

RESEARCH PAPER

Food Security Dynamics in the North-Eastern Region of India: Performance and Policy Implications

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Received: 15-08-2025

Revised: 01-11-2025

Accepted: 22-11-2025

ABSTRACT

This study examines the performance and requirements of food crops in Northeast India during 2023-24. Using secondary data from official sources, including UIDAI, FAOSTAT, Agri-exchange and the Government of India, this study employs a semi-log model and the Cuddy-Della Valle index to estimate growth and instability in the area and production of food crops. The results reveal that the region has a surplus of foodgrains (1699.35 thousand tons), fruits (2749.33 thousand tons) and vegetables (711.06 thousand tons). Despite some states facing deficits, the region is moving towards self-sufficiency in food crops. Foodgrains exhibit positive growth, while fruits and vegetables are already in surplus. The study concludes that increasing the productivity of food crops is crucial, which can be achieved through the adoption of High-Yielding Varieties (HYVs) of seeds, planting materials and improved cultivation practices in the Northeast region.

HIGHLIGHTS

- ❶ Despite negative growth, the North Eastern region has achieved self-sufficiency in food production.
- ❷ Among foodgrains, fruits and vegetables, the highest surplus has been achieved by fruits in the region.
- ❸ There are opportunities to earn foreign currency by increasing exports from the region.

Keywords: Food Security, Northeastern Region, Food Crops, Instability

Food security is achieved when all individuals, at all times, have both physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences, thereby enabling an active and healthy life (World Bank, 1996; Food and Agriculture Organization, 2002; Alonso *et al.* 2018 and International Food Policy Research Institute, 2024). This conceptualization of food security encompasses not only the physical availability and affordability of food but also the absence of social barriers that might hinder individuals' access to nutritious food. Food security is closely linked with nutritional security, and its attainment is vital for realizing individual capabilities. Recognizing individuals as the primary focus of food security is crucial, while also acknowledging the significance

of household-level and community-level food security (Narayanan, 2015). According to the Food and Agriculture Organization (FAO), an estimated 870 million people worldwide suffered from chronic undernourishment between 2010 and 2012, based on the Prevalence of Undernourishment (PoU) indicator. This figure represents 12.5% of the global population, or roughly 1 in 8 individuals. Despite its rapidly growing population, India has achieved self-sufficiency in food production. As home to a significant portion of the world's population, India

How to cite this article: Singh, R. and Sharma, M. (2025). Food Security Dynamics in the North-Eastern Region of India: Performance and Policy Implications. *Econ. Aff.*, 70(04): 385-392.

Source of Support: None; **Conflict of Interest:** None



has faced numerous challenges in ensuring food security. Although significant progress has been made, some states continue to grapple with food insecurity, underscoring the need for sustained efforts toward achieving comprehensive food security (Brahmanand *et al.* 2013; Kumar *et al.* 2014). To maintain food security in India, the government has implemented a range of policies over the past six decades to strengthen food security (Joshi, 2016). A key strategy to address food insecurity and hunger in India is the distribution of foodgrains through fair price shops at subsidized rates via the Public Distribution System (PDS), providing essential support to vulnerable populations (Department of Food and Public Distribution, 2017). Established in the post-World War II era, the PDS aims to improve food security in India and has evolved into the largest distribution network globally, providing foodgrains at subsidized rates. (Kishore and Chakrabarti, 2015; Department of Food and Public Distribution, 2017). The PDS operates through a partnership between the central and state governments, aiming to supplement essential commodities, including rice, wheat, pulses, salt, and sugar, to households. Notably, the scheme is designed to complement, rather than fully provide, the required food items, supporting households by offering goods that supplement their own purchases or farm produce (Department of Food and Public Distribution, 2017; Surie and Sami, 2017). The Food Corporation of India (FCI) serves as the national nodal agency responsible for procuring foodgrains directly from farmers at prices above market rates (Department of Food and Public Distribution, 2017; Buchan, 2007) and supplying them to state governments at subsidized prices, known as issue prices (Department of Food and Public Distribution, 2017; Planning Commission, 2017). Ultimately, state governments distribute these foodgrains to households based on their pre-determined economic status, typically through the Public Distribution System (PDS) or other targeted programs (Department of Food and Public Distribution, 2017).

The Northeastern region of India is characterized by a temperate climate and a topography dominated by hills and valleys. Despite its limited geographical area and scarcity of agricultural resources, the region's foodgrain production is remarkably

low, with rice being cultivated in isolated areas. However, the region's climate is highly conducive to cultivating temperate fruits and vegetables, which are supplied to the rest of the country (Sharma *et al.* 2024). To maintain food security in the Northeast region of India, several initiatives have been adopted. However, the region's vulnerability to climate change, with temporal and spatial changes in temperature and rainfall, has already taken a toll, increasing the incidence of pests and diseases and adversely affecting agricultural productivity. Potential solutions include adopting traditional integrated farming systems and agroforestry practices that incorporate multipurpose plants to enhance food production. Strategic livestock management and creating market opportunities can also contribute to sustainably achieving food security in the region (Bania *et al.* 2024). The consumption patterns in Northeast India differ significantly from other parts of the country, with rice being a staple ingredient in various forms of local cuisine. Due to existing underutilized agricultural potential, achieving Sustainable Development Goal 2 (Zero Hunger) poses a significant challenge. However, adopting practices aligned with Sustainable Development Goal 12 (Responsible Consumption and Production) can facilitate progress toward this target (Hazarika *et al.* 2023). Studies have highlighted the region's food security challenges, with Giribabu (2013) noting its backwardness despite achieving surplus food production phases post-independence. Roy *et al.* (2015) found varying levels of self-sufficiency across Northeast Indian states, while Sati and Vangchhia (2017) reported food insecurity in Mizoram's rural areas and proposed measures to address it. The region's cultivation practices are primarily based on natural farming, characterized by minimal use of chemical fertilizers (12 kg/ha) and pesticides (0.14 g/ha) (Roy *et al.* 2015). This approach contributes to low food crop productivity, resulting in a mismatch between production and demand. This study aims to examine the performance and requirements of food crops in Northeast India, focusing on the current status and challenges.

METHODOLOGY

This study focused on the North Eastern region of India, comprising eight states: Arunachal Pradesh,

Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. It utilized 10 years of secondary data (2013-14 to 2022-23) on food crop production from the Agri-exchange website, Department of Agriculture, Government of India. Projected population data were sourced from the UIDAI website, Government of India.

Estimation of Food Requirements

State-wise food requirements were estimated based on the Indian Council of Medical Research (icmr.gov.in) guidelines for daily dietary intake. Annual requirements were calculated by extrapolating daily requirements. Projected state-wise population data for the year 2021 were collected from UIDAI, Government of India (uidai.gov.in), and the final annual requirements were calculated accordingly. Data on food production and requirements for each NE state were collected and analyzed to determine the deficit/surplus situation. Furthermore, the average production, requirement, and deficit/surplus of food were calculated for all NE states.

Compound Annual Growth Rate (CAGR)

The CAGR was calculated using the semi-log model to analyze the trend in area and production of food crops in the NE region, following the methods outlined by Gupta and Kapoor (2007); Sharma and Singh (2024).

$$Y = ab^t$$

Where, Y indicates the area or production, b indicates regression coefficient, a is the constant term and t stand for time variable of the model. The compound growth rates were obtained from the logarithmic form of the equation, expressed as:

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

The percentage compound growth rate (G) was calculated using the following formula;

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

The pattern of growth rates over the years was identified using the ' b ' coefficient. A statistically significant and positive coefficient indicated an accelerating growth trend in the estimated

parameters over the years. Conversely, a non-significant coefficient suggested a declining growth trend in the estimated parameters.

Cuddy-Della Valle Index

The Cuddy-Della Valle Index (Singh and Byerlee, 1990) was employed to estimate the instability index.

$$I = CV * \sqrt{1 - R^2}$$

Where, ' I ' indicates the instability index, CV is the coefficient of variation and R^2 = shows the corrected coefficient of determination of the log linear function.

RESULTS AND DISCUSSION

Status of Foodgrain in the NE Region of India

The requirement of foodgrain in the NE region was estimated at 6.26 Mt, and the surplus was 1.70 Mt, which was achieved by a substantial increase in production and yield in the region. However, Meghalaya and Mizoram still faced foodgrain deficits of 0.04 Mt and 0.07 Mt, respectively. Assam had the largest surplus (0.84 Mt) among all NE states, primarily due to increased foodgrain production and productivity in the state (Table 1). This highlights regional disparities in agricultural performance, with Assam achieving success in foodgrain output while Meghalaya and Mizoram struggle with deficits. Addressing these deficits may require targeted interventions to boost production and yield in affected areas. Singh and Ngachan (2012) reported that all NE states faced deficits in foodgrain production in 2010. Giribabu (2013) noted that the situation had recovered from the previous decade, contrasting with earlier findings. Roy *et al.* (2015) found a regional foodgrain deficit of 0.21 Mt in 2014 but suggested the NE region had a significant opportunity for achieving self-sufficiency in foodgrains.

Status of Fruits in NE Region of India

The NE region significantly contributes to the nation's fruit and vegetable production, leveraging its favorable agro-climatic conditions. In 2021, the region produced 4.62 Mt of fruits, exceeding the

Table 1: Production and requirement of foodgrains in the NE region of India (2021-22)

State	Population (Projected year 2021)	Production ('000 ton)		Production growth (%)	Requirement (‘000 ton)	Deficit/surplus (‘000 ton)
		TE ₁ (2012 to 2014)	TE ₂ (2019 to 2021)	TE ₂ over TE ₁	(year 2021)	
Arunachal Pradesh	1533000	387.73	379.50	-8.23	187.45	192.05
Assam	35043000	5278.73	5133.86	-144.87	4284.88	848.98
Manipur	3165000	418.16	591.22	173.06	387.00	204.23
Meghalaya	3288000	312.93	356.40	43.46	402.04	-45.64
Mizoram	1216000	63.30	78.346	15.04	148.68	-70.34
Nagaland	2192000	624.93	463.01	-161.92	268.03	194.99
Sikkim	677000	103.53	91.70	-11.84	82.78	8.92
Tripura	4071000	737.80	863.95	126.15	497.78	366.17
NE region	51185000	7927.133333	7958.00	30.87	6258.64	1699.35

Source: Data of production and population collected from DES, Government of India and uidai.gov.in, respectively; TE: Triennium average.

Table 2: Production and requirement of fruits in the NE region of India (2021-22)

State	Population (Projected year 2021)	Production ('000 ton)		Production growth (%)	Requirement (‘000 ton)	Deficit/surplus (‘000 ton)
		TE ₁ (2012 to 2014)	TE ₂ (2019 to 2021)	TE ₂ over TE ₁	(year 2021)	
Arunachal Pradesh	1533000	321.63	129.95	-191.68	55.95	73.99
Assam	35043000	2037.25	2334.63	297.38	1279.07	1055.56
Manipur	3165000	492.62	477.39	-15.23	115.52	361.87
Meghalaya	3288000	347.27	384.63	37.36	120.01	264.62
Mizoram	1216000	329.25	345.15	15.90	44.38	300.76
Nagaland	2192000	365.98	315.61	-50.37	80.01	235.60
Sikkim	677000	16.03	52.31	36.27	24.71	27.596
Tripura	4071000	767.78	577.92	-189.86	148.59	429.33
NE region	51185000	4677.82	4617.59	-60.23	1868.25	2749.33

Source: Data of production and population collected from DES, Government of India and uidai.gov.in, respectively; TE: Triennium average.

requirement of 1.86 Mt and resulting in a surplus of 2.75 Mt (Table 2). This surplus indicates that the NE region meets its own fruit needs and significantly contributes to the national market, showcasing its agricultural strength and potential for enhancing national food security. Roy *et al.* (2014) confirmed that fruits were an emerging sector in the region. In contrast, Sati and Vangchhia (2017) found that Mizoram struggled with food insecurity and suggested improvements to address the issue. Roy *et al.* (2015) reported a fruit surplus of 2.35 Mt in 2014. The current surplus has decreased, potentially due to population growth outpacing fruit production growth in the region. The study’s results showed that fruit production increased in preceding years, driven by higher production levels, contributing to the region’s self-sufficiency.

Status of Vegetables in the NE Region of India

The region has achieved self-sufficiency in vegetable production, despite a growing population, with Tripura, Nagaland, Meghalaya, and Sikkim generating surpluses of 0.50, 0.21, 0.16, and 0.08 Mt, respectively. The region produced 6.31 Mt of vegetables, exceeding its requirement of 5.60 Mt and resulting in a surplus of 0.71 Mt (Table 3). While Raj and Datta (2016) reported food insecurity in the NE region, the region’s vegetable production surplus and strategic location bordering Bangladesh and Myanmar also present opportunities for exports, potentially strengthening the regional economy. The region’s states have significant potential in organic vegetable production, which commands high prices in domestic and international markets,

presenting additional opportunities for growth. The NE Indian vegetable sector recovered from a deficit situation in the last decade (Roy *et al.* 2014), indicating a positive turnaround. According to Roy *et al.* (2015), the NE region faced a vegetable deficit in 2014. However, the region's subsequent progress suggests that vegetable farmers effectively utilized resources to boost production.

State-wise Performance of Foodgrains in the NE Region of India

Table 4 shows a 1.07% increase in foodgrain production, representing a positive and significant growth at the 5% level, largely driven by enhanced cereal and pulse crop productivity. This finding aligns with Siddayya *et al.* (2016) reported in their study that a significant increase in foodgrain production. Tripura showed positive and significant

growth in both foodgrain area and production. Additionally, Arunachal Pradesh, Meghalaya and Nagaland exhibited positive and significant growth in area. Assam's foodgrain production grew significantly despite a decline in cultivation area, driven by increased productivity. In contrast, Sikkim saw declines in both area and production, likely due to farmers shifting to alternative crops. Manipur and Mizoram exhibited high instability in foodgrain area, possibly due to irregular rainfall patterns. In contrast, Manipur, Meghalaya, and Mizoram showed high production instability, likely due to fluctuations in area and productivity. The study suggests the NE region is recovering from a foodgrain deficit due to continuous production increases, likely driven by the successful implementation of the National Food Security Mission (NFSM).

Table 3: Production and requirement of vegetables in the NE region of India (2021-22)

State	Population (Projected year 2021)	Production ('000 ton)		Production growth (%) TE ₂ over TE ₁	Requirement (‘000 ton) (year 2021)	Deficit/surplus (‘000 ton)
		TE ₁ (2012 to 2014)	TE ₂ (2019 to 2021)			
Arunachal Pradesh	1533000	37.85	17.40	-20.45	167.86	-150.46
Assam	35043000	3638.90	3649.49	10.59	3837.21	-187.72
Manipur	3165000	252.95	359.74	106.79	346.57	13.18
Meghalaya	3288000	484.24	517.93	33.69	360.03	157.89
Mizoram	1216000	254.86	212.37	-42.48	133.15	79.22
Nagaland	2192000	397.49	455.53	58.03	240.02	215.50
Sikkim	677000	132.36	156.48	24.12	74.13	82.35
Tripura	4071000	781.89	946.86	164.97	445.77	501.09
NE region	51185000	5980.56	6315.81	335.25	5604.76	711.06

Source: Data of production and population collected from DES, Government of India and uidai.gov.in, respectively; TE: Triennium average.

Table 4: Growth rate and instability of foodgrains in the NE region of India (2021-22)

State	Area		Production	
	CAGR(%)	Instability	CAGR(%)	Instability
Arunachal Pradesh	1.22*	2.97	-0.11 ^{NS}	6.44
Assam	-0.78*	1.60	1.04***	4.56
Manipur	1.07 ^{NS}	16.66	2.26 ^{NS}	21.39
Meghalaya	0.63**	1.91	2.74 ^{NS}	14.82
Mizoram	2.20 ^{NS}	16.83	3.68***	13.38
Nagaland	1.67*	1.09	-0.83 ^{NS}	6.93
Sikkim	-2.91*	2.53	-1.66*	2.79
Tripura	2.12*	3.99	2.33*	3.29
NE region	-0.21 ^{NS}	2.44	1.07**	3.45

Note: ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. NS indicates Not significant.

State-wise Performance of Fruit in the NE Region of India

The Northeastern (NE) region of India is known for its diverse range of fruit crops, notably being the exclusive producer of certain fruits. The NE region saw a significant decline in fruit production, with a 1.47% negative growth rate ($p < 0.05$). Conversely, Mizoram showed positive and significant growth in both fruit crop area and production. Assam and Meghalaya also showed positive and significant production growth rates of 1.38% and 2.81%, respectively. Narmadha and Karunakaran (2022) also found positive and significant growth in fruit production. In contrast, Arunachal Pradesh, a major contributor to the region’s fruit production, exhibited significant negative growth rates of 9.18% in area and 14.32% in production. Tripura’s fruit production declined with a significant negative growth rate of 4.86% ($p < 0.10$), mainly due to

reduced area under fruit crops. This highlights the need for targeted interventions to boost fruit crop productivity and sustainability. The decline’s link to reduced fruit crop area underscores the need to reassess land-use patterns and crop allocation strategies in Tripura. The high degree of instability in area and production of fruit crops observed in Arunachal Pradesh, Sikkim, Tripura, Mizoram and Meghalaya indicates that these states are highly susceptible to fluctuations in fruit production. This instability likely stems from factors such as climate change, pests, and diseases, which can significantly impact fruit farmers’ livelihoods and regional food security. In contrast, Manipur’s high instability in fruit production, despite stability in area, suggests the state’s fruit sector may be more vulnerable to production-side factors. Further, this finding warrants further investigation to determine the underlying factors contributing to this phenomenon.

Table 5: Growth and instability of fruits in the NE region of India (2020-21)

State	Area		Production	
	CAGR (%)	Instability	CAGR (%)	Instability
Arunachal Pradesh	-9.18**	14.51	-14.32**	24.52
Assam	0.03 ^{NS}	1.80	1.38**	3.14
Manipur	-2.78**	4.07	-0.31 ^{NS}	7.93
Meghalaya	1.06 ^{NS}	5.46	2.81**	6.69
Mizoram	2.81**	6.88	1.13 ^{NS}	6.84
Nagaland	-1.81***	5.74	-1.30 ^{NS}	13.65
Sikkim	29.27 ^{NS}	38.43	42.31 ^{NS}	55.60
Tripura	-3.05 ^{NS}	10.92	-4.86***	13.26
NE region	-1.47**	2.57	-0.58 ^{NS}	4.94

Note: *** and ** denote significance levels at 1% and 5%, respectively. NS indicates Not significant.

Table 6: Growth and instability of vegetables in the NE region of India (2020-21)

State	Area		Production	
	CAGR (%)	Instability	CAGR (%)	Instability
Arunachal Pradesh	-0.35 ^{NS}	160.76	-14.85*	76.83
Assam	1.23**	3.65	0.92 ^{NS}	12.24
Manipur	7.71**	27.47	6.58*	9.89
Meghalaya	2.62*	3.78	2.67**	8.27
Mizoram	-0.42 ^{NS}	8.93	-0.12 ^{NS}	17.16
Nagaland	3.68***	13.07	7.57***	23.66
Sikkim	1.54 ^{NS}	28.58	4.61 ^{NS}	30.82
Tripura	1.93***	7.87	2.79**	8.25
NE region	1.86*	4.82	1.82***	6.28

Note: ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. NS indicates Not significant.

State-wise Performance of Vegetable in the NE Region of India

The NE region's climatic conditions are conducive to cultivating numerous vegetables, but production is limited due to fragmented and small landholdings. Nevertheless, the region has achieved positive growth in both area (1.86%) and production (1.82%) of vegetables, with significance levels of 10% and 1%, respectively. Our findings align with those of Sharma and Singh (2024) in their study on Meghalaya. This positive growth trend in the NE region's vegetable sector is a promising development, particularly given the region's potential for vegetable cultivation. However, the persistence of fragmented and small landholdings poses a significant challenge to realizing the region's full potential. The significant growth in vegetable production in the NE region underscores the imperative for targeted research and development initiatives to enhance crop yields, disease resistance and climate resilience. By addressing these challenges and leveraging the region's comparative advantages, the NE region has the potential to emerge as a major hub for vegetable production in India. At the state level, Manipur, Meghalaya, Nagaland and Mizoram demonstrated positive and statistically significant growth in both area and production of vegetable crops. In contrast, Assam showed positive growth only in vegetable area, whereas Arunachal Pradesh recorded negative growth solely in production. This suggests that despite Assam's expansion in vegetable cultivation area, the lack of corresponding growth in production indicates potential inefficiencies or challenges in agricultural practices. Arunachal Pradesh's decline in production highlights significant issues affecting agricultural output. Furthermore, high instability in vegetable area and production was observed in Arunachal Pradesh, Manipur, Mizoram, Nagaland, Sikkim and Tripura. In contrast, Assam and Meghalaya showed high instability only in vegetable production, suggesting that fluctuations in yield were the primary challenge. The varying instability patterns across the NE states may be attributed to differences in agricultural practices or environmental conditions.

CONCLUSIONS AND POLICY IMPLICATIONS

The study's findings highlight the intricate

relationship between fruit production and regional food security. Notably, despite negative growth, the region's self-sufficiency in fruit production has served as a vital buffer against food insecurity. This achievement is bolstered by significant increases in foodgrain and vegetable production, enhancing overall food stability. Although certain states face deficits, regional interdependence helps mitigate these challenges. To build on these successes and address persistent food shortages, enhancing food crop productivity is crucial for creating a more resilient agricultural landscape that meets current and future dietary needs. Moreover, diversification of crops can be a viable strategy, leveraging the region's favorable climatic conditions and topography, which are highly suitable for vegetable and fruit production. Moreover, improving land productivity is essential, as the current productivity levels are lower than their potential. This can be achieved by establishing soil testing laboratories to provide farmers with precise soil health recommendations. Additionally, increasing the consumption of balanced fertilizers, such as NPK, in the region can also contribute to enhanced land productivity. There is need to implement soil testing labs, promote balanced fertilizer use and improve irrigation infrastructure to boost food production and reduce deficits in North-east India.

ACKNOWLEDGEMENTS

The paper is part of a project entitled "Competitiveness and Sustainability of Organic Agriculture in Northeast India", funded by the National Institute of Agricultural Economics and Policy Research (NIAP), Delhi. The authors extend their gratitude to the NIAP for funding the research work.

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