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An Instability Analysis on The Trends and Patterns of Small Millets in The Visakhapatnam District of Andhra Pradesh

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Abstract

The primary food source for rural inhabitants in arid terrain areas has historically been small millets, which are nutrient-rich and drought-resistant. The Indian government has designated 2023 as the International Year of Millets to encourage the production and consumption of these grains in recognition of their significance. The focus of this study is on the volatility and trend of small millets in the Andhra Pradesh district of Visakhapatnam. The Cuddy Della Valle Index was used to collect and analyse secondary data from 2000 to 2019 in order to evaluate instability. The study found a gradual decrease in the area under small millets' cultivation in Visakhapatnam and Andhra Pradesh. While crop output in Andhra Pradesh originally dropped before increasing, it fluctuated without a distinct trend in Visakhapatnam. In general, Andhra Pradesh outperformed Visakhapatnam in yields. The results highlight the need for policy changes to support sustainable small-scale millet farming practises. The study emphasises the significance of creating high-yielding cultivars and suggests regulations to aid small millet growers. The findings aid in comprehending the current circumstance and offer suggestions for agricultural advancement and regulatory actions to increase tiny millet production.

Keywords: Small Millets, Sustainable Agriculture, Instability Analysis, Crop Production, Food Security.

1. Introduction

The history of Indian agriculture witnesses to how the country's new agricultural arrangements, such as the green revolution and economic reforms, have altered the country's conventional cropping patterns in general as well as in Andhra Pradesh. For meeting the demand for food and nourishment, there has been an increased dependence on fewer and fewer plant species. However, the increasing reliance on a few numbers of plant species poses a greater threat to the security of our food and nutrition since it restricts people's access to food, especially those from marginalised social groups who have limited opportunities for employment (Das, B., et all., 2019). Due to improved accessibility to irrigation, better inputs, and high yielding varieties that made commercial crops more cost-effective, millets gradually decreased to the production of rice, wheat, and other commercial crops during the green revolution (Kumar, C. P. 2022). The minor millets are rich source of nutrients and minerals and resistant to drought and stress in rainfed

farming (Anbukkani, et all., 2017). The tiniest millets, which are small-grained cereals, are finger, kodo, foxtail, proso, small, and barnyard millets. Millions of people living in the arid and semiarid tropics of worldwide utilise them as their primary source of nutrition (Gowri, M. U., & Shivakumar, K. M., 2020). These crops are traditionally grown in mountainous and semi-arid areas and are the main source of sustenance for the rural poor in the country's dry land regions (Sah, U., et all., 2021). In order to increase awareness and millets' production and consumption, the Indian government asked the United Nations to recognise 2023 as the International Year of Millets. The government of India is prepared to concentrate on millet development in tribal areas and create livelihood opportunities for tribal communities through millet processing and value addition during this "International Year of Millets."

An attempt was made to analyse the trend of area coverage, production, and productivity of millets during the past two decades (2000-2019) in the region, taking into account the importance of millets in the region as well as the growing importance of millets as a nutritious food in the country it is crucial for Indian policymakers to reconsider small millet farming practises and come up with laws that promote a landscape that is favourable to small millet farmers. In order for consumers to gain benefits from the nutrient-rich millets, scientists and researchers should concentrate more on high producing varieties of millets that should give greater yield and money for the farmer like other crops rice and wheat (Kumar, C. P. 2023). Recent years have seen a significant increase in consumer awareness of what they are eating, particularly in the contexts of sugar and obesity. Therefore, it is crucial to understand the situation and various constraints on the area, production and yield of small millets by a thorough examination of trend and instability analysis. A study on the area, production, and yield of small millet in the study area seems necessary in order to understand the current situation and to provide appropriate policy recommendations that can be strengthened in order to improve their production and the way they advance through the sustainability of agricultural development (Kumar, C. P. & Chandramalla, C. B. 2022).

Thus, the current study aimed to analyse the current trend of small millets' area, production and yield levels in Visakhapatnam district of Andhra Pradesh. In order to analyse the current circumstance and suggest appropriate policy recommendations, the current study will undertake a comprehensive analysis of secondary data at the state level for the Visakhapatnam district of Andhra Pradesh. The objectives of the study to analyse the production area, production and yield in the study area, to examine the instability in area, production and yield of the small millets and to suggest suitable policy measure for the sustainability of small millets

2. Data Sources and Methodology

Small millets are found to be the most produce millets in the district of Visakhapatnam, Andhra Pradesh, hence these were chosen for the current study.

The study used secondary data that was collected from Directorate of Economics and Statistics, Ministry of Agriculture, Govt of India (Anon., 2020). Data from a time series covering the period from 2000 to 2019 on the area, yield, and production of tiny millets in Andhra Pradesh and Visakhapatnam. Data for the entire state as well as each district was gathered from the Directorate of Economics and Statistics, Government of India. An instability index has been used separately for the Andhra Pradesh state and Visakhapatnam district's area, production, and yield of small millets as a whole.

Instability Index

There are various methods to measure the agricultural instability, including using the coefficient of variation, dispersion, Cuddy Della Valle Index (CDVI), Coppock Instability index, etc. the study used, Cuddy Della Valle Index to measure the instability. the data provided is first de-trended, and then the instability is calculated. The coefficient of variation fails to determine the instability of any time series data when it show a trend, and the variation evaluated by these coefficients of variation is overestimated; for example, if the region has expanding production at a constant rate is used to test instability, the coefficient of variation will give the region a high score. Instead, the Cuddy-Della Valle Index (CDVI) uses the coefficient of determination in order to attempt and de-trend the coefficient of variation. For measuring the instability in time series data that can be explained by trend, Cuddy and Valle (1978) first created the Cuddy- Della Valle index (Vennila, M., & Murthy, C., 2021). Hence, the paper used the Cuddy and Della Instability Index to measure the instability.

The co-efficient of variation was calculated using the formula that follows the expression to examine the stability of small millets with regard to area, production, and productivity. The dispersion of data points in a data series around the mean is statistically measured by the coefficient of variation (CV). Even when the means are drastically different from one another, the coefficient of variation, which measures the standard deviation when compared to the mean, can be used to compare the degree of variation between data series.

$$\text{Coefficient of Variation} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

The co-efficient of variation (%) was calculated in order to measure the degree of variability in area, production, and productivity across the entire period. Additionally, the small millet area, production, and productivity instability index in the state of Andhra Pradesh and the Visakhapatnam district was measured using the following formula:

$$\text{Cuddy and Della Instability Index (I)} = \sqrt{1 - R^2} \times \text{CV}$$

CV= Coefficient of variation

R^2 Adjusted coefficient of multiple determination

Coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of 2 multiple determinations (R^2).

Low Instability	Medium Instability	High Instability
0 to 15	15 to 30	Above 30

3. Result and Discussion

Table 1 showed data for Visakhapatnam and Andhra Pradesh for each year from 2000 to 2019 in terms of area, production, and yield. According to the study, Visakhapatnam's cultivable land area slipped over the years, from 23,797 hectares in 2000 to 4,408 hectares in 2019. similarly, Andhra Pradesh's cultivable land area consequently demonstrated a tendency of decline, going from 63,527 hectares in 2000 to 23,310 hectares in 2019. Without a clear increase or decrease trend, Visakhapatnam's crop production

fluctuated from year to year. In 2015, it was at a low of 2,476 tonnes, and in 2010, it was at a peak of 14,732 tonnes. With an unexpected dip from 46,827 tonnes in 2015 to 5,774 tonnes in 2018, agricultural production in Andhra Pradesh has generally fallen throughout the years. But in 2019, it rose once more to 22,075 tonnes. The yield, which is a measure of agricultural productivity, varies between Visakhapatnam and Andhra Pradesh. The yield in Visakhapatnam fluctuated significantly between years, from a low of 0.30 (tonnes/hectare) in 2015 to a high of 1.01 in 2010. In contrast to Visakhapatnam, the yield for Andhra Pradesh ranged from 0.37 in 2009 to 0.96 in 2010, with a general tendency of greater yields. The year 2010 saw the highest yield.

Overall, the study found that both in Visakhapatnam and Andhra Pradesh, the agriculture area has shrunk over time. While crop production in Andhra Pradesh originally declined before increasing once more, crop production in Visakhapatnam has fluctuated without any discernible trend. Over the years the production has been changed across the time and Andhra Pradesh has produced higher yields.

Table: 1 Small Millets Area, Production and Yield in Visakhapatnam in Andhra Pradesh

	Area (Hectares)		Production (Tonnes)		Yield (Production/Area)	
Year	**Visakhapatnam**	**Andhra Pradesh**	**Visakhapatnam**	**Andhra Pradesh**	**Visakhapatnam**	**Andhra Pradesh**
2000	23,797	63527	10,403	37046	0.44	0.58
2001	22,468	54845	11,934	33390	0.53	0.61
2002	21,698	46053	8,688	21646	0.40	0.47
2003	18,941	46352	8,205	27395	0.43	0.59
2004	22,000	46238	8,537	22551	0.39	0.49
2005	19,325	42792	7,864	25611	0.41	0.60
2006	19,347	33527	8,179	16993	0.42	0.51
2007	19,000	34000	8,000	21000	0.42	0.62
2008	18,153	30112	8,041	16220	0.44	0.54
2009	14,175	25125	6,282	9389	0.44	0.37
2010	14,570	28833	14,732	27701	1.01	0.96
2011	15,993	28792	9,862	18389	0.62	0.64
2012	13,000	37000	7,000	35000	0.54	0.95
2013	12,290	27498	6,582	20481	0.54	0.74
2014	9,627	20087	5,426	14578	0.56	0.73
2015	8,299	50626	2,476	46827	0.30	0.92
2016	7,036	31091	2,866	23930	0.41	0.77
2017	6,501	21322	2,494	16069	0.38	0.75
2018	5,169	12737	2,055	5774	0.40	0.45
2019	4,408	23310	2,021	22075	0.46	0.95

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Govt of India

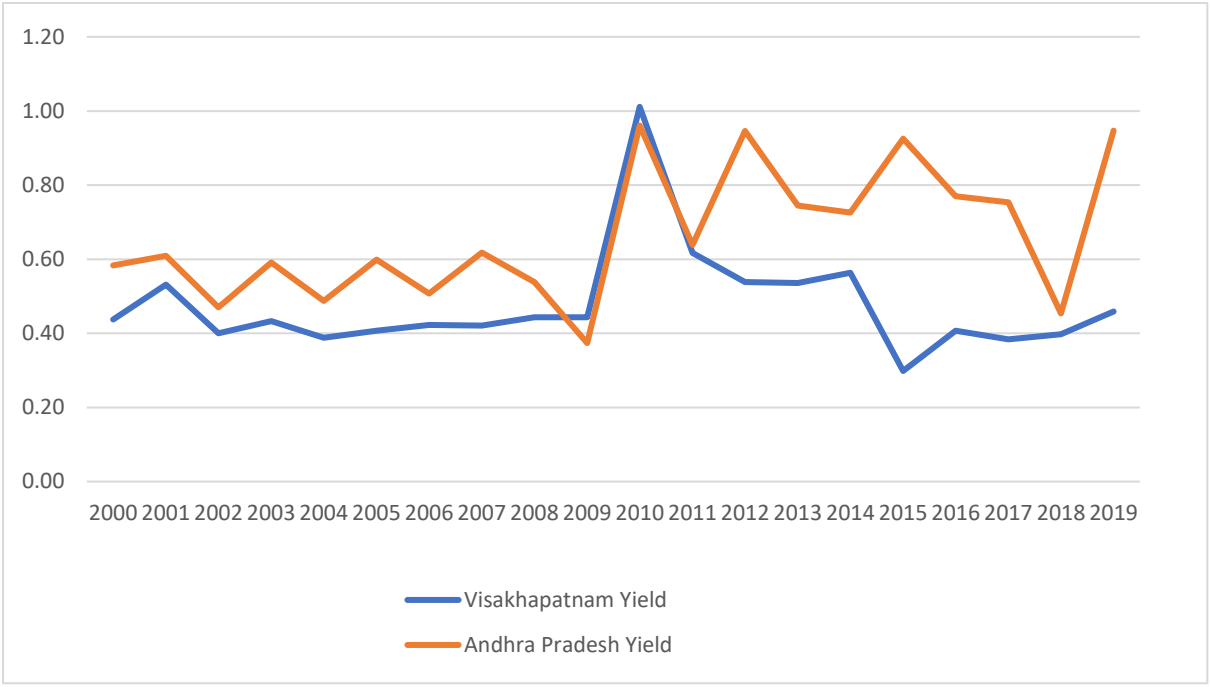

Figure 1: Yield levels of small millets in Visakhapatnam district and Andhra Pradesh, 2000-2019

While the area of small millets cultivation in Andhra Pradesh has been steadily declining since 2000, from 63527 hectares to 20087 hectares, then increasing to 50626 hectares in 2015 and sharply declining to 31091 in 2016. It was noted that in Andhra Pradesh, the area used for the production of small millets was consistently shrinking.

In the Visakhapatnam district, production of small millets slightly increased from 10403 tonnes to 11934 tonnes between 2000 and 2001. However, from 2002 to 2005, production of small millets steadily decreased to 7864 from 8688 tonnes. Thereafter, production slightly increased to 8179 tonnes in 2006, then slightly decreased to 8000 tonnes in 2007 before slightly increasing to 8041 tonnes in 2008. It is noted that 14732 tonnes of small millets were produced in Visakhapatnam in 2010, but that from 2011 to 2019, it steadily fell to 2021 tonnes from 9862 tonnes. While Andhra Pradesh had the lowest production of small millets in the state in 2018 with 5774 tonnes. It has been shown that the production of small millets varies.

The highest yield of small millets from 2000 to 2019 was 1.01 in the Visakhapatnam district in the year 2010. 2017 saw the lowest yield of small millets ever recorded (0.38). In contrast, the highest yield in Andhra Pradesh was 0.96 in 2010 while the lowest yield was 0.37 in 2009. When compared to the Andhra Pradesh district of Visakhapatnam, the yield of small millets is often higher in the state of Andhra Pradesh.

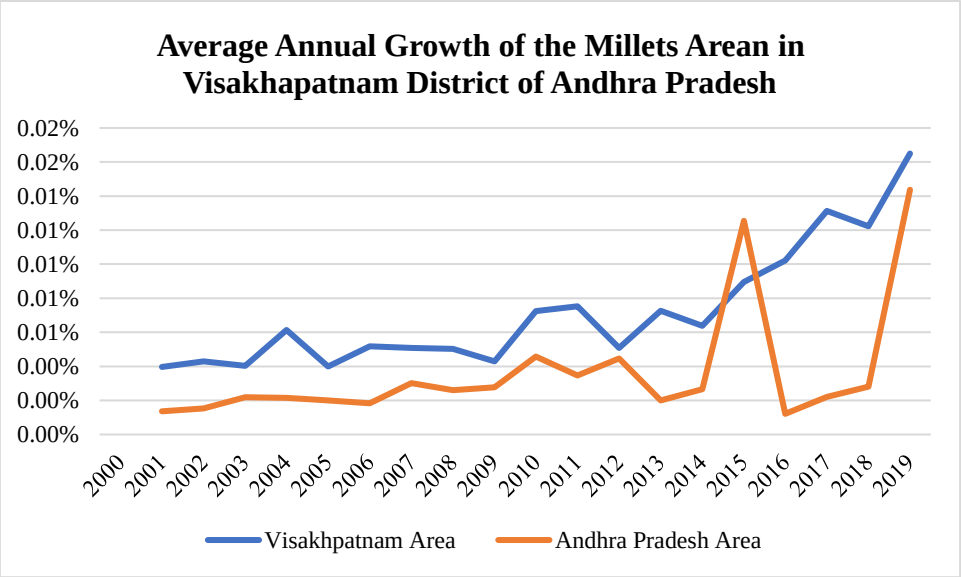

Figure 2: Average Annual Growth of the Millets Area in Visakhapatnam District of Andhra Pradesh

Table: 2 Instability in Area, Production and Yield of Small Millets in Visakhapatnam District of Andhra Pradesh

Year	Area		Production		Yield	
	Visakhapatnam	Andhra Pradesh	Visakhapatnam	Andhra Pradesh	Visakhapatnam	Andhra Pradesh
Mean	14,790	35,193	7,082	23,103	0.48	0.66
SD	6226.761541	12993.06379	3440.62201	9688.206329	0.146024144	0.178440314
CV	42.10158684	36.9190878	48.58023128	41.93438728	30.62076477	26.95350043
Adjusted R Square	0.953510321	0.56124027	0.53876705	0.023391696	-0.055369609	0.233607459
1-R Square	0.046489679	0.43875973	0.46123295	0.976608304	1.055369609	0.766392541
√ 1-R Square	0.215614653	0.66238941	0.679141333	0.988234944	1.027311836	0.875438485
CDVI	9 Low Instability	24 Medium Instability	33 High Instability	41 High Instability	31 High Instability	24 Medium Instability

Table 2 shows the instability in terms of area, production and yield level of small millets in Visakhapatnam and Andhra Pradesh. The mean yield for Visakhapatnam is 0.48 and 0.66 for Andhra Pradesh. The CV is higher in Visakhapatnam in terms of area production and yield comparing with Andhra Pradesh suggesting that there is more variation across the mean. The study found that area of small millets in Visakhapatnam is low instability with an index score 9 but the production and yield are highly instable with instability index score 33 and 31 respectively in Visakhapatnam during the period of 2000 to 2019. Whereas in

Andhra Pradesh state, the study noticed that area (24) and yield (24) of small millets is medium instable but production of small millets in state is highly instable with index score 41.

Small millets have historically been significant dietary mainstays for rural people, especially in areas with limited access to other major grains and water sources. They have been eaten in a variety of meals over the years, including whole grains, flours, porridges, and other customary fare. A healthy diet should include small millets because of their high nutritional content, which includes proteins, dietary fibre, vitamins, and minerals. However, small millets rapidly lost out to larger grains like rice and wheat in terms of demand and acreage with the introduction of green revolution technology and the promotion of high-yielding crop types (Padulosi, S., et all., 2009). The production of small millets decreased as attention switched to increasing the productivity and output of these major crops.

There are many possible reasons for the declining small millets area, production and productivity. Agriculture practises have changed over time to focus on more profitable crops like rice, maize, and cash crops. Small millets may have seen a reduction in cultivation as farmers turned their attention to these crops in response to increased demand, higher market prices, and perceived profitability (Eliazer Nelson, et al., 2019). With an increased emphasis on rice, wheat, and other cereals, consumer dietary choices have changed. Due to a shift in consumer preferences towards eating more processed goods and refined grains, small millets may have fallen out of favour (Padulosi, S., et all., 2009). Small millets must be grown using specialised agronomic techniques and in agroclimatic conditions that are suitable for the development of the crop. Farmers may be discouraged from growing small millets because of factors including the availability of water, soil quality, pest and disease control, and restricted access to better varieties and technology (Brahmachari, K., et al., 2019). Due to lower yields, a smaller market, and difficulties developing a value chain, small millets production may not be as economically viable as other crops. Crops with higher returns and better market potential may be prioritised by farmers (Tripathi, T., & Vyas, S. (2023).

The Andhra Pradesh government established the millets development programme to encourage millets farming and enhance the standard of living for small and marginal farmers. With the help of this programme, millets producers will have stronger market connections, increased production, and more land dedicated to millets cultivation. The government supports the production of millets using organic farming methods. Organic farming techniques aid in improving soil health, lowering chemical inputs, and growing chemical-free, nutrient-rich millet crops. The government offers a range of financial aid and subsidies to farmers that grow millets. These include financial support for the establishment of millet-based businesses and subsidies for the purchase of seeds, fertiliser, insecticides, and farming equipment.

Millets are renowned for their resistance to unfavourable weather circumstances, such as drought and extreme heat. Research focuses on creating millet varieties that can tolerate environmental stress and support sustainable agriculture in areas vulnerable to the effects of climate change. When compared to other crops like rice and wheat, millets use less water, fertiliser, and pesticide inputs. Research supports sustainable agricultural practises, lowers the environmental effect of agriculture, and identifies the optimum agronomic practises for millet cultivation. Growing millets can help small and marginal farmers improve their standard of living. Through the use of better farming practises, post-harvest processing, value addition, and marketing tactics, research helps farmers increase their earnings and get access to more lucrative markets.

Policy Recommendations

1. Encourage farmers to diversify their crop patterns by integrating small millets alongside major crops like rice and wheat. This diversification not only enhances food security but also mitigates risks associated with climate variability and market fluctuations.
2. Allocate funds for research and development focused on breeding high-yielding varieties of small millets that are resilient to environmental stresses such as drought and pest infestations. Additionally, research should focus on improving agronomic practices and post-harvest techniques to enhance productivity and quality.
3. Facilitate market linkages for small millet farmers by establishing procurement centers, creating marketing cooperatives, and connecting them with retailers and consumers. Furthermore, incentivize value addition activities such as processing small millets into flours, snacks, and other value-added products to increase their market appeal and profitability.
4. Provide financial and technical support to farmers practicing sustainable agriculture methods, such as organic farming and zero-budget natural farming, which can enhance soil health, reduce input costs, and improve crop resilience.

Conclusion

Overall, the study observed that the cultivation area has decreased over the years, both in Visakhapatnam and Andhra Pradesh. The production of crops in Visakhapatnam has shown fluctuations without a clear trend, while in Andhra Pradesh, it initially decreased but then increased again. The yield has also varied over the years, with both regions experiencing fluctuations, but generally, Andhra Pradesh has achieved higher yields compared to Visakhapatnam.

The growth rates and instability of the area, production, and yield of small millets in the Visakhapatnam district of the Andhra Pradesh state have been analysed in this study. This would be useful for researchers and policy makers in deciding on their agricultural policies and ensuring that such policies are effectively implemented in the various districts of the state of Andhra Pradesh. The policies can be changed and refocused in accordance with the demands and needs of the Andhra Pradesh districts' small millets stakeholders.

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