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Statistical Analysis of Cotton Cultivated Area, Production and Price

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Abstract

Cotton is one of the most important commercial crop of Pakistan and significantly contributes in the economy. Statistically analysis of cotton status of cultivated area, production and price at very basic level can help for better future policy and management by providing primary figures. Therefore, a survey research study was conducted during year 2014 at Taluka Sakrand district Shaheed Benazirabad, Sindh, Pakistan. The Primary (ground reality) and secondary (history) data were collected. The questionnaire comprised on cultivated area acres of cotton, production/acre (kg) and price 40/kg ($US). A total of 294 farmers from 07 different union councils (Pir Zakri P.Z, Sakrand SKD, Hamal Faqir H.F, Dalel Dero D.D, Marvi MRI, Karam Jamali K.J and Guhram Mari G.M) were selected. The secondary data were obtained for 14 years. The results revealed by primary data showed that max-avg 12.52 acres and min-avg 5.20 acres cultivated area were measured in K.J and G.M respectively. While, the greatest cultivated area 25 acres in MRI and reduced 01 acre in H.F and SKD were recorded. In case of production, high-avg 883.6 kg/acre and highest 1200.00 kg/acre observed in H.F. The low-avg 606.4 kg/acre with lowest 200.00 kg/acre noticed in K.J UC. Furthermore, high-avg-price in D.D and low-avg-price in P.Z, $24.13-19.99 40/kg respectively was observed. However, highest price $29.70 40/kg in H.F was concluded compare to rest of UCs. A strong correlation (0.98) was observed between H.F and G.M for all observations. The Secondary data results were obtained by using one-way analysis and F_ test was conducted to analyze the significance level tested at 5% (0.05). The F-values 0.64 and 0.7 for cultivated area and production were calculated for seven UCs. In the study, the secondary data results with 0.82 and 0.8 values suggest that H_0 must be accepted. Hence, the correlation coefficients, between area and the production had strong correlation 0.8 for the seven UCs. Also, strong correlation 0.522 was detected between price and production.

Keywords: Descriptive statistics, Multistage cluster sampling, Correlation, Cotton

1. Introduction

Pakistan is a historic home of cotton cultivation, ranks 4th big country in term of production and consumption in the world. Cotton as cash crop, shares 8.6% in agriculture and 1.8% in gross domestic product (GDP), 60% in foreign exchange. In 2010-11 cotton crop was produced at good line of an area about 32.3 million acres, however, in past few years the production of cotton showed considerable variability, might be due to fluctuating yield and area (GDP Report, 2011), resulting of higher input costs and lack of resources (Khan *et al*., 1986). There are many factors affecting cotton cultivated area, production and price, such as pest and diseases, weeds (Leghari *et al.*, 2015) floods, unconditional rain, undecided and fluctuated price rate etc. Some appropriate measures should be taken to increase cotton production in the country; because cotton is an economically valuable crop (Arshad *et. al*., 2004) which considered as a white gold of national economy. It is mainly cultivated in the province of Sindh and Punjab and providing main raw material for the textile industries. An estimate, more than 350 cotton ginning units working in Sindh (SBI, 2010). Considering importance, the further improvement of cotton production is required, which is highly dependent on the input of fertilizers, seeds, pesticides and irrigation system (Iqbal *et al.*, 2001); Bakhsh *et al*., 2005). Country is facing numerous challenges to obtain bumper yield, preparation of land, irrigation, quality of seed and training to farmers. Generally, farmers are

taking own efforts using self-experience, If the farmers are educated from the new research and technology, then they can get more production. As whole, 200 thousand hectares are under cultivation in Punjab and Sindh (Rao, 2006) of which 80% area in Sindh is under non- approved and illegal varieties (Imran, *et al*., 2011) including environmental as well socio-economic problems need to be well addressed. In these facts, the present study was started under the hypothesis of (1) cultivated area of cotton has been in increased last 14 years (i.e. 2001 to 2014), (2) due to awareness of technology, cotton production has been increased compare to past, (3) cultivated area and price has positive effect on cotton production, The objective of study were:- to study how growers get awareness of cotton production technology, to examine cotton production and to analysis the growth and status of cotton crop at very basic level for better future policy and management.

2. Method

Study area: Taluka Sakrand is one of the top three rich agricultural city of Shaheed Benazir Abad division, Sindh, Pakistan, at latitude of 26 ° 08' 18.20, Longitude: 68 ° 16' 25.00 E, has approximately 31630 population and has great importance due to wealthy agricultural lands and research institutes (cotton and wheat) are engaged in hybrid seed production and sorts of cotton seed (Soomro *et al*., 2000).

Investigation methodology: Primary and secondary data were collected and analyzed.

Primary data: The primary data comprises on cultivated area, production and price of cotton had been collected from all UCs (Hamal Faqir, Sakrand, Pir Zakri, Guhram Marri, Karam Jamali, Marvi and Dalel Dero) of taluka Sakrand, district Shaheed Benazirabad, Sindh, Pakistan, In the sampling technique, a representative sample of respondents were farmers of the selected area. Multi stage random samples of 21 villages were selected. From each selected village, 14 cotton growers were further nominated randomly. Thus, 294 respondents were selected by using Fitzgibbon *et al*. (1987) table through simple random sampling technique (Figure 1).

Secondary data: The secondary data for the year of 2001 to 2014 were obtained from agriculture statistics (crop reporter) and price obtained from the national cotton factory Sakrand district Shaheed Benazir Abad Sindh Pakistan. The f test was used for secondary data and correlations were calculated for both primary and secondary data.

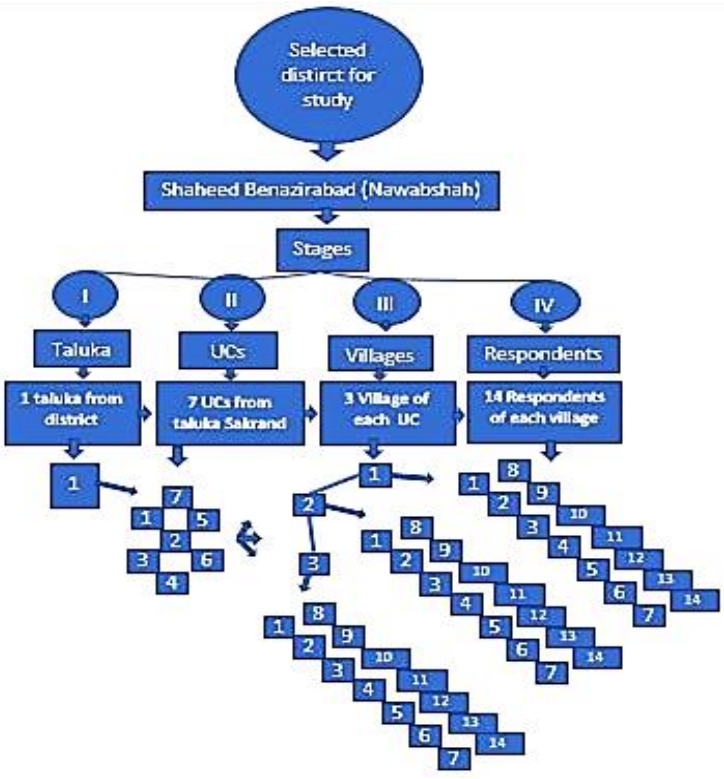

Figure 1. Multistage Cluster Sampling Method (Lavrakas, 2008)

Selection of sample size: Formula for selection of sample size

$$S = x^2 \, NP(1-P) / (N-1) + x^2 P(1-P) \text{ (Krejcie \& Morgan, 1970)}$$

S = required sample size

x^2 = the table value of desired confidence level (3.841)

N = is the population size

P = the population proportion

Validity and reliability

The equation of reliability is

$$\alpha = \frac{K\,\overline{C}}{(\overline{V}+(K-1)\overline{C})} \text{ (Cronbach, (2004) and Cortina, (1993)}$$

Here K is Equal to number of items

$\overline{C}$ is the average inter item covariance among the items

$\overline{V}$ equals the average variance. 0.8

≥ 0.9: Excellent

0.7 ≤ < 0.9: Good reliability

0.6 ≤ < 0.7: Acceptable

0.5 ≤ < 0.6: Poor

< 0.5 Unacceptable

After putting the value of survey data (by using SPSS 17 version) the result shows 0.7 which lies in the limit 0.7 ≤ < 0.9 which shows good reliability.

Therefore, our data is said to be reliable.

Statistical correlation calculation method

Values of its correlation range -1.0 to +1.0. It provides the sign of the strong point connection. In common, r > 0 shows positively connection and r < 0 shows negatively connection. However, r = 0 shows not any connection (variables are not relating, or variables are not dependents). It defines the proper positive correlation. r = -1.0 defines a unique negative correlation. In close coefficients are +1.0 and -1.0 maximums are the stronger of the connection between the variables (Table 1)

Table 1. The strength relationships are following (Bewick *et al.,* 2004; Explorable.com)

r Value	Relationship of Strength
-1.0 to -0.5 or 1.0 to 0.5	Strong relation
-0.5 to -0.3 or 0.3 to 0.5	Moderate relation
-0.3 to -0.1 or 0.1 to 0.3	Weak relation
-0.1 to 0.1	Very weak relation

Correction is examining the proper relation between two variables of the data.

The collected data statistically analyzed at SPSS: 17 computer software package.

3. Results

Primary data: Results showed that maximum 25 acres cultivated area in UC MRI and 23 acres in K.J, followed by 21 acres in G.M. While, minimum 1 acre cultivated area was found in H.F and SKD. From mean point of view, the 12.52 acres increased cultivated area in K.J and 5.20 acres in H.F were recorded. In case of production, the highest 1200 kg/acre in H.F and 1120 kg/acre in G.M, closed by P.Z with 1080 kg/acre, while lowest production 200 kg/acre in K.J and 240 kg/acre in MRI was observed. Maximum mean result showed as 883.6 kg/acre and reduced 606.4 kg/acre noticed in

UCs H.F and K.J respectively. Least yield could be cause of biological factors such as weed infestation (Leghari *et al.,* 2015) or socio-economic impact (Bakhsh *et al.,* 2005). While, highest price $29.70 40/kg recorded in H.F and UC D.D was next with $27.72 40/kg and minimum $17.82 40/kg measured in P.Z, MRI, K.J and G.M. The maxi-mean $24.13 40/kg in D.D and $23.93 40/kg in H.F. Here SKD showed $23.14 40/kg and min-mean $19.88 40/kg in P.Z. (table 2; Figure 2). In this study the data were also evaluated from the correlation statistical aspects, it was declared as negative (-0.750) between area and production (if one variable increases then other decreases). Further, area of cotton has (-3.88) negative correlations with the price, it means, as area increases as price decrease that effects on the total cultivated area. The weak positive correlation (+.396) between price and production was observed in the data (table 3). Result shows a highest positive correlation (0.69) between P.Z and SKD, P.Z and H.F (0.81), P.Z and D.D (0.79). While, the most positive relationship (0.89) between P.Z and MRI was noticed. The union councils P.Z and K.J, SKD and K.J has a strong positive correlation (0.59), seen in the data. While, P.Z and G.M, SKD and MRI correlation has (0.89) which is the highest relationship between union councils. Detail analysis showed a strong correlation (0.79) relationship for SKD and H.F. SKD and D.D has also strong positive correlation (0.69). Similarly, SKD and G.M has strong correlation (0.91) between each other. The furthermore, correlation (0.89) and (0.79) was noticed for D.D, H.F and MRI, which is a very positive strong relationship and H.F and K.J has (0.69). According to calculated correlation between H.F and G.M has a very strong positive correlation (0.98). The highest positive correlationship (0.69) between D.D and MRI was observed. The D.D and K.J has a positive strong correlation (0.79). With same as D.D and G.M is also strongly correlated with each other (0.81). The further union councils MRI and K.J has highest strong positive correlation (0.69) and MRI with G.M (0.79). In last highest positive correlation (0.59) was observed in K.J and G.M. (table 4). The secondary data analysis revaluated that maximum cultivated area was 4807.0 and minimum was 1010.5 acres with mean of 2630.48 acres. The maximum and minimum production was recorded as 1040 kg/acre and 200 kg/acre respectively. The 666 kg/acre production was resulted as mean.

Table 2. Statistical analysis of cotton cultivated area (acres), Production (kg) and Price (40/kg) of 7 union councils.

Cultivated Area (Acres)						
UCs	Area	S.D	Variance	Mini.	Max.	Sum
P.Z	5.96	3.12	9.76	2	12	250.00
D.D	5.81	3.12	9.76	2	10	244.00
H.F	5.20	3.89	15.5	1	12	218.50
SKD	7.71	4.27	18.3	1	14	324.00
MRI	11.23	7.73	59.83	2	25	472.00
K.J	12.52	6.74	45.52	2	23	526.00
G.M	7.97	5.17	26.75	2	21	333.00
Production (kg)						
UCs	Production	S.D	Variance	Mini.	Max.	Sum
P. Z	801.6	164.8	880.8	400.00	1080.00	33680.00
D.D	767.6	130.0	422.00	600.00	1000.00	32240.00
H.F	883.6	192.8	930.00	600.00	1200.00	37120.00
SKD	811.2	116.0	340.00	600.00	1000.00	34080.00
MRI	771.2	162.4	662.00	240.00	1000.00	32400.00
K.J	606.4	160.8	647.6	200.00	880.00	25640.00
G.M	798.0	153.2	587.2	520.00	1120.00	33520.00
Price (40/kg) US$						
UCs	Price	S.D	Variance	Mini.	Max.	Sum
P. Z	19.99	248.39	61701.51	17.82	24.75	860.39
D.D	24.13	151.33	22903.60	21.78	27.72	1013.86
H.F	23.93	272.25	74124.56	18.81	29.70	1005.44
SKD	23.14	193.47	37415.80	18.81	25.74	972.27
MRI	22.56	177.42	31480.84	17.82	25.74	948.51
K.J	21.09	301.62	90969.80	17.82	25.74	886.13
G.M	21.00	235.07	55261.32	17.82	25.74	882,17

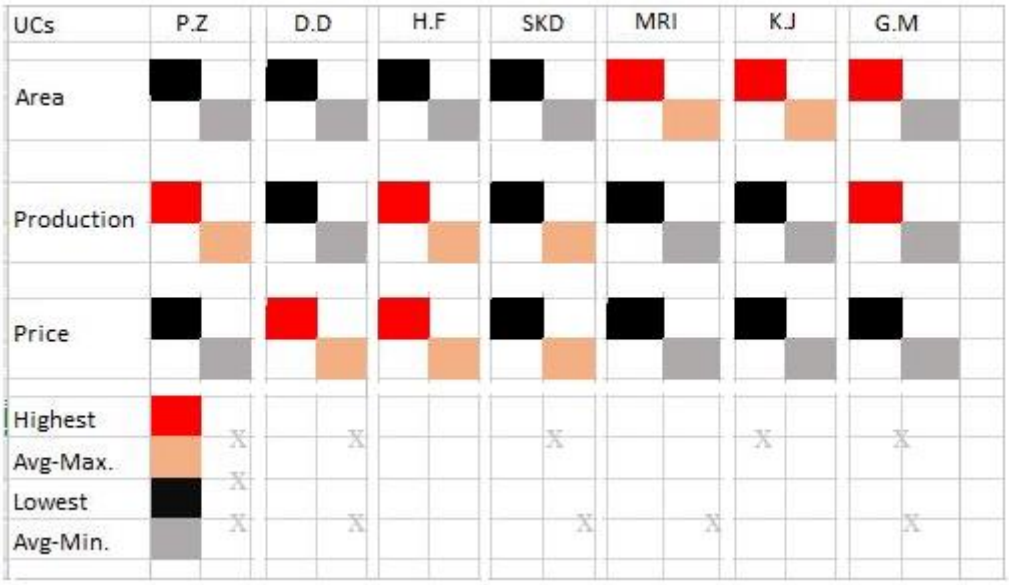

Figure 2. The color chart indicates that MRI and K.J union councils has highest cultivated area (acres), but price and production are low. While, both production and price are high in H.F, except cultivated area. Farmers of K.J union council were noticed most affected in term of production and price rate.

Table 3. Correlations between area, production and prices

Parameters	UCs	Area (acres)	Production (kg)	Price (40/kg)
Area (Acres)	7	1	-0.750	-0.388
Production (Kg)	7	-0.750	1	0.396
Price (40/kg)	7	-0.388	0.396	1

Table 4. Correlations between union councils

	P.Z	SKD	H.F	D.D	MRI	K.J	G.M
P.Z	1	0.69	0.81	0.79	0.89	0.59	0.89
SKD	0.69	1	0.79	0.69	0.89	0.59	0.91
H.F	0.81	0.79	1	0.89	0.79	0.69	0.98
D.D	0.79	0.69	0.89	1	0.69	0.79	0.81
MRI	0.89	0.89	0.79	0.69	1	0.69	0.79
K.J	0.59	0.59	0.69	0.79	0.69	1	0.59
G.M	0.89	0.91	0.98	0.81	0.79	0.59	1

Secondary data: The14 years data revealed that mean cultivated area, production and price for 7 studied union councils were 2630.48 acres, 666 kg and $17.51 40/kg price respectively. Maximum and minimum price was calculated as $32.17 40/kg and $7.54 40/kg (table 5). The *F* statistic for the UCs of cultivated area 0.64 and for production 0.7. The observed significance level was 0.82 for cultivated area and 0.8 is for production. This means that H_0 must be accepted (table 6 and 7). The strong correlation (0.8) coefficients between area and the production of cotton showing relationship for all the seven UCs. Also, strong correlation (0.522) was observed between price and production (table 8).

Table 5. Statistical analysis of cotton cultivated area, production and price of Taluka Sakrand for 14 years

	Mean	S.D	Variance	Min.	Max.	N (Years)
Area (Acres)	2630.48	813.46	661723.46	1010.50	4807.0	14
Production (kg/acre)	666	174.8	764.8	200	1040	14
Price ($US 40/kg)	17.51	790.83	625107.38	7.54	32.17	14

Source: Agricultural statistics (crop reporters) Sakrand, Sindh

Table 6. Statistical analysis of cotton cultivated area (acres) of Taluka Sakrand

Source	Sum of Squares	D.F	Mean Squares	F	Sig
Between Groups	5747394.3	13	442107.3	0.64	0.82
Within Groups	58439782	84	695711.7		
Total	64187176.4	97			

Table 7. Statistical Analysis of cotton production (/acre) Taluka Sakrand for 14 years

Source	Sum of Squares	D.F	Mean Squares	F	sig
Between Groups	2187497.6	13	168269.05	0.7	0.8
Within Groups	770132.9	84	9168.24		
Total	2957630.6	97			

Table 8. Correlations between area and production of secondary data for 14 years

	N (years)	Production 40/kg
Area	14	0.795
Price	14	0.522

4. Discussion

The main purpose of secondary data (history) collection was to compare with primary data (ground reality) figures. It was found that the cultivated area (25 acres), production (1200.00 kg/acre) and price ($29.70 40/kg) are increased as compare to past 14 years. However, a non-similar price rate for all UCs was observed. The reason of overall increase of cultivated area is that cotton is a major and cash crop in Pakistan (Naheed, and Rasul, 2010) which gives more net return as contrast to other minor crops, performing the role of backbone for textile industries in Pakistan. Farmers are focusing on cotton crop cultivation and applying much inputs, particularly, fertilizers for higher productivity, they have belief that enormous fertilizer application is a surety of profitability (Leghari *et al*., 2016). The seriously less cotton output 606.4 kg/acre in KJ UC was observed, where main problem could be soil conditions, quality of seed and/or fertilizer availability. Our point outs are in line with Rehman *et al.* (2017), elaborated that cotton yield and fertilizer has positive relationship. Before this, Nadeem *et al*. (2013) reported that resources are important for more yield, particularly, improved cotton varieties (Pray *et al*. 2001), hence, the maximum yield 1200.00 kg/acre and high price $29.70 40/kg found in UC H.F is an evidence in this regards, since H.F is a rich agricultural zone of taluka Sakrand, there is no agricultural input problem, particularly irrigation availability. However, in agricultural point of view, it is not an enough yield (Constable and Bange, 2015). It should be at least 1650 kg/acre (NIA, 2010).

Furthermore, our study, concludes that price may significantly influence on production and cultivated area, less average price $19.99 40/kg measured in P.Z, also has reduced 5.96 acres average cultivated area and relatively low production 801.6 kg/acre. It is agreeing with Hina *et al*. (2004), they concluded that prices of cotton influence on production and cultivated area, which is also confirmed from finding of Guillham *et al*. (1995) as well. Cultivated area, production and price are interrelated, raising of prices of cotton support to extend of cultivated area by encouraging farmers, ultimately production, but situation is different, during survey, we found that farmers complain about day-by-day raising of cultivation cost and low rate of cotton, this factor should not be avoided in the policy management, since, great variation

for the cultivated area seen in different UCs, In this support, we have reference of Dome *et al.* (2015) said that input cost has negative effect on farmers in the cotton cultivation progress, such as cost of cultivation, like sowing, fertilizer, seed, irrigation, labor and pesticide are main changing factors in cotton production (Nabi, 1991) and damagingly affect profit (Ahmed *et al*., 2016).

In details, study indicating increase of both maximum and minimum cultivated area and production toward time, but maximum price 40/kg did not increase in all UCs of taluka Sakrand. It has adverse effect on small farmers, they are suffering, because of usually they have less total production, on other hand, raised farm expenditures. Yilmaz*et al*. (2005) already explained negative affect of cost of production on small growers. While, condition of large cotton farmholds is stable in all studied areas. Large cotton growers comparatively have more total output result of more inputs induction for the sake of profitability. So, rate of cotton may not adversely affect as compare to smallholder farmers, they face social and economic hardship (Kathage and Matin, 2012).

Our data shows that a wide number of cotton farmers are holding small cultivated area in Taluka Sakrand. According to results of study, government is required to take serious attention on the cotton crop which can be more beneficial for the economy of country.

5. Conclusion

According to statistical results, it was concluded that the cultivated area, production and price of cotton are increase compare to past 14 years in Taluka Sakrand District, Shaheed Benazir Abad, Sindh, Pakistan. However, the trend of cotton cultivation is decreasing in some UCs may be due to low price rate of 40/kg. Study found that farmers of UC H.F receiving high price $29.70 for 40/kg which is greater than all other UCs. Particularly, P.Z, MRI, G.M and K.J are most affected areas, where price 40/kg rate is very low about $17.82. In term of cultivated area, maximum 25 acres had been seen in MRI, but low output also observed in this location. It could be due to soil fertility problem and no crop rotation etc. Under the over scenario, performance of UC H.F is good, where 1200 kg/acre yield was measured. However, in agricultural point of view, it is not enough yield. Hence, attention of government is required to take steps for the improvement of cotton crop.

Based on the results we are suggesting that: -

Farmers to be trained for the modern agricultural technology of crop cultivation.

A functional relation between farmers and researchers should be established.

Cotton price should be strictly controlled to provide same price to every farmer.

6. References

Abdullah, A. (2010). An Analysis of BT cotton cultivation in Punjab, Pakistan using the agriculture decision support system (ADSS). *AgBio Forum*, (13), 274-1287.

Ahmad, D., Muhammad, I. C., Abdur, R., & Mohammad, A. (2016). Economic analysis of cotton cultivation underagro-climatic conditions of District Muzaffargarh. *American-Eurasian J. Agric. & Environ. Sci*, *16*(8), 1498-1503, 2016. https://doi.org/10.5829/idosi.aejaes.2016.1498.1503.

Arshad, M., Afzal, M., Khan, M. I., & Rashid, M. (2004). Performance of newly developed cotton strains for economic and fiber traits in National Coordinated Varietal Trials (NCVT). *Pak. J. Agri. Sci. and Ind. Research, 46(5)*, 373-375.

Awan, A. G., Nasir, N., & Muhammad, A. N. (2015). Analysis of profitability of BT cotton growers in District Multan Pakistan. *J. of Resources Develop. and Manage, 5*, 1-7. http://citeseerx.ist.psu.edu/viewdoc/ download? https://doi.org/10.1.1.679.4434&rep=rep1&type=pdf.

Bakhsh, K., Hassan, I., & Maqbool, A. (2005). Factors affecting cotton yield: A case study of Sargodha (Pakistan). *J. Agric. Soci. Scie, 01*(4), 332–334.

Bewick, V., Liz, C., & Jonathan, B. (2004). Statistics review 7: Correlation and regression. *Critical Care, 7*(6), 451-9. https://doi.org/10.1186/cc2401.

Constable, G. A., & Bange, M. P. (2015). The yield potential of cotton (*Gossypium hirsutum* L.). *Field Crops Research, 182*, 98-10. https://doi.org/10.1016/j.fcr.2015.07.017.

Cortina, J. M. (1993). What is coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297-334.

Cronbach, L. J. (2004). My current thoughts on coefficient alpha and successor procedures. *Educ.and Psychological Measure, 64*(3), 391–418. https://doi.org/10.1177/0013164404266386.

Dome, B., Dmitry, K., & Yaw, N. G. (2015). The impact of increasing input costs to the farmers in cotton production in Tanzania. *Applied and Comput. Math, 4*(5). http:// doi379-386. doi: 10.11648/ j.acm.20150405.18.

Explorable.com/statistical-correlation (The relationship between variables), Online available at https://explorable.com/statistical-correlation.

Fitzgibbbon, T., Carol., & Lym, L. M. (1987). *Table for determining sample size from the given population. How to design a program evaluation. Sage publications.* Newbury park CA.

Gillham, F. E. M., Bell, T. M., Arin, T., Matthews, G. A., Le Rumeur, C., & Hearn. A. B. (1995). Cotton production prospects for the next decade." *World Bank Technical Paper* No. 287. Washington, D.C.

Gross domestic product report. (2011) Ministry of finance. Pakistan economic survey. Islamabad: Government of Pakistan, Available at http://www.finance.gov.pk/survey_1011.html.

Hina, A., Muhammad, A., & Huma, A. (2004). Economics analysis of input trend in cotton production process in Pakistan. *Asian Economic and Finance review, 2*(4), 553-567.

Imran, M., Shakeel, A., Farooq, J., Saeed, A., Farooq, A., & Riaz, A. K. K. (2011). Genetic studies of fiber quality parameter and earliness related traits in upland cotton (*Gossypiumhirsutum*L.). *AAB Bioflux, 3*(3), 151-159.

Iqbal, M., Azeem, M., & Ahmad, M. (2001). Determinants of higher wheat productivity in irrigated Pakistan. *The Pakistan Dev. Review, 40*, 753-65.

Kathage, J., & Matin, Q. (2012). Economic impacts and impact dynamics of BT (Bacillus thuringiensis) cotton in India. *Proc Natl Acad. Sci. USA, 109*(29), 11652-11656. https://doi: 10.1073/pnas.1203647109.

Khan, B. R., Khan, B. M., Razzaq, A., Munir, M., Aslam, M., Ahmad, S., Hashmi, N. I., & Hobbs, P. R. (1986). Effects of different tillage implements on the yield of wheat. *J. of Agric. Research, 7*, 141-147.

Krejcie, R. V., & Morgan, D. D. W. (1970). Determining sample size for research activities. *Educa. psychological measure, 30*, 607-610. https://doi.org/10.1177/001316447003000308.

Lavrakas, P. J. (2008). Encyclopedia of survey research methods. Online available at http://methods. sagepub.com/ Reference/ encyclopedia-of- survey-research- methods. https://doi.org/ 10.4135/ 9781412963947.

Leghari, S. J., Leghari, U. A., Laghari, G. M., Buriro, M., Soomro, F. A. (2015). An overview on various weed control practices affecting crop yield. *Journal of Chemic. Biologic. and Physic. Scie, 6*(1), 059-069. https://doi:.org/10.24214/jcbps.

Leghari, S. J., Buriro, M., Jogi, Q. D., Kandhro, M. N., & Leghari, A. J. (2016). Depletion of phosphorus reserves, a big threat to agriculture: Challenges and opportunities. *Science Internat. (Lahore), 28*(3), 2697-2702.

Nabi, M. (1991). Relationship between cotton productivity and input usage. *J. of international development, 8*, 68-88.

Nadeem, A. H., Xu, J., Nazim, M., & Hashim, M. (2013). Factors influencing sustainable production of cotton in Pakistan: A case study from Bahawalpur District. *International J. Sciences: Basic and Applied Reses. (IJSBAR), 11*(1), 193-204.

Naheed, G., & Rasul, G. (2010). Recent water requirement of cotton crop in Pakistan. *Pak. J. Meteor. 6*(12), 75-84.

NIA, Nuclear institute of agriculture, 2010. Cotton varieties. Online accessible from http://www.nia.org.pk/gin%20cotton.html.

Pray, C., Ma, D., Huang, J., & Qiao, F. (2001). Impact of BT cotton in China. *World Development, 29*(5), 813-825. https://doi.org/10.1016/s0305-750x(01)00010-9 .

Rao, I. A. (2006). First BT cotton grown in Pakistan. Pakissan. Online available at http://www.pakissan.com/english/advisory/biotechnology/first.bt.cotton.grown.in.pakistan.shtml.

Rehman, A., Luan, J., Abbas, A. C., Imran, H., Shoaib, A. W., & Qurat, U. A. M. (2017). Economic perspectives of cotton crop in Pakistan: A time series analysis (1970–2015) (Part 1). *J. the Saudi Society of Agric. Scie*. https://doi.org/10.1016/j.jssas.2016.12.005.

S. B. I. (2010). Sindh board investment the land of endless opportunities Govt: of Sindh, Accessible online at http://sedf.gos.pk/pdf/sindh-profile1.pdf.

Soomro, A. R., Kaneez, S., Soomro, A. W., Soomro, A. H., Mallah, G. H., Panhwar, G. N., & Kalhoro, A. D. (2000). Progress with varietal development at CCRI, Sakrand Sindh. *Pakistan J. of Biological Scie, 3*(3), 466-468. https://doi.10.3923/pjbs.2000.466.468.

Yilmaz, I., Akcaoz, A., & Ozkan, B. (2005). An analysis of energy use and input costs for cotton production in Turkey. *Renewable Energy, 30*(2), 145-155. https://doi.org/10.1016/j.renene.2004.06.00.