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Status of Turmeric in Meghalaya State: An Analysis of Trend, Instability and Decomposition of Area, Production and Productivity

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ABSTRACT

Turmeric is an important spice crop with high commercial potential and medicinal properties. The purpose of this study is to examine the production performance of the crop through the lens of growth, instability and decomposition analysis of turmeric in the state of Meghalaya (India). The study examined the growth, instability and decomposition analysis of turmeric during the last 10 years i.e. from 2013 to 2023. The published secondary data were collected from the website of the Department of Economics and Statistics and the Directorate of Horticulture, Government of Meghalaya. Compound growth rate, an instability analysis and a decomposition model were used to analyse the turmeric production, area, and productivity. The study found gradual increase and relative stability in the performance of turmeric in terms of area and production. According to the decomposition analysis, the area factor is vital for the production of turmeric in Meghalaya over the years, having larger influence than those of yield effect and interaction effect. The influence of Lakadong Mission on the production of turmeric in the state was evident in the findings.

Keywords Meghalaya, Lakadong, Turmeric, Compound Growth Rate, Cuddy-Della Valle Index, Decomposition analysis.

INTRODUCTION

The golden spice turmeric (*Curcuma longa* L.) belongs to the family Zingiberaceae and is a rhizomatous perennial herb. It is cultivated throughout the world and is believed to be originated in India and Southeast Asian Countries (Papang *et al.* 2016, Ray *et al.* 2023). Marco Polo (1280 AD) referred to turmeric as the saffron of India (Prasad and Aggarwal 2011). It has various vernacular names, such as *Haldi* in the Northern, Eastern part of India, *Manjal* in the Southern part of India (Prasad and Aggarwal 2011) and *Halodi* in Assam, India. In Meghalaya, they are

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called *Shynrai* (Khasi), *Shyrmit* (Jaintia) and *Haldi* (Garo). Turmeric has been extensively used as a culinary spice, in cosmetics, and traditional health care remedies from ancient. It is valued in various traditional medicine systems for its health benefits, including boosting energy, enhancing digestion, and alleviating arthritis, respiratory issues, skin disorders, and digestive concerns (Aggarwal *et al.* 2007, Akhila and Gopi 2020). It is known for its anti-oxidant, anticancer, anti-inflammatory, antibacterial and antiseptic properties (Prasad and Aggarwal 2011, Lal 2022).

India is the largest producer, consumer and exporter of spices in the world and hence it is named as "Home of Spices" (Papang *et al.* 2016). Spices play a key role in augmenting farm income and the export market. A number of varieties are available in the country and is known mostly by the name of the locality where they are cultivated. Some of the popular cultivars are Duggirala, Tekkurpet, Sugandham, Amalapuram, Erode local, Alleppey, Muvattupuzha, and Lakadong (grown in Meghalaya) (Papang *et al.* 2016). The Government of India established the National Turmeric Board (NTB) in 2025 to promote the growth and export of turmeric and related products (Press Information Bureau 2025). India is the world's leading producer, consumer, and exporter of turmeric, known for its high curcumin content. In 2022-23, turmeric cultivation covered 3.24 lakh hectares, yielding 11.61 lakh tonnes—over 75% of global production. Major producing states include Maharashtra, Telangana, Karnataka and Tamil Nadu. India dominates the global turmeric trade with a 62% share, exporting 1.534 lakh tonnes worth $207.45 million in 2022-23 (Ministry of Food Processing Industries 2025b). Key markets include Bangladesh, the UAE, the USA, and Malaysia. The country aims to boost exports to $1 billion by 2030 through strategic initiatives. The agroclimatic conditions of North-Eastern region of India, especially Assam, Meghalaya, Manipur and Mizoram, is conducive for diverse varieties of turmeric with varying performances (Momin *et al.* 2018, Singh *et al.* 2013).

Meghalaya stands tall with its most coveted variety of turmeric, Lakadong and its hybrid Megha Turmeric I. Lakadong turmeric is famous for its high curcumin content (~7–10%) (Verma *et al.* 2015, Sarma *et al.* 2023) compared to regular turmeric (~2–4%) (Aswathi *et al.* 2023). Lakadong turmeric inherits its name from the small village Lakadong in the Meghalaya district of Northeastern India. Organic cultivation methods have been adopted in Meghalaya, leading to higher yields and economic returns compared to non-organic methods. Turmeric cultivation has become a regular profitable enterprise for the SHGs along with other income generation enterprises in Meghalaya (Deshmukh *et al.* 2013).

With its significant presence and importance in the state, it is imperative to examine the production performance of the crop. Growth, instability and decomposition are important indicators of measuring production performance (Meetei *et al.* 2024). Examining production performance provides an overview which helps to develop a plan for minimum risks and further improvement in the crop production.

MATERIALS AND METHODS

For the study, time series data on area, production and productivity of turmeric were considered for the years from 2013-14 to 2022-23. There were 7 districts in Meghalaya from which the number of districts had been increased to 11 in 2012. The study period has been split into two phases, 2013-14 to 2017-18 and 2018-19 to 2022-23, to normalize the study and to understand the impact of Lakadong Mission in the state. The published secondary data were collected from the websites of National Horticulture Board, Department of Economics and Statistics, Government of Meghalaya (National Horticulture Board 2021, Department of Agriculture, Government of Meghalaya 2025). Compound growth rate, an instability analysis and a decomposition model were used to analyze the turmeric production, area and productivity.

Growth rate

Growth rate was estimated using the compound growth rate (CGR) and it was calculated as:

$$Y_t = ab^t u_t$$

Where,

Y_t = Area/Production/Productivity (Dependent Variable) in the time period t.

a = Intercept

b^t = Regression Coefficient (1 + r)

t = Years which takes value 1, 2, … …, n

u_t = Error term for the year t

Taking logarithm to the both sides to transform the equation into log linear form for estimation:

$$log^Y = loga + logb$$

The compound growth rate (r) of area, production and productivity in percentage was computed by using the function:

$$CAGR\ (r)\ (\%) = \{Antilog\ of\ (\ln b) - 1\} \times 100$$

Instability analysis

The instability analysis was determined using Cuddy-Della Valle Index (CDVI). It was calculated as:

$$Instability\ Index\ (Ix) = CV \times \sqrt{1 - R^2}$$

Where, CV=coefficient of variation

R^2= Coefficient of determination

Range: 1. <15 = Low instability

2. 15–30 = Medium instability

3. >30 = High instability

Decomposition analysis

The change in production was taken as the effect of three factors such as area factor, yield factor and interaction factor.

$$\Delta P = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y$$

Where,

ΔP= change in production

ΔY= change in yield

ΔA= change in area

A0 = area in the base year

Y0=yield in the base year

RESULTS AND DISCUSSION

Current status and growth rate

The area, production and yield trends of turmeric showed that there was a noticeable increase annually over the years of study (Table 1). There was an increase in production from 15126 tonnes from area of 2465 ha in 2013-14 to 23082 tonnes from 3609 ha in 2022-23. The yield of turmeric in the state was 6.40 MT/ha in 2022-23. It is mostly cultivated in the West Jaintia Hills district, followed by West Garo Hills, Ribhoi, South Garo Hills and so on. North Garo Hills, West Khasi Hills and South West Khasi Hills districts had the least area under turmeric cultivation.

During period I, districts like East Jaintia Hills, South West Khasi Hills, and Ribhoi, exhibited the highest CGR in area expansion at 8.70%, 8.50%, and 5.65%, respectively. Correspondingly, production in these districts also showed significant growth, with

Table 1. Area, production and yield of turmeric in Meghalaya.

Year	Area (Ha)	Production (MT)	Yield (MT/Ha)
2013-14	2465.00	15126.00	6.14
2014-15	2516.00	15671.00	6.23
2015-16	2577.00	16324.00	6.33
2016-17	2632.00	16386.00	6.23
2017-18	2649.00	16497.00	6.23
2018-19	2658.00	16557.00	6.23
2019-20	2980.00	18614.00	6.25
2020-21	3006.00	18797.00	6.25
2021-22	3024.00	18924.00	6.26
2022-23	3609.00	23082.00	6.40
CGR (%)	3.62	3.84	0.21

Source: Department of Economics and Statistics and Directorate of Horticulture, Government of Meghalaya.

Table 2. Compound growth rate of turmeric in different districts of Meghalaya. Source: Author's calculation.

District	Period I (2013-2018)			Period II (2018–2023)			Overall (2013-2023)		
	Area (%)	Production (%)	Yield (%)	Area (%)	Production (%)	Yield (%)	Area (%)	Production (%)	Yield (%)
Ribhoi	5.65	7.47	1.74	0.38	0.40	0.00	2.46	3.00	0.53
East Khasi Hills	5.14	3.25	–1.78	0.58	0.65	0.06	2.42	1.59	–0.81
West Khasi Hills	–0.79	0.24	1.04	5.26	7.12	1.75	1.07	1.94	0.86
South West Khasi Hills	8.50	9.33	0.72	1.25	1.37	0.18	3.93	4.23	0.30
East Jaintia Hills	8.70	10.21	1.39	5.06	2.01	–2.90	4.85	4.45	0.38
West Jaintia Hills	0.28	0.42	0.13	9.78	10.40	0.58	4.64	4.83	0.18
East Garo Hills	0.14	–4.55	–4.69	7.07	6.85	–0.18	2.15	–0.06	–2.15
North Garo Hills	1.01	–2.74	–3.71	2.23	2.41	0.16	1.69	0.05	–1.61
West Garo Hills	2.69	3.91	1.18	0.20	0.23	0.03	1.17	1.58	0.40
South West Garo Hills	3.00	5.38	2.33	1.17	1.23	0.06	1.56	2.51	0.93
South Garo Hills	6.25	7.23	0.93	8.86	13.08	3.87	5.06	6.49	1.36
Overall Meghalaya	1.91	2.21	0.29	6.46	7.05	0.55	3.62	3.84	0.21

East Jaintia Hills leading at 10.21%, South West Khasi Hills with 9.33%, and Ribhoiwith 7.47%. However, yield performance varied, with South West Garo Hills achieving the highest with 2.33%, while East Khasi Hills and East Garo Hills experienced negative yield growth at –1.78% and –4.69%, respectively, indicating a decline in productivity despite increased area and production. Meghalaya, as a whole, showed an increase of 1.91% in area, 2.21% in production and 0.29% in yield.

The second period witnessed shifts in trends. South Garo Hills exhibited remarkable growth, with area and production increasing by 8.86% and 13.08%, respectively, and a notable yield improvement of 3.87%. West Jaintia Hills also demonstrated significant gains in area (9.78%) and production (10.40%). However, some districts, such as East Jaintia Hills and East Garo Hills, faced challenges, with East Jaintia Hills experiencing a negative yield growth of -2.90% and East Garo Hills showing a slight decline in yield (-0.18%). Meghalaya, as a whole, showed a significant increase of 6.46% in area, 7.05% in production and 0.55% in yield.

The compound growth rate revealed a steady rise in turmeric production in the state of Meghalaya from 2013-14 to 2022-23 with 2.26% in area, 3.84% in production and 0.21% in productivity (Table 2). In the study period, South Garo Hills district showed the highest growth rate in area (5.06%), production (6.49%) and yield (1.36%), followed by East Jaintia Hills, West Jaintia Hills and South West Khasi Hills. However, there was a slight decline in production in East Garo Hills with –0.06% and a steep decrease in yield in East Khasi Hills, East Jaintia Hills, East Garo Hills and North Garo Hills in terms of yield.

The positive growth rate of turmeric production in Meghalaya can be attributed to Lakadong's popularity, enhanced technical knowledge of farmers, market demand and government initiatives. The wide adoption of turmeric in Meghalaya has been due to its suitability and adaptation to the traditional farming and food systems. Introduction of a high yielding variety with disease resistance and considerably high curcumin content, called Megha Turmeric I, has resulted in higher production (Singh *et al.* 2013, Dutta *et al.* 2022). Considering Lakadong under GI tag was also a motivating factor for the farmers of Jaintia Hills. The influence of Lakadong Mission (launched in 2018) on the production of turmeric in the state was evident from the findings of the period II, showing higher CGR. Lakadong Mission has helped farmers in training and production. Moreover, this Lakadong turmeric variety has also been recognized under "One District, One Product" Initiative as a product for West Jaintia Hills (Ministry of Food Processing Industries 2025a). There is significant attention from the scientific domains in terms of economics, production, post-harvest management and micropropagation techniques (Sarma *et al.* 2011, Singh *et al.* 2013,Papang *et al.* 2016, Singh *et al*. 2020, Dutta *et*

al. 2022), thus helping to improve the performance of turmeric production in the State.

Instability index

Meghalaya maintained a low instability in the period I with 0.49 in area, 1.32 in production and 1.03 in yield (Table 3). Most of the districts of the state exhibited low instability in area, production and yield, ensuring stable cultivation trends. East Garo Hills, North Garo Hills and South West Garo Hills displayed higher instability, indicating fluctuations that may hinder consistent output. Very low instability in the main producing districts like West Jaintia Hills was an important achievement.

Meghalaya exhibited a relatively higher instability index in the period II with 5.04 in area, 0.64 in production and 5.45 in yield (Table 3). All the districts maintained low instability in all parameters, except for South Garo Hills. South Garo Hills exhibited higher variability across all parameters, with area at 13.74%, production at 21.36%, and yield at 6.24%, reflecting considerable fluctuations (Table 3).

During the study period (2013-2023), Meghalaya as a whole experienced a 5.45 instability index in the area of cultivation, while the production instability and yield instability were measured at 6.13 and 0.90 (Table 3). Among the districts, South Garo Hills, East Garo Hills and West Jaintia Hills had the highest instability indices in area, (11.84, 9.53 and 9.51) and production (19.38, 12.57 and 10.25). In contrast, West Garo Hills exhibited the lowest levels of instability in area and East Khasi Hills in production. Overall, the state and districts showed low instability in the area, production and yield over the study period considered.

The study featured the low instability in the turmeric production in Meghalaya owing to its ideal soil and climatic conditions, crop diversification and intercropping farming system. Turmeric is known to be ideal for intercropping with many crops and grows well in different farming systems like Jhum, farms, homesteads and gardens (Bhatt *et al*. 2005, Negi *et al.* 2020, Singh *et al.* 2022). Frontline demonstrations in the Ri-Bhoi district have shown that adopting recommended practices can significantly enhance turmeric yield and profitability. The Megha Turmeric 1 variety, with a high curcumin content, has demonstrated a yield increase of 26.5-39.4% over traditional methods, resulting in higher net profits for farmers (Barua and Tripathi 2014). Farmers have acquiredsuitable technical knowledge for turmeric cultivation. Availability of high-quality native varieties ensured a stable production trend in the state.

Decomposition analysis

The analysis involved breaking down the variability in production into its individual components for

Table 3. Instability index of turmeric in different districts of Meghalaya. Source: Author's calculation.

District	Period I (2013-2018)			Period II (2018-2023)			Overall (2013-2023)		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Ribhoi	2.31	2.20	1.44	0.15	0.16	0.00	3.94	5.03	1.67
East Khasi Hills	2.10	1.42	2.80	0.23	0.28	0.13	3.41	2.08	2.37
West Khasi Hills	3.83	4.75	1.19	4.25	5.85	1.59	6.25	7.88	1.71
South West Khasi Hills	5.70	5.54	0.65	0.49	0.54	0.07	5.94	6.21	0.64
East Jaintia Hills	3.51	4.60	1.30	5.59	0.45	4.56	5.71	5.85	4.47
West Jaintia Hills	0.41	1.24	0.86	7.47	8.14	0.68	9.51	10.25	0.86
East Garo Hills	3.61	9.70	5.98	9.77	9.20	0.49	9.53	12.57	5.53
North Garo Hills	4.05	9.15	5.05	0.58	0.63	0.08	2.81	7.18	4.61
West Garo Hills	1.01	1.40	1.01	0.08	0.09	0.05	1.94	2.83	1.12
South West Garo Hills	2.16	1.60	1.29	0.69	0.69	0.05	2.06	3.13	1.89
South Garo Hills	2.07	2.05	0.74	13.74	21.36	6.24	11.84	19.38	5.26
Overall Meghalaya	0.49	1.32	1.03	5.04	5.70	0.64	5.45	6.13	0.90

Table 4. Decomposition analysis of turmeric in different districts of Meghalaya. Source: Author's calculation.

District	Period I (2013-2018)			Period II (2018-2023)			Overall (2013-2023)		
	Yield effect	Area effect	Interaction	Yield effect	Area effect	Interaction	Yield effect	Area effect	Interaction
Ribhoi	24.15	70.93	5.22	0.00	96.24	0.00	22.00	72.68	5.35
East Khasi Hills	–38.55	147.01	–7.51	7.56	89.83	0.17	–29.03	135.49	–6.68
West Khasi Hills	174.86	–71.14	–3.43	21.83	73.52	4.37	35.96	57.46	6.35
South West Khasi Hills	7.78	89.19	2.43	12.60	90.40	0.60	8.09	88.99	3.03
East Jaintia Hills	12.38	82.87	4.83	–160.00	300.52	–41.38	–13.96	124.60	–10.89
West Jaintia Hills	42.12	57.80	0.56	4.54	92.94	2.66	5.76	90.88	3.50
East Garo Hills	119.93	–22.38	3.24	–2.89	104.25	–1.12	–67.83	198.31	–30.25
North Garo Hills	192.00	–104.17	12.00	6.93	92.33	0.67	–178.67	312.50	–33.50
West Garo Hills	27.89	68.83	2.82	19.24	87.14	0.14	26.68	70.05	2.99
South West Garo Hills	35.54	59.95	4.86	5.70	95.32	0.30	27.59	67.02	5.66
South Garo Hills	12.48	84.49	3.09	25.02	62.11	12.92	18.28	65.24	16.58
Overall Meghalaya	16.42	82.35	1.23	6.78	90.79	2.43	8.04	88.23	3.73

study period, and the outcomes of the decomposition analysis are presented (Table 4).

In Period I, most the districts experienced dominant contribution from the area effect which indicated that there was high impact of area expansion in the production of turmeric in the state. However, there were significant effect of yield factors in North Garo Hills (192.00), West Khasi Hills (174.86) and East Garo Hills (119.93), where there were negative pulls from the decline of area of cultivation. Meghalaya as a whole also experienced the high contribution of area effect with 82.35, while yield effect and interaction effect stood at 16.42 and 1.23. While in the Period II, all the districts of state exhibited a higher impact from the area factor. Moreover, districts such as East Jaintia Hills and East Garo Hills showed negative yield factor in the decomposition analysis.

The decomposition analysis of the full study period revealed that area effects (88.23) were the primary driver of turmeric production growth in Meghalaya, while the yield effect and interaction effect stood at just 8.04 and 3.73.

The substantial contribution of area factor is due to its high demand and profitable venture. Lakadong Mission and other initiatives from organizations like ICAR, and Spice Board encouraged the farmers resulting in better production and productivity. Such extension can make significant contributions to agricultural production and development (Boyacı 2022). Geospatial techniques such as the Analytical Hierarchical Process (AHP) and Weighted Overlay Analysis (WOA) have been employed to identify suitable sites for turmeric cultivation in the Jaintia Hills (Negi *et al.* 2020). These analyses have identified significant areas as highly suitable for expanding Lakadong turmeric cultivation. However, it is imperative to formulate further researches on varietal evaluation, high yielding varieties and adoption of modern technology.

Challenges and future prospects of Turmeric production in Meghalaya

Turmeric production and marketing in Meghalaya face significant challenges that limit its full potential. One of the primary concerns is the absence of a regulated market, which leads to price instability and discourages farmers from investing in high-quality turmeric cultivation. Despite the superior curcumin content of Lakadong turmeric, it is often sold at the same price as lower-curcumin varieties like Lasyien and Lachein, reducing incentives for farmers to focus on its production (Papang *et al.* 2016, Ray *et al.* 2023). There are notable threats from climate change and uncertain weather events. Additionally, there is a dearth of research in the region. Without systematic interventions, Meghalaya's turmeric industry risks stagnation, preventing farmers from reaping the full economic benefits of their produce.

However, Meghalaya possesses immense potential for organic turmeric production, which, if

properly harnessed, could command premium pricing in both domestic and international markets. The success of organic turmeric cultivation in Sikkim serves as an example of how systematic interventions can enhance profitability (Singh *et al.* 2020). To achieve similar success, there is a need for market regulation, systematic grading, and the development of direct export channels to ensure fair pricing for high-quality produce. There is scope for expansion of such valued horticultural crops owing to large unutilized land coverage in the region (Momin *et al.* 2018). Furthermore, the increasing global demand for turmeric and its derivatives presents an opportunity to promote value addition and incentivize farmers to expand cultivation. Institutions such as the Spices Board of India, the Meghalaya Basin Development Authority (MBDA), and various NGOs must play a pivotal role in strengthening the turmeric value chain through research, farmer training, and infrastructure development.

CONCLUSION

The study conducted an empirical analysis of turmeric production performance and productivity variability in Meghalaya State from 2013-14 to 2022–23 in order to determine the trend in growth of area and production. The results from the study will help various stakeholders to create appropriate policies to maintain or increase production and reduce production variability. Turmeric cultivation in the state showed an overall positive trend with positive annual growth rates in area and production. The instability analysis showed a stable trend. Decomposition analysis highlighted the significant role of the area effect in influencing production. To ensure sustainable growth, efforts should also be focused on addressing instability in specific districts, improving yield and promoting best agricultural practices. Future studies in the value chain, marketing channels, genetics and breeding are recommended.

Author Contributions

W. A. Meetei: Conception and design of the study, acquisition of data, statistical analysis, drafting of manuscript, visualization, reviewing and revising the manuscript, approval of version for publication.

T. Y. Tara: Conception and design of the study, drafting of manuscript, reviewing and revising the manuscript, approval of version for publication.

G. W. John: Conception and design of the study, statistical analysis, drafting of manuscript, visualization, reviewing and revising the manuscript, approval of version for publication.

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