Agri Business Potential in Tripura through Fruits and Vegetable Production. *Econ. Aff.*, **63**(1): 137-140.
- Ministry of Statistics and Programme Implementation. 2019. Government of India. <http://www.mospi.gov.in/>
- Mittal, S. 2008. Demand and supply trends and projection of food in India. *Working paper* No. 209, Indian Council of Research on International Economic Research, New Delhi.
- Nath A., Meena L.R., Kumar, V. and Panwar, A.S. 2018. Post Harvest Management of Horticultural crops for doubling farmer's income, *J. Pharmacognosy and Phytochem.*, pp. 2682-2690.
- National Sample Survey Organisation (NSSO). 2011-12. *Level and Pattern of Consumer Expenditure*. 68<sup>th</sup> round NSS Report No. 555, pp. A-11.
- Pareek, O.P., Sharma, S. and Arora, R.K. 1998. Underutilized edible fruits and nuts: an inventory of genetic resources in their regions of diversity. IPGRI office for South Asia, International Plant Genetic Resources Institute, Rome, Italy.
- Roy, S.K. 1989. Role of PHT of Horticultural Crops in India – Trends in Food Science and Technology. Proceedings of the Second International Food Convention. Mysore, 18-23 February, pp. 349-356.
- Statistical Handbook of Assam. 2019. Directorate of Economics and Statistics, Government of Assam, Guwahati.

