

Medicinal Crop Production in Pakistan's Agriculture: Economic Analysis, Performance and Challenges of Production of Ginger, Turmeric and Garlic

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Abstract

Ginger, garlic and turmeric are in human use due to their medicinal importance, strong healing, anti-inflammatory and antioxidant properties (due to phenolic compounds) from the ancient times. Enhancing the product quality and market expansion need crop stability and performance evaluation. This research is planned to analyses the past performance of these three specialty crops on the basis of 19 years secondary data. The efficiency of the resources in these crops is an important aspect of the current research. To determine the time of rapid growth and reduced instability, as well as the impact of coordinated research and innovative green technologies, the gathered data was divided into a few decades and studied accordingly. Cuddy-Della Valle Instability index was applied to estimate instability in relation to production area and yield. Utilizing the Cuddy-Della Valle instability index for series following a time trend and the coefficient of variation for no-time trend series, the amount of risk in area, production, and yield was calculated. Growth rate of these crops were measured using compound annual growth rate. Results indicated overall significant fluctuation in instability index and growth rate. Further regression for percentage growth rate and instability index was calculated by applying Cuddy-Della Valle index which showed positive and negative effect of growth rate and performance instability under the area and yield of this medicinal crop which indicate their stability level in this time series data.

Keywords: Garlic, Ginger, Turmeric, Growth Instability, Production Area, Pakistan.

Introduction

Agriculture is an incredible contributing factor to the GDP of Pakistan's financial system. It contributes about 18.5 % in Pakistan's GDP and two third population of country is directly and indirectly involved and depend on it for their livelihood. Growth in GDP suggests the improvement of social and economic system (Lu et al., 2022). Measuring instability and evaluation of

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performance are vital for enhancing the quality of agriculture product and continuous progress within the respective sector (Voiku & Varlamov, 2019). In this regard analysis of time series data is important to check relationship of financial output that shows to the overall available resource during that time frame and to predict the future trend (Pandey & Mookerjee, 2018). Further to check crop's profit and to determine threshold level management analysts do critical analysis of potential revenue of area and quality of yield. High return show the farmer to handle the resources efficiently and effectively on the other hand low return emphasize on the further critical analysis of all the stages of production to harvest to identify the gaps (Ali, 2019; FAO, 2021; Saad et al., 2010).

Current, severe climate changes, Covid -19, and other economic instability factor effect most of the world which leads to reduce in agriculture production. It is emphasizing the need to do above discuss, performance analysis of major and minor crops (Zaman et al., 2021). Previously research has been done on major crops (Alam et al., 2017) while ignoring of analysis performance of important medicinal and high return aromatic plants. Present paper did critical review on how we can increase the production efficient of ginger, turmeric, garlic at scale, so that the producer can make stable decision. The minor crops can enhance the economic stability and sustainability (Dumitrache & Rotaru, 2022; Humphries & Knowles, 1998). It's always the micro level that will provide a base to macro sustainability and the minor crops could play a very important role in GDP and as we have discussed above their part in GDP it is important to work efficiently (Brown, 2012; GoP, 2022; Santhosh, 2018; Voiku & Varlamov, 2019).

Garlic (*Allium sativum*, family Amaryllidaceae), ginger (family Zingiberaceae) and turmeric (family Zingiberaceae) (As, 2008; Campbell, 2003; Voiku & Varlamov, 2019) are among ancient plants that have been used for medicinal purpose and as a food source (Fallahiarezoudar et al., 2022; Yurievna, 2022). Currently in Pakistan these are grown as minor crops and mostly cultivated in Kasur, Okara, Lahore, and Sialkot districts in Punjab, Bannu and Haripur areas in Khyber Pakhtunkhwa, and Mirpurkhas and Sanghar districts in Sindh areas. Pakistan, regardless of being a modest ginger, garlic and turmeric producer, maintains to export and import to neighboring countries (FAO, 2021; Nandy, 2022).

Table 1: Crop overview of ginger, turmeric and garlic

Segments	Ginger	Turmeric	Garlic
Market value	Export : 111945 tons Import :55 tons	Export: 227 tons Import: 102 tons	Export :1,708 Import : 67,315
Pakistan major producing area	Punjab :40% Khyber Pakhtunkhwa:80%	Punjab province: 72% Kasur district: 80% of the country's production. Banu:12% Others :16%	Khyber Pakhtunkhwa=32,205 tonnes Punjab (24,143 tonnes), Balochistan (7,880 tonnes) and Sindh (6,557 tonnes).
Major producing countries	United States, China, Vietnam, Thailand, Bangladesh, the United Arab Emirates, and U.K	India, Pakistan, Bangladesh, Sri Lanka, Taiwan, China, Burma and Indonesia. Caribbean and U.S.A.	India, China, Bangladesh and Pakistan, Korea, Malaysia ,U.S.A, Spain.

Hypothesis

This article evaluates the production of crops in the country including per year yield and production in tons and estimate the performance analysis of ginger, turmeric and garlic.

(H₀): Medicinal plant (garlic, ginger, and turmeric) have a significant result of instability on performance.

(H₁): Medicinal plant (garlic, ginger, and turmeric) have an insignificant result of instability on performance.

(H₂): The growth rate of food crops medicinal plant (garlic, ginger, and turmeric) are partially positive and partially negative effect.

(H₃): The growth rates of medicinal plant (garlic, ginger, and turmeric) are neutral.

Material and Methods

Present study focused on medicinal plant (garlic, ginger, and turmeric) of Pakistan, follows the two steps which are associated directly to performance analysis of above mentioned crops.

Data Source

Data were collected from published literature further more area and yield data was collected from the Food and Agricultural Organization (Campbell, 2003; Voiku & Varlamov, 2019) statistics, and portals of indexmundi, to carry out this study. To present study includes the importance of efficiency of the resources in these crops. The obtained data were divided into a few decades and analyzed accordingly to determine the phase with high growth and reduced volatility, as well as the impact of coordinated research and green revolution technologies (Cuddy & Valle, 1978; Wardhono et al., 2022).

Research Analysis

To analyze this, excel has been used to run the trend analysis in order to study the yield in each 20 years. It has been proved really helpful to study the impact of these crops on the agriculture sector and economic situation of the country. The trend analysis that has been drawn is helping to understand the growth rate and performance instability of these crops (Alam et al., 2017; Backus et al., 2001; Lu et al., 2022). The data has also proved helpful in telling the contribution of these crops (turmeric, garlic, ginger) in the economy of Pakistan (Dumitrache & Rotaru, 2022).

Compound Annual Growth Rate (CAGR)

To estimate the growth in area, production, and performance, the following standard expression is used: $Y_t = Y_{t-1} (1+r)_t$. The variable for which growth is being calculated is Y_t , and the compound growth rate is r . The CAGR can be calculated using the Ordinary Least Square (OLS) method, and it is expressed as a percentage (Campbell, 2003; FAO, 2021).

Performance Instability (Cuddy-Della Valle Index)

If the absolute dispersion is defined as the standard deviation, and the average is the mean, the relative dispersion is called the coefficient of variation (CV) or coefficient of dispersion. Instability in area, production, and yield was estimated to examine the extent of risk in those variables using the coefficient of variation for no-time trend series and Cuddy-Della Valle instability index for the series following a time trend. The Cuddy-Della Valle Index (Murgai, 2001, Cuddy & Valle, 1978) was computed as

$$I = CV * (1 - \text{adj}R^2)^{1/2} \dots \dots \dots \text{eq 1}$$

Where, CD=Cuddy-Della Valle Index, CV=Coefficient of variation (%) (Abdi, 2010; Alam et al., 2017) and is equal to standard deviation/average. $AdjR^2$ = (adjusted R-square) is the coefficient of determination from time trend regression analysis (Brown, 1998; Cuddy & Valle, 1978; Ittner, 1999; Shah et al., 2022).

Table 2: Overall growth rate in selected crops area and yield (2001-2019)

Crop	Period	Growth rate%		Instability Index%	
		Area	Yield	Area	Yield
Ginger	2001-10	2.182	13.190	7.46	29.56
	2011-19	4.539	-12.014	12.23	68.03
Garlic	2001-10	-0.061	0.694	2.29	8.79
	2011-19	1.373	3.360	1.41	3.60
Turmeric	2001-10	0.646	-1.248	3.84	3.56
	2011-19	2.656	1.769	4.58	7.39

Figure 1: Growth rate

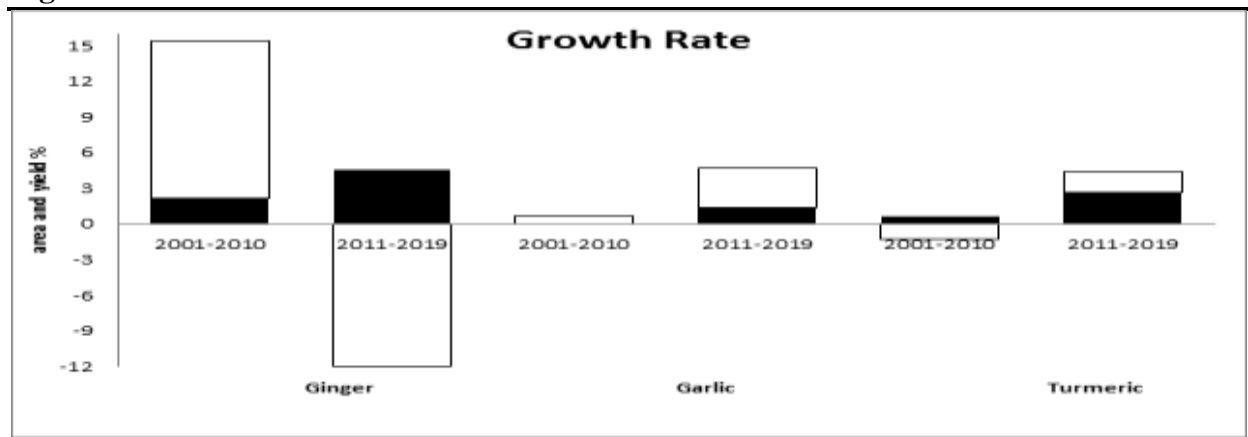
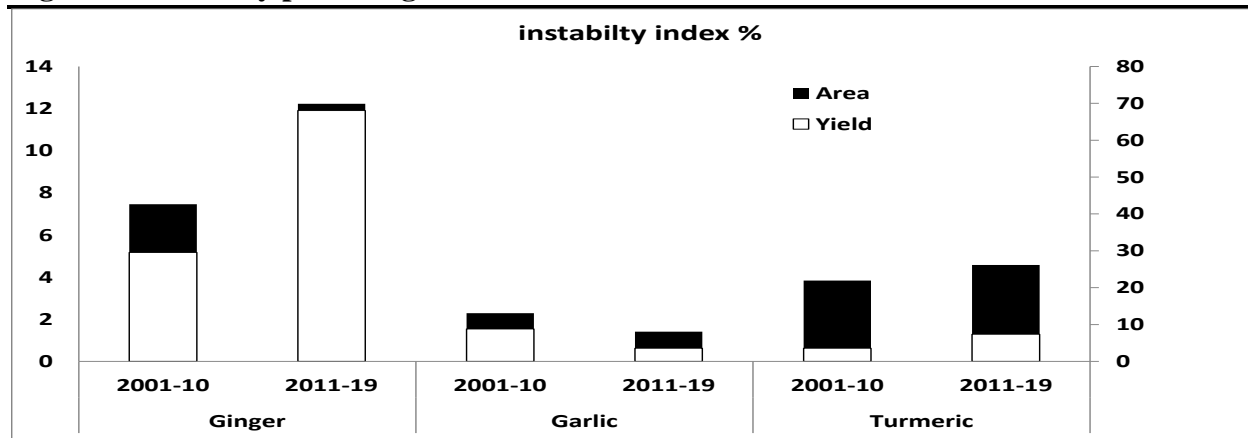


Figure 2 Instability percentage



Results and Discussion

Area under ginger production increased in Pakistan more rapidly from 2001 to 2016 but it started to decline (figure 4), that's why its show the falloff in growth rate. From 2010 decade the growth rate in area was 2.182 (table 2), the growth rate increase by 4.5% (table 2), while the instability index was increase from 7.46 to 12.23% (table 2), respectively (figure 1 and 2), the yield of ginger was growing was increasing rapidly from above 13% (table 2), from the decade while in second decade it's become negative. Similarly the instability index of yield was very high as it was 29% in 1st decade while 68% (table 2) in second which mean it's highly unstable. As per data of FAO STAT, the China is leading with the highest yield of China, 2nd to India while Pakistan is showing the potential to increase its demand because its potential to grow is high but having instability in performance (FAO, 2021; GOP, 2018-2019).

Area trend shown (figure 1 and 2) of 1st decade of garlic is decline, -0.061%, while in second decade its show positive growth rate with 1.373 with decline in instability 1.41%, similarly the yield instability from 2001 to 2010 was high at 8.79%, while in second decade its instability start decreasing to 3.60%, which show the positive potential performance stability. Accordingly Pakistan trending to highest garlic yield after China in comparison to India and Bangladesh. (Arifullah et al., 2009; As, 2008; Weerasooriya & De Silva, 2014).

Turmeric is shown (figure 1 and 2) positive increase rate in area within two decade, with the percentage of 0.646 % to 2.656 %, (table 2) similarly the yield of turmeric show the positive increase 1.769 % (figure 1 and 2). But the instability index show the high instability up to 7.39 % in second decade which indicate the low stability, as the yield have shown the increasing trend so its indicate the positive potential to cultivate turmeric.

Table 3: Overall growth rate and instability in selected crops area and yield (2001-2019)

Crop	Growth rate%		Instability Index%	
	Area	Yield	Area	Yield
Ginger	-0.05	1.487	59.71	11.86
Garlic	0.745	0.821	8.18	2.90
Turmeric	2.398	2.106	10.49	5.51

According to the table 3, the overall growth rate of ginger area is -0.05%, with the high instability of 11.86% which means of lowest stability. The growth rate of garlic area is 0.745 with the yield instability rate is 2.90% which show the low instability, mean highest stability performance. Turmeric show the growth rate of 2.398%, with the instability of yield 5.51 % (table 3) which eventually consider as high, so the performance stability of turmeric is low. These are the high potential crops, which are used for medical purpose as well as domestic. Productivity of these crops should be enhancing to maintain positive performance stability (FAO, 2021; GOP, 2018-2019; Zaman et al., 2021).

Hypothesis

(H₀): Medicinal plant (garlic, ginger, and turmeric) have a significant result of instability on performance.

(H₁): Medicinal plant (garlic, ginger, and turmeric) have an insignificant result of instability on performance.

(H₂): The growth rate of Medicinal plant (garlic, ginger, and turmeric) is partially positive and partially negative effect.

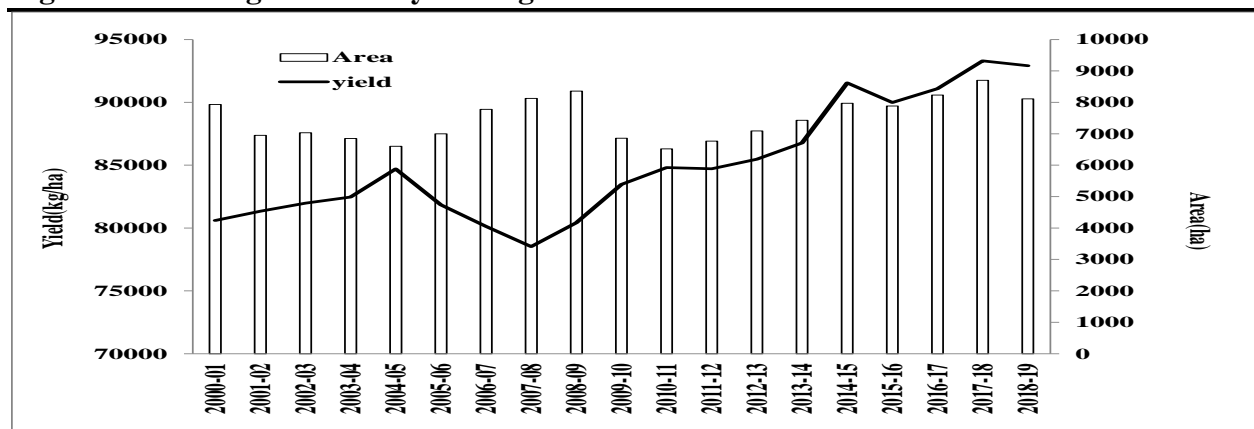
(H₃): The growth rates of Medicinal plant (garlic, ginger, and turmeric) are neutral.

As per our hypothesis we will accept the H₀ because the stability of garlic is positive, turmeric have a potentially stabile, while turmeric shown a slightly decline effects. So we will reject H₁ and accept H₀. According to the growth rate the H₂ is accepted according to the table 3 which indicate the growth rate is partially positive and partially negative effect. It suggested to accept H₂ and reject H₃.

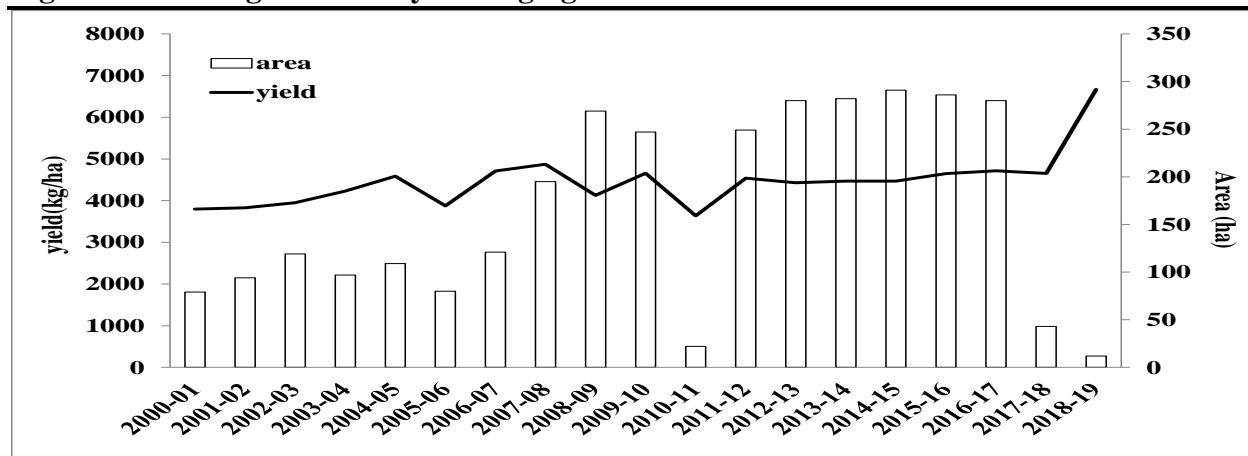
Discussion

This article includes the importance of efficiency of the resources in the agriculture business especially in the field of pharmaceutical industry. Present study suggested how, farmer should operate in the given area and how he should produce efficiently so that he can minimize his actual cost and maximize profit. It has been also seen how optimal combinations can be made to improve the economy of Pakistan. Three main plants: turmeric, garlic and ginger were selected to discuss trend and efficiency analysis. Previous nineteen years data of following variables i.e., area, and yield was collected through FAO (2021) and National Food Safety Research Bureau (2022). To understand the growth rate and instability index of the economy data collected for trend analysis by using excel which further indicate the stability trend.

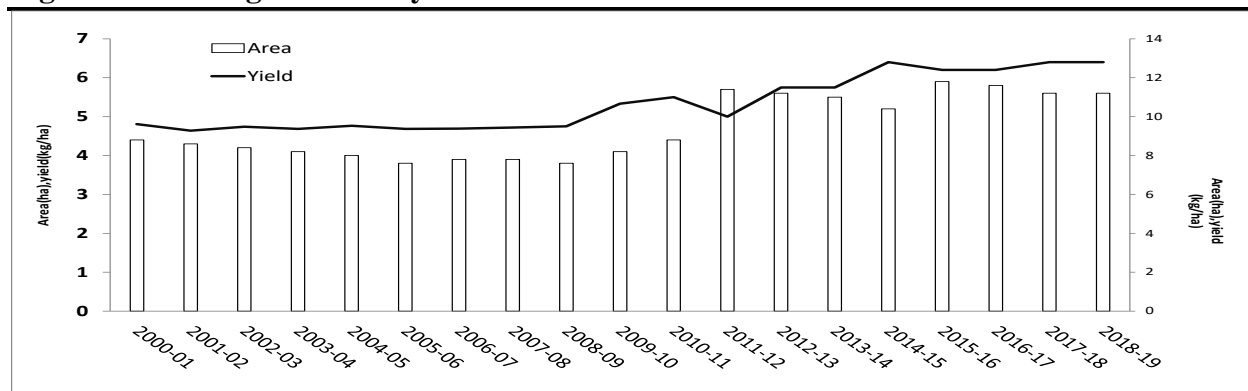
Figure 3: Showing trend analysis for garlic



Trend analysis for garlic shown in (figure 3), in 2000 production of garlic was 63.9 tons but further decline in production was observed on yearly basis, further data showed increasing trend from 2002 to 2006. Prominent peak observed at 2006 and then in 2019. Presented data showed that in recent past production increased and it also reduced the economic gap as well (FAO, 2021). Producers felt more profit in it and they increased their production. It means that combinations or cost structure taken by the labor was worthy and with a slight change it changes the production that was lost gained again.

Figure 4: Showing trend analysis for ginger

The trend analysis of ginger exhibited that production of ginger (figure 4) has increased till 2010 but in 2011 it showed decreasing trend and after it indicated increasing trend from 2012 till 2017 but again in 2018 the production starts falling. Moreover latest report shows that the production of ginger was 100 tons in 2019, it has been seen that in past 20 years the production gap has been reduced with the positive trend (FAO, 2021).

Figure 5: Showing trend analysis for turmeric

The trend analysis for turmeric shown in figure 5. In 2000 production of turmeric was 42.3 tons but right after decline was observed till 2005, after it slight increase in production was observed from 2009 i.e. 43.7 tons and from onward 2009 to 2016 sharp surge in production was noted. In 2018 and 2019 the production fluctuate, it has been observed that in the past 20 years the production gap has been reduced with positive trend (GOP, 2018-2019; Shah et al., 2022). Fluctuation in production has been observed but overall trend showed good production in lateral years compare to 1990s, moreover better results can be obtained by adopting more accuracy (FAO, 2021; GoP, 2022).

Challenges and Opportunities of Various Crops

Present study pointed that main constraints in production of these minor crop are restricted crops, production level, marketing and processing level constraints due to which the production can get affected (Backus et al., 2001; Campbell, 2003; Fallahiarezoudar et al., 2022). It is further also

identify the gaps and emphases or enhancing production potential, current demand, and marketing potential, and specification of these particulars allow the farmer to produce better yield measurement to maximize the production (Dumitrache & Rotaru, 2022). There high demand in domestic and pharmaceutical industry provides an excellent opportunity for these crops to have a market competition and future high profit trending demand (Shahrajabian et al., 2022).

Conclusion

It has been proved really helpful to study the impact of these plants on the agriculture sector and economic situation of the country. The trend analysis that has been drawn is helping to understand the growth rate and instability index of the economy. The ginger area's overall growth rate is -0.05%, and its high instability of 11.86% indicates its lowest stability. The yield instability rate is 2.90% and the growth rate of the garlic area is 0.745, indicating low instability and the greatest mean stability performance. Turmeric has a 2.398% growth rate and a yield instability of 5.51% . As a result, turmeric's performance stability is low. These are the very promising crops that are utilized both domestically and medicinally. Enhancing agricultural productivity is necessary for preserving good economic stability. Pakistan can make their economy sustainable and can create a boom if the producer knows how to use the resources efficiently and it can be done through performance analyses. This trend analysis allows the producer to understand where they stand and how much of the potential they still need to put in their crop. We can describe efficiency and stability analysis which allow you to understand the optimal level. This is a model that associates with performance management with strategic development and evaluation of these minor crops. Therefore, it was concluded that researchers have to create strategic resource management knowledge to promote these minor crop as they play a vital role in the pharm industry as well as to create a profile amount for Pakistan.

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