

INTERDECADAL GROWTH VARIABILITY AND DECOMPOSITION ANALYSIS OF FRUIT CROPS IN PUNJAB, PAKISTAN

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ABSTRACT:- Horticulture has a well realized role in providing essential major and micro nutrients in the diets of people in Pakistan. The study examines the trends and variation of area, production and yield of fruit crops in Punjab province from 1971 to 2014. The growth trend of fruits' production in the province showed positive behavior for major fruits (citrus, mango and guava) in almost all the decades, except for mango in 1970s and guava in 2000s. The decline in production of mango in 1970s was due to negative growth in both area and yield. While, a slowdown growth in the area and decrease in yield were reasons of decline in production of guava in 2000s. Growth in production of minor fruits showed a cyclical trend i.e., increased and decreased in alternate decades. Results of Cuddy-Della Valle Index showed that variations in production of major fruits decreased over time (from 1970s to 1990s); however, variability in their production escalated and reached to the highest levels for citrus and mango again in 2000s. While, variations in guava production were the highest in 1970s followed by 1980s. On the basis of growth rate data these can be attributed to expansion in area to a great extent and partially to productivity improvement. Variations in production of minor fruits increased overtime (from 1970s to 1990s) and then declined in 2000s. During the study period, fruit production varied due to area, though productivity altered considerably. The results of decomposition analysis indicated a relatively stronger stimulus of area expansion in production of citrus. While yield affect remained dominant in production of mango, guava and minor fruits across decades as well as during the study period. Chances of expansion in area of fruit crops are limited due to constraint of availability of agricultural land. Thus, to keep healthy growth in fruits' production, improvements in yield levels of fruits crop are required.

Key Words: Cuddy-Della Valle Index; Fruit Crops; Variability; Decomposition Analysis; Pakistan.

INTRODUCTION

In developing countries like Pakistan, fruits are having important position in human nutrition, and fruit production helps to improve the

social and economic status of rural people. Furthermore, labour intensive nature of fruit farming helps to accommodate ample labor force in developing countries (Wasim, 2011). Overtime, agricultural sector has

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developed in terms of technologies and irrigation infrastructure. Regardless of such improvement, horticulture sub-sector is still facing seasonal variations in growth which adversely affect the farmers' living and disturb their saving behavior. Therefore, these fluctuations are posing big challenges for the agriculture sector (Ali and Jabbar, 2015). Sustainable growth in agriculture sector is possible by achieving high production growth with low level of instability.

Technological development is considered as an important reason for increasing fluctuations in agricultural production. A connection between agricultural production growth and latest technology was first observed by Sen (1967). He stated that high variability in agricultural production occurs due to expansion of marginal lands by using inputs intensively. Similarly, empirical work done by McIntire and Fussell (1985) explained that modern technology is a cause of low variability in production of wheat in 57 countries. Singh and Byerlee (1990) also coded few research studies in favor of adoption of modern technology in agricultural production. Variability in production of major fruits in Balochistan and Khyber Pakhtunkhwa, provinces of Pakistan have increased due to adoption of modern technology; shifting focus from area expansion to adoption of high yielding varieties and extensive use of improved inputs e.g. planting material and fertilizers etc. (Wasim, 2011; Ali and Jabbar 2015).

Growth is a key factor for the achievement of development in agriculture. According to Singh (1981) yield and area are extremely impor-

tant factors in agricultural growth, while Ranade (1980) stated that investment in agricultural activities helps to boost the growth. Along trend and variability, decomposition analysis has remarkable significance for researchers and policy makers. These help them in understanding nature and reasons of fluctuations in production of fruit crops and enable them to appropriate measures for steady growth of the sub-sector.

In Pakistan, Punjab is the largest fruit producing province, it contributes 62% (3968.4 th t) of total annual production, followed by Balochistan 17% (944.3 th t), Sindh 15% (1091.5 th t) and Khyber Pakhtunkhwa 7% (419.7 th t). The Punjab province contributes more than 95% in citrus production and 75% each in guava and mango production. Therefore, citrus, mango and guava are considered as major fruits of the province and all other fruits viz., banana, apple, apricot, peach, pear, plum, grapes, pomegranates, dates and almonds are regarded as minor fruits. To investigate the growth, variation in the growth and factors responsible for the growth in production of fruits crop during 1971 to 2014 were ascertained. The study has been undertaken to analyze the growth trend of area, production and yield of fruits crop in Punjab; examine the variation in area, productivity and production of fruits crop; and to determine contribution of sources of output growth in fruits' production.

MATERIALS AND METHOD

The present study is based on secondary data of area, production

and yield of citrus, mango, guava and minor fruits of Punjab from 1971 to 2014. Data has been taken from Pakistan Economic Surveys and various issues of Agricultural Statistics of Pakistan. Growth rate, variability and decomposition analysis are carried out by decade (1971-80, 1981-1990, 1991-2000 & 2001-2010) and for the study period during 1971-2014. Growth of fruit crops measured by using the following equation.

$$\text{Log}(X_t) = \beta + \gamma.t \quad (1)$$

where,

X_t = Area, production and yield of fruits crops

β = Constant term

γ = Parameter/slope of variable or growth rate of interest variable

t = time

Cuddy-Della Valle Index (CDVI) is used to measure the variation in fruit crop with respect to area, production and productivity. Kathale et al. (2015), Chatterjee (2014) Sitarambabu and Paul. (2014), Bairwa et al. (2012) also used CDVI to determine instability in production of gram, pulses, groundnut and fruit crop in India, respectively. While in Pakistan, Ali and Jabbar (2015), Rani et al. (2012) and Wasim (2007, 2011) applied CDVI in their research works.

$$\text{CDVI} = C.V*(1-R^2) \quad (2)$$

where,

CDVI = Cuddy Della-Valle Index

C.V = Standard deviation/mean *100

R^2 = Coefficient of determination,

obtained from time trend regression equation (1)

In agriculture, mostly growth is defined by the increase in agricultural production over time. Three factors account for the increase in total production of agricultural output: (a) increase in total area under various crops (b) increase in the yield of various crops and (c) crop diversification, but area and productivity are considered more important. Thus, to measure the relative contribution of area and yield to total output change for individual crop, component analysis model as given by equation 3 is used. In this model, the total change in production is decomposed into three effects, viz. area effect, yield effect and the interaction effect due to changes in yield and area. Most of the researchers used this technique to check the growth performance in agricultural production; like Dhakre and Bhattacharya (2013) and Bairwa et al. (2012) used the analysis to check the growth performance of vegetable cultivation and fruit crops in India, respectively. Rehman et al. (2011) also employed component analysis technique to analyze production of the agricultural crops in Pakistan.

$$\Delta P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y \quad (3)$$

where,

ΔP = Change in production

A_0 = Area in base year

ΔY = Change in yield

Y_0 = Yield in base year

ΔA = Change in area

RESULTS AND DISCUSSION

Area, Production and Productivity Growth in Fruit Crops

Major production grew positively in most of the decade, except of mango in 1970s and guava in 2000s (Table 1). The decline in production of mango in 1970s was due to negative growths both in area and yield. While a slowdown in growth in area and decrease in yield were reasons of decline in production of guava in 2000s. Mango ranked second by volume of production after citrus in the province, its production exhibited an increasing trend after 1970s due to continuous area expansion and improvement in productivity. Mango production growth reached at its peak (10.94% per annum) during 2000s. Over the study period (1970-2014) production of major fruits

(citrus, mango and guava) improved primarily due to continuous expansions in area under production. Growth in production of minor fruits showed a cyclical trend; increased in 1970s and 1990s and declined in 1980s and 2000s (Table 1). The declines in production of minor fruits in 1980s and 2000s were due to contractions in area under minor fruits i.e., growth in area was negative. Over the study period (1970-2014) production of minor fruits increased mainly due to productivity improvement.

Decade wise evaluation of growth performance of major fruits showed that it was relatively low in 1990s as compared to earlier decades. Same growth behavior has been noticed in area, although productivity of major fruits also improved to some extent in 1990s and 2000s. Main reason of contraction in the area of fruit crops

Table 1. Growth rate of area, production and yield of fruit crop in Punjab

(%)

Fruits	Performance Indicators	Decades/Time Period				
		1971-80	1981-90	1991-00	2001-10	1970-2014
Citrus	Area	8.93	4.89	1.60	0.70	3.50
	Yield	2.71	-1.21	0.72	1.60	0.13
	Production	6.87	3.78	2.22	2.80	3.40
Mango	Area	-0.22	4.92	0.50	0.74	3.93
	Yield	-2.21	-2.29	1.35	-0.63	0.02
	Production	-2.68	2.63	2.09	10.94	3.96
Guava	Area	6.70	6.36	2.30	1.90	4.20
	Yield	0.91	0.37	1.39	-0.90	0.79
	Production	5.00	6.40	3.36	-1.70	4.64
Minor Fruits	Area	2.45	-4.42	6.20	-4.60	0.06
	Yield	0.90	1.05	8.33	1.50	3.10
	Production	3.25	-3.38	14.52	-3.20	3.00

Note: Minor fruits include banana, apple, apricot, peach, pear, plum, grapes, pomegranates, dates and almonds.
Source: GoP, 2014

was Structural Adjustment Program (SAP) introduced by the IMF for Pakistan in 1988, through which subsidies from agricultural inputs viz., seed, pesticides and machinery were withdrawn. Study results are consistent with those of Wasim (2011), Ali and Jabbar (2015). Production growth patterns of citrus, mango, guava and minor fruits remained positive during the period (1970-2014). Data showed that production of citrus, mango and guava increased mainly due to area expansion, while improvement in production of minor fruits was primarily due to yield growth (Table 1).

Variability in Production of Fruit Crops

Variability plays a significant role in sustainable supply of agricultural products. Thus, lower variability lea-

ds to more sustainable agricultural production. In Punjab province, variability in production of major fruits has decreased from 1970s up to 1990s; however, exhibited an upward trend in 2000s (Table 2). Among selected fruits, variability in production in 2000s was the highest in mango (18.64) followed by citrus, minor fruits and guava. Almost, similar trend has also been observed in area variation; whereas, in productivity highest variability was in citrus followed by guava, mango and minor fruits. During the entire study period (1971-2014) area under fruit crops varied more as compared to productivity. Highest variability occurred in production of minor fruits, followed by guava, mango and citrus. Production of fruits varied mainly due to changes in area, though productivity also varied considerably.

Table 2. Instability index of fruit crops in Punjab

(No.)

Fruit	Performance Indicator	Decades/Time period				
		1971-80	1981-90	1991-00	2001-10	1970-2014
Citrus	Area	7.86	3.43	2.06	3.45	19.43
	Yield	10.68	2.17	4.52	14.56	10.05
	Production	10.6	4.79	6.33	15.09	18.59
Mango	Area	8.94	3.87	2.17	18.00	19.42
	Yield	11.01	3.80	4.69	3.66	9.69
	Production	7.54	5.50	4.90	18.64	21.20
Guava	Area	16.62	13.22	2.09	1.26	24.29
	Yield	8.75	1.78	1.21	4.12	9.53
	Production	13.26	11.90	2.07	4.04	23.78
Minor Fruits	Area	11.30	21.72	7.28	7.24	23.02
	Yield	5.89	16.73	14.65	2.31	18.07
	Production	10.52	14.91	19.71	8.48	29.57

Source: Authors' calculation

Decomposition of Growth Production of Fruit Crops

Relatively stronger stimulus of area expansion has been noticed in production of citrus (Table 3).

While yield effect remained dominant in production of mango, guava and minor fruits across study decades as well as during the study period. This implies that both area expansion and yield improvement contributed to the production of fruits in the province during study period. In citrus area affect remained dominant over yield till 1980s, thereafter a shift in yield impact occurred. In mango yield impact gained dominance in 1980s and same situation continued in later decades. In guava area impact was prevalent till 1990s; thereafter, yield impact gained dominance. In minor

fruits yield impact was prevalent in 1970s, then in 1980s area impact became dominant but lost to yield impact in later decades. Interaction affect of area and yield also varied overtime; however, did not change much as compared to individual affects of area and yield.

CONCLUSION AND RECOMMENDATIONS

Fruits production has grown positively overtime in the province. Production variations in major fruits have decreased with the passage of time; escalated again in the decade of 2000s. On the contrary, variation in production of minor fruits increased initially, declined in the last decade. Production of fruits varied mainly due

Table 3. Decomposition analysis of major fruits production in Punjab by decade

Fruits	Effect	Period (%)				
		1970s	1980s	1990s	2000s	Overall
Citrus	Area	240.01	87.29	47.41	4.36	87.10
	Yield	-115.40	12.90	52.13	95.27	18.40
	Interaction	-24.61	-0.19	0.46	0.37	-5.50
Mango	Area	44.90	26.04	108.20	19.50	0.14
	Yield	44.51	69.15	216.07	77.96	97.59
	Interaction	10.59	4.81	7.88	2.55	2.27
Guava	Area	354.14	49.40	65.63	16.53	-177.35
	Yield	-224.47	49.30	33.99	83.59	458.44
	Interaction	-29.67	1.36	0.38	-0.12	-180.81
Other Fruits	Area	44.36	83.77	44.31	238.91	-6.41
	Yield	65.13	11.43	4.84	352.52	110.06
	Interaction	-9.49	4.81	0.85	13.62	-3.64

Source: Authors' calculation

to changes in area, though productivity also altered considerably. Production of major and minor fruits except citrus, increased due to yield improvements which means that future increase in production will also depend on productivity enhancement; though, area expansion is also possible to some extent by sparing excess area from cereal crops in wake of low international prices and bringing it under fruit crops. Further more, productivity can be enhanced by developing true to type nurseries of high yielding fruit varieties, management of fruit orchards on scientific lines and by building capacity of farmers in pre and post harvest management of losses in fruits production. Agricultural extension department and community support organizations can play an instrumental role by establishing fruit plant nurseries, organizing farmers' field days and trainings in orchard management and pre & post harvest management of production losses. Moreover, productivity of fruit crops can also be enhanced by teaching farmers scientific management of fruit orchards through effective utilization of various modes of communication, especially electronic and print media.

LITERATURE CITED

- Ali, S. and A. Jabbar. 2015. Growth and variability in area production and yield of selected fruit crops in Khyber Pakhtunkhwa. *Pakistan J. Agric. Res.* 28 (1): 64-69.
- Bairwa, K.C., R. Sharma and T. Kumar. 2012. Economics of growth and instability: Fruit crops of India. *Raj. J. Ext. Edu.* 20:128-132.
- Dhakre, D.S. and D. Bhattacharya. 2013. Growth and instability analysis of vegetables in West Bengal, India. *Inte. J. Bio. Str. Man.* 4(3): 456-459.
- Chatterjee, S., R. Nath, Jui Ray, M. Ray, S.K. Gunri and P. Bandopadhyay. 2014. A decadal analysis of pulse production in major states of India. *J. of Food Legum.* 27(2): 56-6.
- GoP. 2014. Pakistan Economic Survey 2013-14, Finance Division, Economic Advisor's Wing, Government of Pakistan, Islamabad.
- Kathale, S. D., N.V. Shende and R. R. Meshram. 2015. Growth and instability of gram crop in Nagpur Division. *Social Res. Found.: Remarking Multi-disciplinary Intern. J.* 2 (4):12-15.
- McIntire, J. and L.K. Fussell. 1985. Sources of millet gram yield variation and their research implications. Paper presented at the IFPR /DSE workshop on Sources of Increased Variability in Cereal Yields. Feldafing, Germany. p. 26-29.
- Ranade, C.G. 1980. Impact of cropping pattern on agricultural production. *Indian J. Agric. Econ.* 35 (2):85-92.
- Rani, S., H. Shah, A. Ali and B. Rehman. 2012. Growth, instability and price flexibility of major pulses in Pakistan, *Asian J. Agric. Res. Dev.* 2 (2):107-112.
- Rehman, F., I. Saeed and A. Salam. 2011. Estimating growth rates and decomposition analysis of agriculture production in Pakistan: Pre and post sap analysis. *Sarhad J. Agric.* 27 (1):125-131
- Sen, S.R. 1967. Growth and instability in Indian agriculture.

- Address to the 20th Annual Conference of the Indian Society of Agricultural Statistics. Waltair, India, January. p. 1-31
- Singh, A. and D. Byerlee. 1990. Relative variability in wheat yields across countries and over time. *J. Agric. Econ.* 41(1):21-32.
- Singh, D.V. 1981. A component analysis and value productivity growth of important crops in Himachal Pradesh. *Agric. Situation in India.* 36(6):479-484.
- Sitarambabu., V. C. N. A. and S. Raju Paul. K. 2014. Trends, growth and variability of Bengal Gram in Andhra Pradesh. *Inte. J. Dev. Res.* 4 (12): 2560-2562.
- Wasim, M.P. 2007. Issues, growth and instability of inland fish production in Sindh (Pakistan) Spatial – Temporal analysis. *Pakistan Economic and Social Review* .45 (2): 203-230
- Wasim, M. P. 2011. Trends, growth and variability of major fruit crops in Balochistan-Pakistan. *J. Agric. Bio. Sci.* 6 (12): 27-36.

AUTHORSHIP AND CONTRIBUTION DECLARATION

S.No.	Author Name	Contribution to the paper
1.	Ms. Mubbashira Nazir	Conceived the idea, Wrote abstract, Methodology, Results and Discussion
2.	Ms. Saira Batool	Data collection, Data entry in SPSS and analysis
3.	Dr. Abid Hussain	Wrote abstract, Methodology, Conclusion, Technical input at every step
4.	Mr. Sultan Ali Tariq	Overall management of the article, Data entry in SPSS and analysis
5.	Ms. Ya Skina	Data collection, Introduction, References

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