National Journal of Multidisciplinary Research and Development
ISSN: 2455-9040
Impact Factor: RJIF 5.22
www.nationaljournals.com
Volume 3; Issue 1; January 2018; Page No. 164-169

Production trends and spatio-temporal characteristics of walnut cultivation in Jammu and Kashmir state

Atiqullah Malik, Imtiyaz A Malik, Feroz A Wani
Ph.D. Research Scholars (Geography), CCAS, University of Kashmir, Srinagar, Jammu and Kashmir, India

Abstract
Jammu and Kashmir is a Himalayan state, located in the northern part of the Indian subcontinent. The state is divided into three regions, viz., Jammu, Kashmir and Ladakh, representing varied agro-climatic zones, thus producing diversified crops and fruits of various kinds. The diversity in agro-climatic variations and the existence of temperate, sub-tropical and cold arid zones offers good scope for cultivation of various crops and a variety of temperate fruits like apple, apricot, almond, walnut etc. Over the years, horticulture emerged as an important sub sector of agriculture, and the farmers are now diversifying to cash crops like fruits, vegetables and flowers, as a result of this the area under fruits in the State has increased from 25.83 thousand hectares in 2004-05 to 33.85 thousand hectares in 2016-17 showing almost 31% increase in the area under walnut cultivation. Jammu and Kashmir State is well known for its dry fruits especially walnuts and almond, not only in India but the world over. The aim of the present paper is to analyze the trends in walnut production and area from 2004-05 to 2016-17 in the state of Jammu and Kashmir.

Keywords: agro-climatic, dry fruits, indigenous, production, trend, economy

Introduction

The state of Jammu and Kashmir is located in the northern part of the Indian sub-subcontinent and extends between 32˚ 17' to 37˚ 6' North latitudes and 73˚ 26' to 80˚ 30' East longitudes (Fig. 1) covering a total geographical area of 222,236 sq. km (Hussain, 2000). The state falls in the great North-western complex of the Himalayan Mountain Ranges with marked relief variations, snow-capped summits, antecedent drainage, complex geological structure and rich temperate flora and fauna. The state is bounded on the North by Chinese Republic, on the East by Tibet, on the south by Indian state of Punjab and on the West by Pakistan. The state is located in the middle of three climatic regimes of Asia. In its southern border lies the weak monsoon zone of Punjab, on the north the vast Arid Plateau of Tibet while the Northwest border areas face the Eastern limits of Mediterranean climatic region (Ahmad *et al*., 2017) [1].

Due to favourable agro-climatic conditions Horticulture sector has emerged as an important sector of the state economy. Dry fruits from the state fetch a very good return and have various multifaceted benefits for health. Walnut is one of the important dry fruits grown in the state and about 90 percent of walnut production of India comes from Jammu and Kashmir (Mir *et al*., 2016). Locally known as Doon or Dun, walnut is indigenous to Kashmir. It is grown mostly in Kashmir region with a lesser area under the crop in Jammu region. Total walnut production of the state in 2016-17 was 266280 metric tons (MT). Anantnag with a production of 41763 MT is the leading walnut producing district of the state followed by Kupwara (37423 MT), and Kulgam (25159 MT). In Jammu region, Doda district with 22548 MT is the major contributor to walnut production followed by Poonch (14500 MT) and Kishtwar (12000 MT). However, during the same time period, Kulgam district recorded highest walnut productivity with an average of 4.37 MT per Hectare followed by Kupwara (4.26 MT/Ha) and Shopian (3.94). Similarly, in Jammu division Kathua district tops in the list with 3.49 MT per Hectare, followed by Doda (3.48 MT/Ha) and Kishtwar (2.58 MT/Ha).

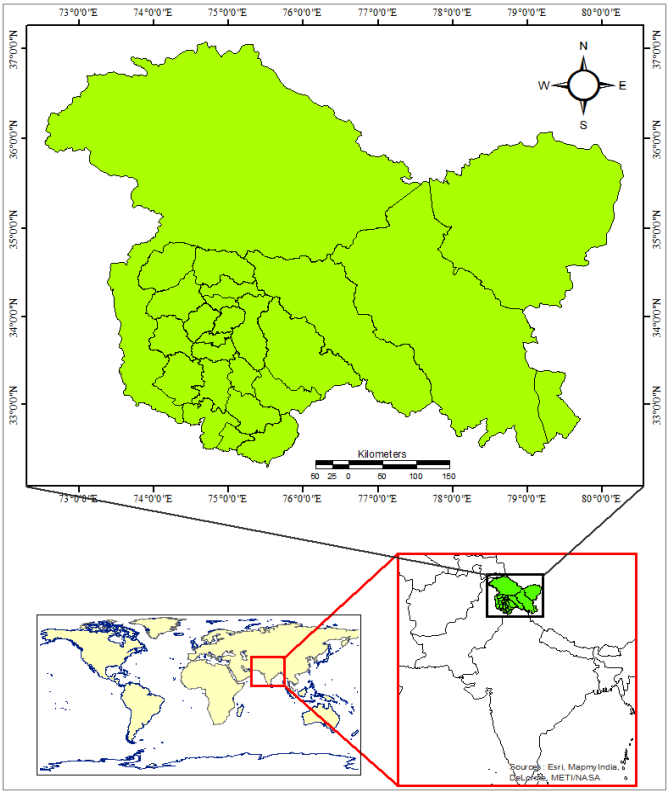

Fig 1: Location Map of Jammu and Kashmir State

Materials and Methods

The present study has been carried out by using secondary data. The secondary data on area under cultivation and

production of walnut fruit crop for a period of 13 years from 2004-05 to 2016-17 was obtained from the publications of Govt. of J&K, the main sources of which include Digest of Statistics, published by the Directorate of Economics and Statistics, Economic Surveys of Govt. of J&K, Directorate of Horticulture, Rajbagh Kashmir, J&K Government, and Department of Agriculture Cooperation and Farmers Welfare, Govt. of India. The data has been analysed and interpreted through tabulation and simple percentage methods. To study the trends in walnut production and area under cultivation, Linear Regression Model has been applied. ArcGis 10.2 was also used to create maps of the basis of data.

Linear Regression Model: Growth rate on area and production of walnut crop were computed for a period of 13 years from 2004-05 to 2016-17. The linear regression model was employed to study the trends in growth. Different functional forms were tried in the past for working out trends in area and production. However, it was found that Linear Regression Model was the better and most frequently used one, which is given as follows:

$$Yt = a + bx \quad \text{..... (I)}$$

Where, Yt= Dependent variable for which the trends are estimated over time i.e., area, production, X is explanatory variable, b= Regression coefficient and a= Intercept

Subjected to the given normal equation

$$\Sigma Y = Na + b\,\Sigma X \quad \text{..... (II)}$$

$$\Sigma XY = a\Sigma X + b\Sigma X2 \quad \text{..... (III)}$$

Percentage growth rate has been used to measure yearly growth rate in production and area under cultivation over the study period (2004-05 to 2016-17) by using the following formula:

$$GRP = \frac{(\text{V present} - \text{V past})}{\text{V past}} \times 100$$

Where, GRP = Growth Rate in Percent
V present = Present or Future Value
V past = Past or Present Value

Analysis and Discussion

The present research paper analyzes the trends in production and area in Walnut cultivation in the state for a period of 13 years from 2004-2016. During 2004-05 J&K's walnut industry produced about 100596 MT of walnut which was equivalent to about 90% of the country's total. The estimated walnut production of the state in 2016-17 was 266280 MT and recorded an increase of around 1.06% compared 2015-16. According to Directorate of Horticulture J&K, Walnut is the next major fruit after apple occupying 24.39% in the overall area under fruits. As of 2016-17 around 89339 hectares of land is under the cultivation of walnut, an increase of around 0.42% compared to the previous year (Table 1 & Fig. 2). However, in 2014-15 both the area and production under the crop decreased systemically due to the devastating September 2014 floods. Both the area and production under the crop recorded a negative growth of 40.32% and 14.80% with 57048 hectares and 187934 MT respectively.

Table 1: Walnut: Production and Area under Cultivation

Year	Production (MT)	Annual Growth Rate (%)	Area (Ha.)	Annual Growth Rate (%)
2004-05	100596	-----	74894	-----
2005-06	108274	7.63	77217	3.10
2006-07	114926	6.14	81393	5.40
2007-08	146781	27.71	82045	0.80
2008-09	149135	1.60	85148	3.78
2009-10	154276	3.44	88593	4.04
2010-11	163744	6.13	89789	1.34
2011-12	224596	37.16	91992	2.45
2012-13	209051	-6.92	93641	1.79
2013-14	220589	5.51	95601	2.09
2014-15	187934	-14.80	57048	-40.32
2015-16	263466	40.19	88960	55.93
2016-17	266280	1.06	89339	0.42

Source: Directorate of Horticulture, Jammu Kashmir.

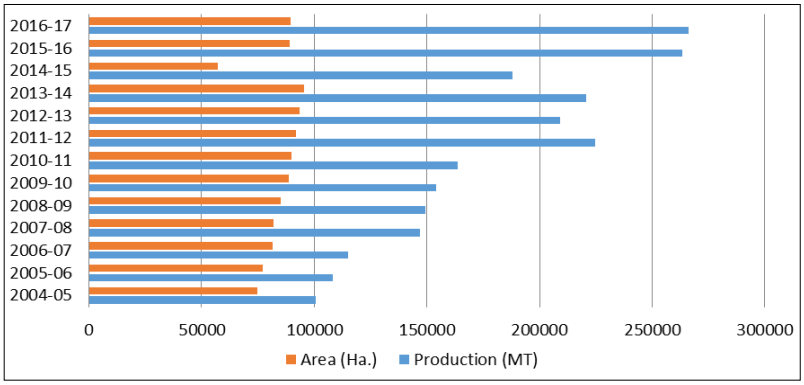

Fig 2: Walnut: Production and Area under Cultivation

Trends in Production and Area under Walnut Cultivation

For analysing the trends in walnut cultivation, Linear Regression Model has been used. The trend analysis for the walnut production for the time period 2004-05 to 2016-17 is calculated in Table 2 and Table 3. However, the trend value for area under the said fruit has been carried out separately. The trend line for the production is shown in the Fig. 3.

Table 2: Trend Analysis of Walnut Production (MT)

Year	Production (Y)	$X = (A - \bar{X})$	X^2	XY
2004-05	100596	-6	36	-603576
2005-06	108274	-5	25	-541370
2006-07	114926	-4	16	-459704
2007-08	146781	-3	9	-440343
2008-09	149135	-2	4	-298270
2009-10	154276	-1	1	-154276
2010-11	163744	0	0	0
2011-12	224596	1	1	224596
2012-13	209051	2	4	418102
2013-14	220589	3	9	661767
2014-15	187934	4	16	751736
2015-16	263466	5	25	1317330
2016-17	266280	6	36	1597680
N = 13	**ΣY = 2309628**	**ΣX = 0**	**ΣX^2 = 182**	**ΣXY = 2473672**

Putting the values of ΣX, ΣY, ΣXY, ΣX^2 in aforementioned equations i.e. equation (II) and equation (III), we get the values of 'a' and 'b' as 177663.69 and 13591.60 respectively. Then put the values of 'a' and 'b' in equation (I) to calculate the trend value as shown in table 3:

Table 3: Trend Values Walnut Production

Year	X	Y^t= a+bx	Trend Value (Y^t)
2004-05	-6	177663.69+13591.60 (-6)	96069.09
2005-06	-5	177663.69+13591.60 (-5)	109705.69
2006-07	-4	177663.69+13591.60 (-4)	123297.29
2007-08	-3	177663.69+13591.60 (-3)	136888.89
2008-09	-2	177663.69+13591.60 (-2)	150480.48
2009-10	-1	177663.69+13591.60 (-1)	164072.09
2010-11	0	177663.69+13591.60 (0)	177663.69
2011-12	1	177663.69+13591.60 (1)	191255.29
2012-13	2	177663.69+13591.60 (2)	204846.89
2013-14	3	177663.69+13591.60 (3)	218478.48
2014-15	4	177663.69+13591.60 (4)	232030.09
2015-16	5	177663.69+13591.60 (5)	245621.69
2016-17	6	177663.69+13591.60 (6)	259213.29

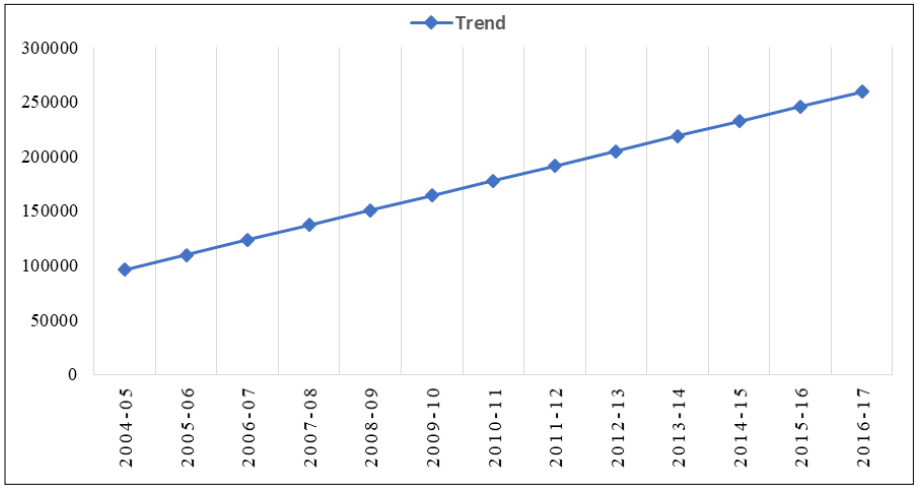

Fig 3: Trend Line of Walnut Production

The trend value for area under the said fruit for the same time period has been carried out in Table 4 and Table 5. The trend line for the area is shown in the Fig. 4.

Table 4: Trend Analysis of Area (Ha.) under Walnut Cultivation

Year	Area (Ha.) (Y)	$X = (A - \bar{X})$	X^2	XY
2004-05	74894	-6	36	-449364
2005-06	77217	-5	25	-386085
2006-07	81393	-4	16	-325572
2007-08	82045	-3	9	-346135
2008-09	85148	-2	4	-170296
2009-10	88593	-1	1	-88593
2010-11	89789	0	0	0
2011-12	91992	1	1	91992
2012-13	93641	2	4	187282
2013-14	95601	3	9	286803
2014-15	57048	4	16	228192
2015-16	88960	5	25	444800
2016-17	89339	6	36	536033
N = 13	**ΣY = 1095660**	**ΣX = 0**	**ΣX^2 = 182**	**ΣXY = 9057**

By putting the values of ΣX, ΣY, ΣXY, ΣX^2 in equation (II) and equation (III), we get the value of 'a' equal to 84281.53 and the value of 'b' equal to 9.76. Now to calculate the trend value put the value of 'a' and 'b' in equation (I) as shown in table 5:

Table 5: Trend Values Walnut Area

(Y^t = a + bx)	Trend Value (Y^t)
84281.53+49.76(-6)	83982.97
84281.53+49.76 (-5)	84032.73
84281.53+49.76 (-4)	84082.49
84281.53+49.76 (-3)	84132.25
84281.53+49.76 (-2)	84182.00
84281.53+49.76 (-1)	84231.77
84281.53+49.76 (0)	84281.53
84281.53+49.76 (1)	84331.29
84281.53+49.76 (2)	84381.05
84281.53+49.76 (3)	84430.81
84281.53+49.76 (4)	84480.56
84281.53+49.76 (5)	84530.33
84281.53+49.76 (6)	84580.09

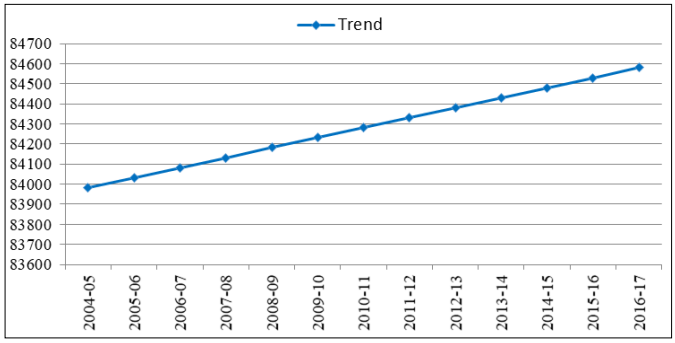

Fig 4: Trend Line of Area under Walnut Cultivation

In J&K, the area under walnut has increased from 74894 hectares in 2004-05 to 89339 hectares in 2016-17. The production of walnut in the state has increased from 90596 MT in 2004-05 to 266280 MT in 2016-17. The percentage share shows variations during the study period varying from 37.16% to -14.80% in production and 55.93% to -40.32% in area under the crop. The increase in production was not only due to increase in area under the crop but also due to increase in productivity during the given period of time in the state. Fig. 2 & Fig. 3 show the trends in walnut crop and clearly depict the increased trend in both area and production of the crop during the period under study.

It is evident from the above data that the area under the walnut crop has shown minor fluctuations except in 2014-15 when the crop recorded a negative growth due to floods of September 2014 in the Kashmir Valley. Overall the trend values calculated by regression analysis for the area under walnut crop from the year 2004-05 to 2016-17 has shown a positive growth which is evident from the figure 3. The trend values of walnut production for the said period have been calculated as 96069.09 in 2004-05 and 259213.29 in 2016-17 respectively. The fluctuating trends are mainly attributed to the changing land-use/land-cover, environmental and technological factors. Although the conversion of agriculture land into horticultural area has increased the production of horticultural crops like apple and walnut but at the same time has left negative impact on the cereal crop production in the state.

District-wise Walnut Production and Productivity

The total land under walnut production in J&K state is 89339 hectares producing about 266280 MT of walnuts during 2016-17, thus giving an average productivity of 2.98 MT per hectare (Table 6). Out of total 57% (50957 Ha.) of the land under walnut cultivation is found in Kashmir region, 43% (38318 Ha.) is in Jammu, while only a meagre 0.07% (64 Ha.) of the total land under walnut production is found in Ladakh region.

During 2016-17, the total walnut production in the regions of Kashmir and Jammu was 173931 MT and 38318 MT respectively. Only four districts of the state viz. Anantnag, Kupwara, Kulgam and Doda produced about 40% of the total production of the state producing 41763 MT, 37423 MT, 25259 MT, and 25259 MT of walnuts respectively. Srinagar, Leh and Kargil are the least walnut producing districts of the

state with a production of 606 MT, 109 MT and 12 MT of walnuts during the same period. However, there are only two districts, i.e. Jammu and Samba, which witnessed no production (Fig. 5a).

So far as the productivity level is concerned, Kashmir region shows high productivity with 3.41 MT/Ha., while Ladakh region has low level of productivity with 1.89 MT/Ha. In Kashmir region, the highest walnut productivity is found in district Kulgam with 4.37 MT/Ha., followed by district Kupwara (4.26 MT/Ha.), district Shopian (3.94 MT/Ha.), and district Pulwama (3.75 MT/Ha.). While on the other hand Bandipora district has low productivity level with 1.99 MT/Ha. In Jammu region, Kathua (3.49 MT/Ha.) and Doda (3.48 MT/Ha.) districts top the list while district Ramban produce only 1.34 MT/Ha. Similarly in Ladakh region, Leh district has the productivity level of 2.22 MT/Ha., but Kargil produce only 0.80 MT/Ha. Jammu and Samba are the only districts in the state where walnut production is not found are (Fig. 5b).

Table 6: District-wise Walnut Production and Productivity in 2016-2017

District	Area (Ha.)	Production (MT)	Productivity (MT/Ha.)
Anantnag	14393	41763	2.90
Bandipora	1238	2463	1.99
Baramulla	3114	9956	3.20
Budgam	3991	14198	3.56
Ganderbal	5302	11155	2.10
Kulgam	5781	25259	4.37
Kupwara	8787	37423	4.26
Pulwama	4849	18184	3.75
Shopian	3280	12924	3.94
Srinagar	222	606	2.73
Kashmir Valley	50957	173931	3.41
Kargil	15	12	0.80
Leh	49	109	2.22
Ladakh Region	64	121	1.89
Doda	6480	22548	3.48
Jammu	0	0	0.00
Kathua	3271	11404	3.49
Kishtwar	4650	12000	2.58
Poonch	6991	14500	2.07
Rajouri	4370	7900	1.81
Ramban	5210	7000	1.34
Reasi	2706	6965	2.57
Samba	0	0	0.00
Udhampur	4640	9910	2.14
Jammu Region	38318	92227	2.41
J&K State	89339	266280	2.98

Source: Directorate of Horticulture, Srinagar, Govt. of Jammu and Kashmir.

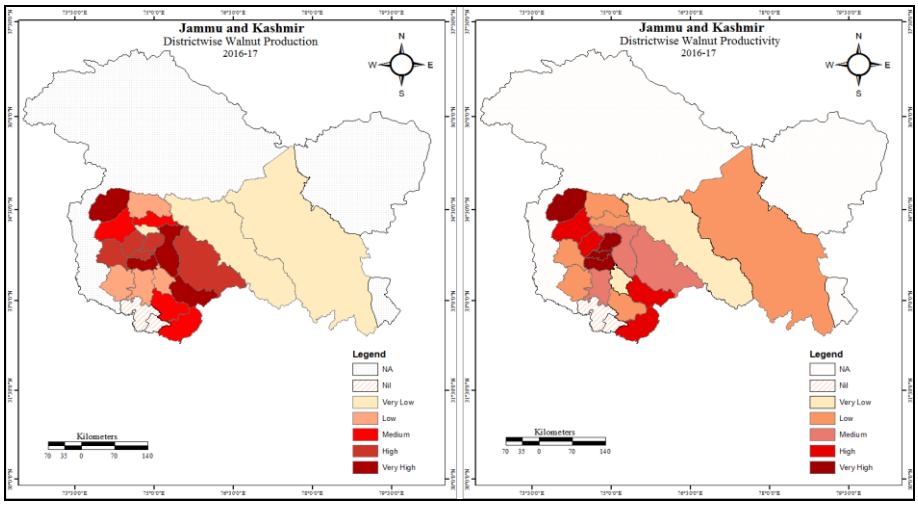

Fig 5: (a) District-wise Walnut Production (b) District-wise Walnut Productivity

Conclusion and Suggestions

The state produced more than 2.23 million MT of fruit which comprise about 1.96 million MT of fresh fruit and 0.27 million MT of dry fruit during 2016-17. Horticultural sector has witnessed significant increase in both production and area during the recent years. The fruit crops mostly walnuts and apple has bright growth prospects and the important reason being handsome returns to the farmers. Apple and walnut industry can employ a large workforce and can turn into an important industry. The state government need to encourage the sector given its high economic prospects and horticultural crops especially walnut should be left untouched by GST. The government must also restrict walnut exports from other countries. This will help to save livelihood of tens and thousands of people in the state who are directly or indirectly associated with the sector.

References

1. Ahmad L, Kanth RH, Parvaze S, Mahdi SS. Agro-climatic and Agro-ecological Zones of India. In *Experimental Agrometeorology: A Practical Manual*, Springer, Cham, 2017.
2. Dar FA. Production of fresh and dry fruits, a district wise analysis in Jammu and Kashmir, International Journal of Applied Research. 2017; 3(7):336-340.
3. Husain M. *Systematic Agricultural Geography*, Reprinted 2004, Rawat Publication, Jaipur and New Delhi, 1996.
4. Husain M. *Systematic Geography of Jammu and Kashmir*, Rawat Publication, Jaipur and New Delhi, 2000.
5. Lone RA, Sen V. Horticulture Sector in Jammu and Kashmir Economy, European Academic Journal, 2014; 2(2):2405-32.
6. Rather NA, Reshi AR, Mir MM. An Analytical study on production and Export of fresh and dry fruit in Jammu and Kashmir, International Journal of Scientific and Research Publications, 2013; 3(2).
7. Rather S. Issues of Food Self Sufficiency in Jammu and Kashmir, International Journal of Business Quantitative Economics and Applied Management Research, 2014; 1(1).
8. Shafi M. Measurement of Agricultural Productivity of the Great Indian Plains, The Geographer, 1972; 19(1):7-9.
9. Shah A. Food security and Access to Natural Resources: A Review of recent Trends, Economic and Political Weekly, 1997; 32(26).
10. Shah AR *et al*. Trends in Cereal Crop Production in Jammu and Kashmir India, International Journal of Recent Scientific Research. 2014; 5(3):645-648.
11. Shah RA, Bakshi P. Walnut Industry in India: Present Status and Future Strategies, *Biotec Articles*. Retrieved from https://www.biotecharticles.com/Agriculture-Article/Walnut-Industry-in-India-Present-Status-and-Future-Strategies-3511.html, 2016.
12. Sharma S, Sehgal S. Trends in Area, Production and Productivity of Wheat crop in J&K vis-à-vis India, Journal for Studies in Management and Planning, Retrieved from https://edupediapublications.org/journals/index.php/JSMaP/article/ download/2388/2280, 2015; 1(6):123-36.
13. Vinayaka K, *et al*. Growth and Instability Analysis of fruits crops in India - An Economic Analysis, Journal of Environmental Science, Computer Science and Engineering & Technology, 2014; 3(4):1808-1813.
14. Agriculture Production, Directorate of Horticulture, J&K Government, 2004-05.
15. Agriculture Production, Directorate of Horticulture, J&K Government, 2016-17.
16. Digest of Statistics, Directorate of Economics and Statistics, J&K Govt, 2015-16.
17. Economic Survey, Directorate of Economics and Statistics, J&K Govt, 2004-05.
18. Economic Survey, Directorate of Economics and Statistics, J&K Govt, 2010-11.
19. Economic Survey, Directorate of Economics and Statistics, J&K Govt, 2015-16.
20. Department of Agriculture Cooperation and Farmers Welfare, Govt. of India, http://www.agricoop.gov.in/sites/default/files/201718%281st%20Adv.%20Est%29.pdf
21. Cultural Heritage of Kashmir, http://koausa.org/culture/walnuts.html.