A Trend Analysis of Crop Production, Market Arrival and Prices in Meghalaya, India

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Authors' contributions

This work was carried out in collaboration between both authors. Author MS designed the study, performed the statistical analysis, and wrote the protocol and the first draft of the manuscript. Author RS managed the literature searches and the analyses of the study. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aims: The study was carried out to examine the growth performance of the major crops, *i.e.,* rice, potato, pineapple, ginger, rapeseed and mustard and pea, for the last decade (2010–2019) during 2021–22.
Methodology: The study was based on secondary data collected from various official sources of the Government of Meghalaya. The Compound Annual Growth Rate (CAGR), Seasonal Variability Index (SVI) and coefficient of variation were used to examine the objectives of the study.
Results: The result of the study showed that positive growth accounted for area, production and productivity of selected crops, but high growth was recorded in production than area and

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productivity due to an increase in the area during the preceding years with high fluctuations in market arrivals and their prices. The positive relationship between market arrivals and prices for several months of the year could be beneficial for growers, whereas the negative relationship might be a loss for growers.

Conclusion: The study recommended that there is a need to increase the area under cultivation to increase production and narrow the fluctuation in price of the same crops in the state.

1. INTRODUCTION

In several past decades, the climate change phenomenon has drawn wide attention across the globe from various angles, like the preservation of biodiversity, food security and environmental sustainability. However, the need for recognizing abrupt climate change and its far-reaching adverse consequences on food security and the livelihoods of millions has been realized recently in India [1,2,3,4]. On the other hand, agricultural production both in terms of quantity and quality has been adversely affected. The Indian population is increasing rapidly, alarmed to increase agricultural production in hilly regions where there is already a mismatch between demand and supply of food crops. The state of Meghalaya is in deficit in foodgrains by 1.21 lakh metric tonnes annually to feed a population of 2.9 million. This is due to a lot of constraints, such as undulating topography, transport and communication problems, population dispersal problems, inadequate credit support, poor marketing systems, etc. In the North-Eastern Hilly Region, the state of Meghalaya, where agriculture is a major source of income, provides employment to more than 81 per cent of the population [5] and [6]. The state is slowly and steadily progressing in spite of numerous constraints and limiting factors. Practicing improved and modern methods of agriculture by the farmers, using chemical fertilizers, plant protection measures and the introduction of High Yielding Verities (HYVs) seeds of rice, wheat, maize, etc. has contributed to the increase in production of foodgrains [7].

The farmers of the state cultivate a wide range of agricultural crops due to its highly diversified topography, altitude and climatic conditions. The climatic conditions of state allow the temperature to range from 20 °C to 36 °C at 300 to 2000 meters of altitude above the mean sea level. The state of Meghalaya receives the highest rainfall per year throughout the continent, which helps in the production of agriculture without or with less irrigation. In the state, the majority of farmers are landless, with merely 24 per cent of the total population having their own land for cultivation [8,9].

Since a significant proportion of the total farmers are engaged in agriculture, they take production for homestead consumption, which leads to imports from other states to meet the requirements of the non-farming population. Among market-oriented producers, the majority of them sell their produce just after harvesting at a low price due to a lesser quantity of produce or a lack of organized bargaining power. Implementation of Farmer Producer Organisations (FPOs) and Self Help Groups (SHGs) can be helpful to mitigate such problems in the state. Through the implementation of these schemes, farmers would be encouraged to engage in collective farming so that the volume of production could be increased, ultimately strengthening the production and marketing of agriculture. On the other hand, farmers faced difficulties in marketing due to wide price fluctuations, which can be mitigated by facilitating warehouses in the state. The market arrivals, or the quantity of produce made available by farmers in the market for sale, fluctuated season by season due to the seasonal nature of crops. In the off-season for different crops, market arrivals are low because most of the farmers have sold their produce in nearby local markets. To do agricultural development, it is necessary to know the present status of agriculture in Meghalaya. Particularly, the growth rate of major crops in the context of area, production, productivity, situation, and relationship between market arrivals and their prices have been analyzed in this study. The study has been carried out under the following objectives: (i) to estimate the growth rate of area, production and productivity; (ii) to analyze the relationship between market arrivals and prices.

2. METHODOLOGY

The study was conducted in the state of Meghalaya to determine the trend of area, productivity and productivity of selected major

crops and examine the relationship between market arrivals and their prices over the past decade (2010–2019).

Selection of crops: Among each crop group, one crop with the largest area, such as rice among cereals, potatoes among vegetables, pineapple among fruits, ginger among spices, rapeseed and mustard among oilseed crops, and pea among pulse crops, was selected for the study.

Data collection: Secondary data were used for the study, collected from various official sources like the Department of Agriculture of the Government of Meghalaya and the State Agricultural Marketing Board [10] of the Government of Meghalaya, for the analysis of the results of the research objectives. The time series data of ten years of area, production and productivity has been analyzed. The statistical data of market Lewduh (Shillong) were implemented in the analysis of trends in price and market arrivals of selected crops. In this market, most of the arrivals were arrived at the time of harvesting and prices have become low as compared to off-season. The wholesale price was taken into consideration in the analysis of this study.

Analytical tools: The Compound Annual Growth Rate (CAGR) per cent was estimated to analyze the growth rate of area, production, productivity, market arrivals and price of selected crops by Gupta and Kapoor [11]. In order to examine the growth performance of selected crops, the compound annual growth rate (CAGR) was applied by using the following formula:

$$Y = ab^t$$

Where, Y = dependent variable, a = intercept term, b = slope coefficient and t = time variable
CAGR (%) = (Antilog b-1) ×100

$$\text{Coefficient of variation (\%)} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Seasonal variability index was estimated by using following steps:

In first step, data collected from secondary sources were arranged in months and years. In second step, average Xi, (i = 1,2,3,…….,12) for the ith month for all the years. Average of the monthly averages were calculated using formula, i.e.,

$$\bar{x} = \frac{1}{12}\sum_{i=1}^{12} \bar{x}i.$$

Seasonal indices of months were calculated by expressing monthly averages as percentage of $\bar{x}$. Thus, monthly seasonal indices of ith months were calculated as follows: Gupta and Kapoor [12].

$$\text{Seasonal index} = \left(\frac{\bar{x}i}{\bar{x}}\right) \times 100; i = 1,2,3, \dots \dots 12.$$

3. RESULTS AND DISCUSSION

The compound annual growth rate (%) of selected crops was positive, which denotes an increasing growth trend presented in Table 1. The maximum growth in area recorded for pea was 6.04 per cent followed by rapeseed and mustard, pineapple, potato, ginger and rice at 2.25 per cent, 1.68 per cent, 0.78 per cent, 0.61 per cent and 0.22 per cent, respectively. The positive growth rate of selected crops was also reported by De et al. [13]; Singh et al. [14] in their study. The production pattern of various selected crops accounted for a positive trend over the decade, as pea production attained a maximum growth rate of about 8.67 per cent, followed by rapeseed and mustard at 5.67 per cent, pineapple at 3.72 per cent, rice at 3.07 per cent, ginger at 1.51 per cent and potato at 1.36 per cent. Even though the productivity of all selected crops was found to be increasing in trend over the year, the pea crop achieved extreme growth in productivity of 2.47 per cent, followed by rapeseed and mustard, pineapple (2.05 %), ginger, potato and rice (2.00 %), (0.93 %), (0.68 %) and (0.46 %), respectively. The findings of the study were found to be in positive support, as reported by Roy et al. [15]; Mittal [16].

The trend line of area, production and productivity of rice is presented in Fig. 1 for the period from 2010 to 2019. The trend lines exhibited a relatively flatter increase for area and productivity of rice, whereas production displayed a steeper rise compared to area and productivity. It may be due to the increase in area and productivity of rice.

The growth trend of potato presented in Fig. 2 showed a positive trend in area and productivity of potato; the growth rate of potato was recorded to be lower but still positive, reflecting a flatter trend in the last decade. The reason for the increasing trend in production was the increase in area and productivity of potatoes in the state.

The graphical presentation of trend line of area, production and productivity of pineapple during

the preceding year from 2010 to 2019 has been presented in Fig. 3. The pineapple is the traditional crop in Meghalaya. The area and production of pineapple showed flatter increase, whereas, productivity exhibited relatively more increasing trend than area and production due to the effective management of production program after implementation of effective policy by government in context of pineapple.

The graphical representation of area, production and productivity of ginger during the preceding year from 2010 to 2019 mentioned in Fig. 4. The area and productivity line of ginger were exhibited flatter increase, whereas, production of ginger reflected relatively greater increase as compare to area and productivity due to increase in area and productivity of ginger in the study area.

The area and production showed disaster growth as compared to productivity during the year from 2011 to 2012. The trend line of area, production and productivity of mustard during the period from 2010 to 2019 presented in Fig. 5. It may be due to getting more incentives from government policies by farmers particularly in mustard crop. However, last few years exhibited flatter increase.

Trend lines showed a flatter increase from 2010 to 2011, but there was disaster growth recorded for 2011 to 2012. The trend lines of area, production and productivity of ginger during the period from 2010 to 2019 presented in Fig. 6. Production showed more increment as compare to area and productivity after that reflected flatter increment. There has been a positive growth rate in production, productivity and area. It is obvious that the profit and standard of living of crop farmers ought to have increased to some extent. Unfortunately, crop farmers were still tied to the exploitative behaviors of marketers and also seasonal and market fluctuation of crops produce. This limits the chances of farmers and thus continuation poverty.

The seasonal variability index of market arrival presented in Table 2. The arrival index of various crops calculated based on average of the market arrivals to examine the fluctuations of market arrivals from the mean. Value of arrival index greater than 100 indicates market arrivals was greater than the average. But if arrival index much lesser than 100 indicates value of market arrival lesser than the average. Maximum fluctuations of arrival recorded for rice in the month of May, potato in July, pineapple in August, ginger in September, rapeseed and mustard in November and pea in the month of September.

The seasonal variability of index of the prices presented in Table 3. indicated the fluctuations of the price index of selected crops in different months. Maximum fluctuation recorded in the month of December for rice, September for potato, December for pineapple, May for ginger, September for rapeseed and mustard and December for pea. The result was found in line with the findings of Gayathri [17].

The annual variability and CAGR of mean arrivals of selected crops presented in Table 4. showed that maximum fluctuations were recorded for rice in 2020, followed by potato in 2013, pineapple in 2019, ginger in 2017, rapeseed and mustard in 2011 and for pea in 2010. CAGR was found to be maximum for potato (6.89%), followed by pineapple (5.24%), pea (4.70%), rice (4.27%), rapeseed and mustard (2.25%) and ginger (1.89%). It can be concluded that increased major agri-production leads to self-sufficiency for the state. Vasavada in 2021 [18] also reported positive growth rates for major agricultural products in his findings.

Table 1. Growth rate of area, production and productivity of selected crops (2010-11 to 2019-20)

Crops	Area (ha)	Production (MT)	Productivity (kg/ha)
Rice	0.22	3.07*	0.46
Potato	0.78	1.36	0.68*
Pineapple	1.68***	3.72**	2.00**
Ginger	0.61	1.51	0.93
Rapeseed and Mustard	2.25**	5.67***	2.05*
Pea	6.04**	8.67**	2.47**

Source: Author's computation
*Note: ***, ** and * are indicates the level of significance at 1%, 5% and 10%, respectively*
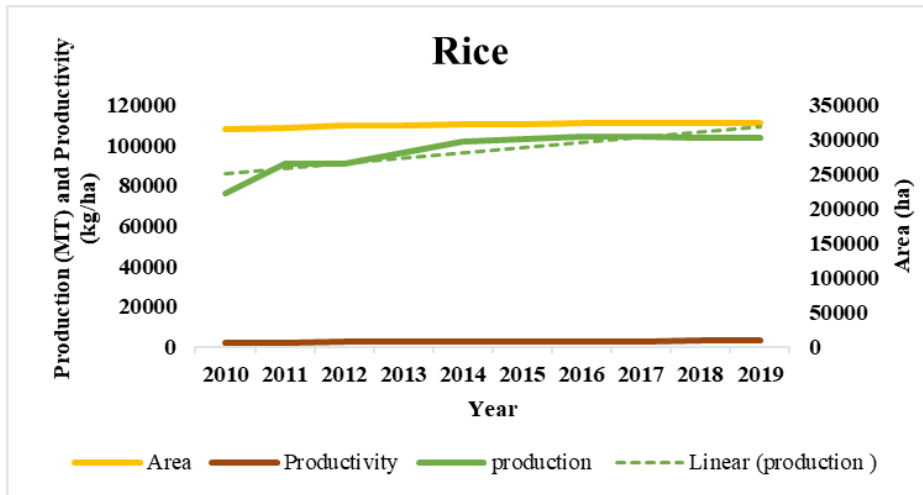
Fig. 1. Trend of the area, production and productivity of rice (2010 to 2019)
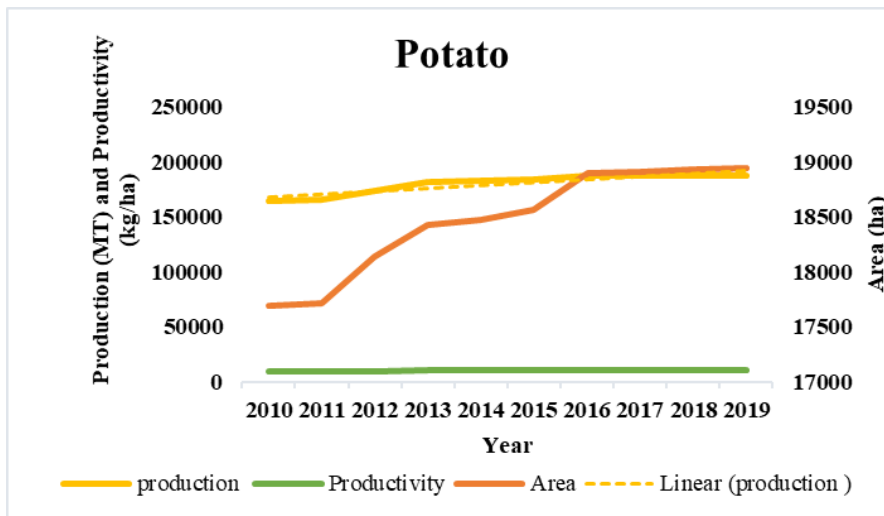

Fig. 2. Trend of the area, production and productivity of potato (2010 to 2019)
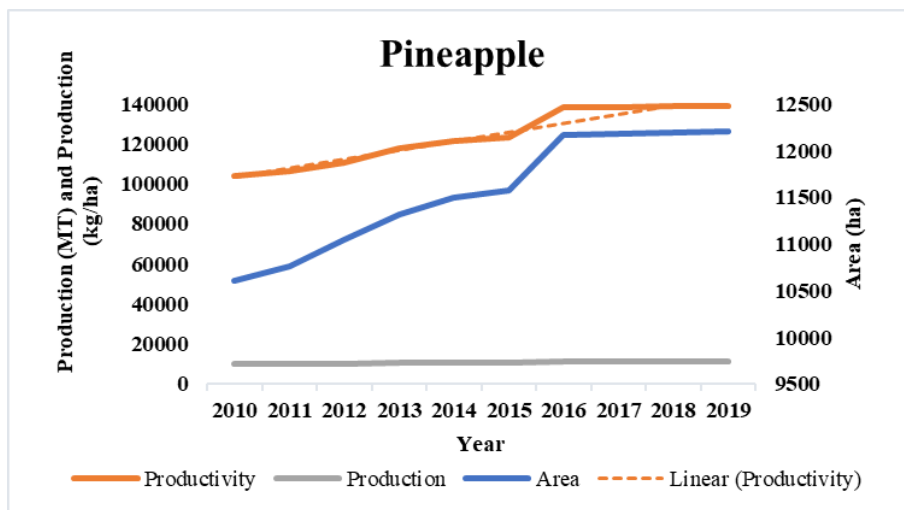

Fig. 3. Trend of the area, production and productivity of pineapple (2010 to 2019)
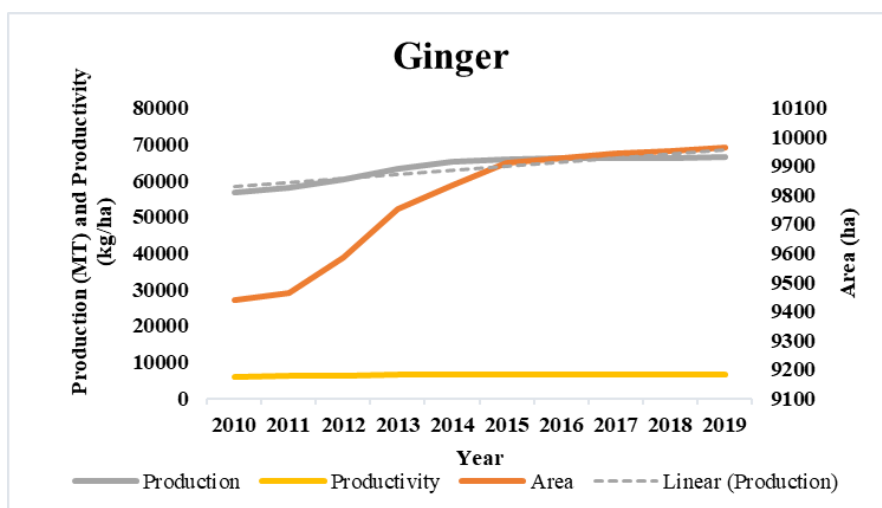
Fig. 4. Trend of the area, production and productivity of ginger (2010 to 2019)
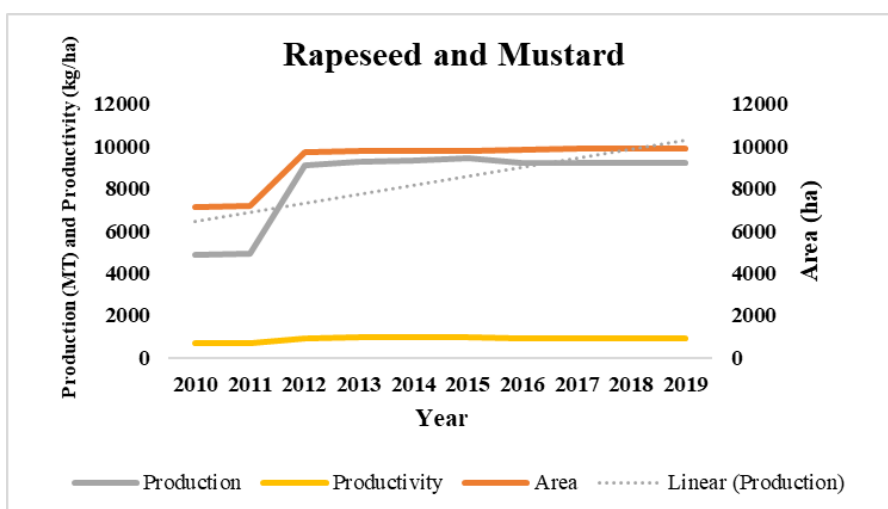

Fig. 5. Trend of the area, production and productivity of rapeseed and mustard (2010 to 2019)
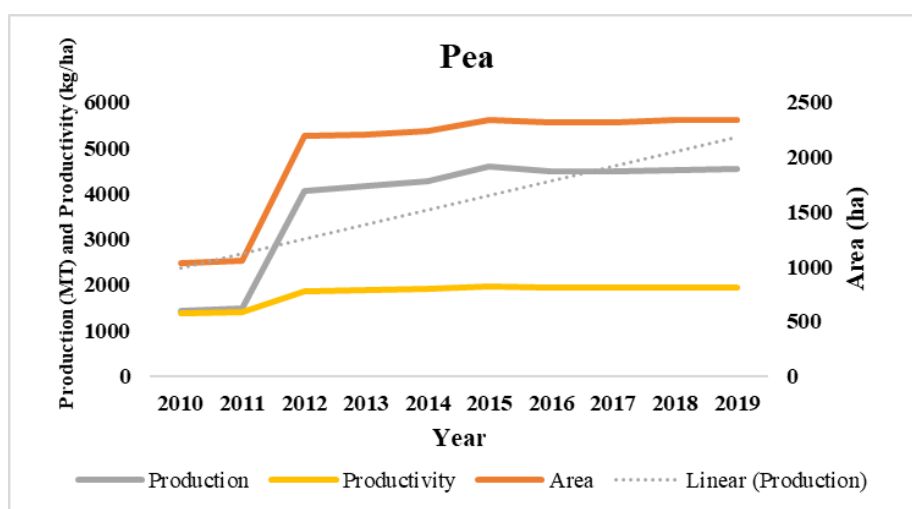

Fig. 6. Trend of the area, production and productivity of pea (2010 to 2019)

Table 2. Seasonal variability index of market arrivals of selected crops in Meghalaya (2010 to 2019)

Month	Arrival index					
	Rice	**Potato**	**Pineapple**	**Ginger**	**Rapeseed and Mustard**	**Pea**
JAN	71.86	4.38	18.18	79.26	96.18	79.88
FEB	101.96	8.79	16.43	66.44	111.56	66.96
MAR	101.37	13.23	14.10	83.20	93.30	83.85
APR	68.83	9.10	6.62	77.78	83.41	78.39
MAY	150.88	35.51	14.03	91.79	105.75	92.51
JUN	90.51	148.71	144.03	91.49	79.22	92.21
JUL	117.30	193.06	296.77	100.35	100.36	99.48
AUG	150.43	180.61	376.69	116.09	87.912	117.00
SEP	91.10	154.50	147.44	141.70	98.01	142.81
OCT	90.64	166.18	42.71	116.54	116.37	117.45
NOV	94.81	185.88	22.95	135.33	130.66	136.39
DEC	70.28	137.92	14.32	92.29	97.22	93.01

Source: Author's calculation

Table 3. Seasonal variability index of prices of selected crops in Meghalaya (2010 to 2019)

Month	Price index					
	Rice	**Potato**	**Pineapple**	**Ginger**	**Rapeseed and Mustard**	**Pea**
JAN	98.74	81.86	88.16	60.26	102.07	86.82
FEB	97.03	78.93	91.33	74.99	86.59	93.58
MAR	99.85	90.75	113.77	102.96	88.91	91.53
APR	97.31	96.09	112.45	104.95	83.02	98.01
MAY	101.02	94.40	105.55	128.69	100.62	98.37
JUN	98.38	105.30	93.54	113.23	88.03	102.01
JUL	98.33	111.17	93.20	104.20	90.12	107.95
AUG	97.95	110.30	90.68	102.52	107.63	104.97
SEP	98.210	117.34	94.30	89.19	149.15	108.05
OCT	102.71	111.51	96.13	100.91	115.32	97.76
NOV	103.23	110.09	102.79	123.93	98.04	102.04
DEC	107.19	92.21	118.04	94.11	90.45	108.84

Table 4. Annual variability and CAGR (%) of mean arrivals of selected crops in Meghalaya

Year	Rice		Potato		Pineapple		Ginger		Rapeseed and Mustard		Pea	
	Mean Arrivals	CV (%)	Mean Arrivals	CV (%)	Mean Arrivals	CV (%)	Mean Arrivals	CV (%)	Mean Arrivals	CV (%)	Mean Arrivals	CV (%)
2010-11	309.08	73.94	2101.58	78.27	166.00	145.03	479.00	42.21	149.00	20.60	231.58	53.31
2011-12	262.58	36.66	1289.08	90.35	174.41	114.77	503.50	45.70	189.33	50.31	397.66	37.81
2012-13	190.83	52.76	1267.25	90.02	175.58	122.64	484.00	44.95	213.08	27.08	399.00	51.71
2013-14	176.75	38.27	1171.83	96.30	309.91	112.11	401.83	36.46	203.00	24.87	401.83	36.46
2014-15	137.75	30.13	2217.50	78.61	399.00	124.08	481.83	38.53	156.50	28.70	481.83	38.53
2015-16	137.66	11.19	1970.08	81.05	269.75	147.50	462.50	19.70	178.83	22.49	418.00	32.49
2016-17	184.66	14.30	1926.08	75.03	230.25	153.06	597.50	18.62	196.25	18.73	584.16	20.16
2017-18	231.25	95.64	1588.41	76.86	254.50	153.96	626.33	88.44	168.58	17.49	459.66	34.07
2018-19	220.91	21.04	2155.08	75.94	272.08	141.04	359.58	22.19	249.16	27.58	359.58	22.19
2019-20	358.16	102.86	2149.08	81.88	342.08	160.68	407.33	28.54	243.91	18.98	507.33	26.46
CAGR (%)	4.27*		6.89***		5.24*		1.89		2.25*		4.70*	

Source: GoM. [19]
*Note: *** and * indicate the level of significance at 1% and 10%, respectively*

Table 5. Relationship between market arrivals and prices of selected crops in Meghalaya

Month	Coefficient of correlation between market arrivals and prices					
	Rice	Potato	Pineapple	Ginger	Rapeseed and Mustard	Pea
JAN	0.30	0.03	0.43	0.03	0.50	-0.48
FEB	-0.43	-0.35	0.22	0.23	0.80*	-0.39
MAR	-0.58	-0.58	-0.40	0.54	0.44	0.35
APR	0.82*	0.07	-0.51	0.70*	-0.13	0.09
MAY	0.44	0.29	-0.21	0.01	0.48	-0.12
JUN	-0.37	0.15	-0.24	0.91*	0.67*	-0.45
JUL	-0.48	0.47	0.81*	0.22	0.72*	-0.02
AUG	0.02	0.40	0.78*	0.82*	0.97*	0.73
SEP	-0.13	0.35	-0.35	0.82*	0.82*	0.57
OCT	-0.15	-0.28	0.18	0.85*	0.86*	-0.08
NOV	0.26	0.12	-0.28	0.76*	0.52	-0.23
DEC	-0.26	-0.07	-0.14	0.89*	0.92*	0.17

Source: Author's calculation;
*Note: * indicates the level of significance at 10 per cent*

Most of the agricultural crops are seasonal in nature; the bulk of produce reaches the market in peak arrival season at the same time the price goes down, reducing the profit share of farmers. The relationship between market arrivals and the prices of major crops in different months is presented in Table 5. The positive relationship between arrivals and their prices benefits, whereas the inverse relation gets a loss for famers. In the case of ginger, a positive relationship recorded for each month indicated that the marketing of ginger was beneficial throughout the year for producers. In the case of other selected crops, the observed positive and negative correlations imply that farmers gain profits when the relationship is positive but incur losses when it is negative.

4. CONCLUSION

The findings of the study exhibited a positive growth rate in area, production and productivity experienced by all selected crops. The implemented agricultural policies have a positive influence and have positively impacted the agrarian economy of this state, but there should be an awareness program for scientific cultivation, establishing processing units, constructing scientific storage units, and providing efficient market avenues to augment the overall production and productivity. In Meghalaya, there is even a need for credit facilities at a subsidy rate of interest, which would encourage farmers to increase the area under cultivation. Moreover, there is a need to enhance productivity, which would ultimately help in an increase in domestic production and result in increased profit from foreign exchange as the state shares the international boundary with Bangladesh.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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