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Identification and prioritization of agricultural risks and their management strategies adopted by cotton growers in the Punjab, Pakistan

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Abstract

Cotton is the major cash crop of Pakistan. Pakistan is also included in the list of top ten cotton producing countries of the world. Inspite of its significance in the national economy and in overall agricultural production, the average cotton production in Pakistan is declining since last five years. A number of factors are responsible for this decline of cotton production including the perception that overall agriculture has become a risky business. With this rational the present research was formulated for the identification and prioritization of agricultural risks and their management strategies adopted by cotton growers in the Punjab, Pakistan. Data were collected from 400 cotton growers of three selected districts of the Punjab. Face-to-face interviews were conducted for data collection. The collected data were analyzed using SPSS. The results shows that majority of the respondents had age upto 35 years. Majority of the respondents were literate having educational level up to ten years of schooling. Family landholding of 40.0% of respondents was 6-10 Acres. Overall rating of risks that were being faced by cotton growers in the research area shows that "Human Risks" is on the top with highest mean value (4.26/5.00). Respondents practiced a wide variety of risk management strategies. Out of these adoption of multiple income sources was on the top with highest mean (3.58/5.00).

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Introduction

Agriculture is one of the oldest professions of human civilization (Hanif *et al.,* 2010). The history of human civilization reveals that agriculture sector is the major provider of food and fiber around the world and still possesses the same significant role in insuring food security (FAO, 2011). The livelihoods of majority of the people in the whole world are linked with this sector directly or indirectly (Berchoux *et al.,* 2019). Role of agriculture in the development of any country is very much significant especially in case of developing countries where majority of the poor and food insecure people are residing (Tadesse *et al.,* 2016).Agricultural production is directly linked with various factors that may be climatic, non-climatic and socio-economic (Fahad *et al.,* 2018). All of these factors are beyond the control of farmers due to which agriculture is regarded as a risky business around the globe (Hardaker *et al.,* 2015). Due to the occurrence of different risks, entire agricultural production is quite unpredictable that results into fluctuation of prices of food commodities (Sookhtanlo and Sarani, 2011).

The typology and intensity of risks associated with agricultural production is varying from region to region. High level of risks in agriculture is very much common in developing countries (Pervez *et al.,* 2016).However, in most of the cases four major types of risks are being identified as market risks, production risks, financial risks, institutional risks and human risks (Arbuckle *et al.,* 2015; Jianjun *et al.,* 2015; Wang *et al.,* 2017; Duong *et al.,* 2019 and many others).All of these risks are very much sensitive and expressively linked with each other (Ullah and Shivakoti 2014). The linkage and correlation between different types of risks were also reported by Tangermann (2011).With special reference to Pakistan Iqbal *et al.,* (2016) reported three major types of agricultural risks as production, marketing and financial.

Pakistan is developing as well as possesses agricultural based national economy. Agriculture is the single largest sector of economy that provides 38.5% employment to the total country's national labour force. The percentage share of agriculture sector in comparison to other sectors of economy i.e. industry and services during the last five years is evident clear from the Fig. 1 given below.

Cotton is the major source of fiber in the whole world and is being cultivated in more than 100 countries including Pakistan (Cianchetta and Davis, 2015). Cotton is well known cash crop of Pakistan and contributes significantly in overall national economy. This is considered as the white gold for Pakistan's economy. Pakistan is the 4th largest producer of cotton and 3rd largest exporter of raw cotton.

Last year cotton production is declined by 17.5% (Government of Pakistan, 2019).Multiple factors are responsible for this decline including climatic and non-climatic attributes (Iqbal *et al.,* 2018). Occurrence of diverse nature of risks is one of the main features of cotton production in Pakistan like other regions of world with wide range of frequency and magnitude (Kouser and Qaim, 2014).The prevalence of risks in cotton crop was also reported by Zulfiqar *et al.,* (2016). These risks instigate from multiple sources like climate variability, state national policies, international market policies, access to crop insurance/microcredit services, provision of extension or rural advisory services, geographical location etc. The mitigation of these risks is largely depends upon the perceptions of farmers about its intensity and frequency (Meraner and Finger, 2017).

Risk management is a complex process and comprises of different steps. First step is the identification and nature of risk and 2nd step is to evaluate its consequences at farm and societal level. Conclusively, risk assessment is the major element of any risk management strategy. Adoption of risk management strategies at farm level is very much essential to involve generations in farming (Hardaker *et al.,* 2004). Different risk management strategies are available for farmers to adopt (Ullah *et al.,* 2015). Three main types of risk management strategies were identified by Okunmadewa (2003) as presentation,

mitigation and copping strategies. The responsibility of selection of any of these management strategies lies on the shoulder of farm manager. In developing countries a number of research studies were conducted to probe out typology of agricultural risks, risk sources and management strategies adopted by farmers. However, limited studies are available in case of developing countries like Pakistan. Adoption of risk management is also very important to mitigate the risks faced by cotton growers in the country. Multiple factors manipulate the adoptability of different risk management strategies by cotton growers in Pakistan (Zulfiqar *et al.,* 2016). Limited literature is available regarding identification of factors involved in adoption of risk management strategies by cotton growers in Pakistan.

The basic objective of the current study was to identify and prioritize the risks associated with cotton production along with identification and prioritization of risk management strategies adopted by cotton growers to minimize the mentioned risks.

Methodology

Description of research area

The study was conducted in the Punjab province of Pakistan. On the basis of population, Punjab is the largest province of Pakistan. The province is very much famous for its maximum share in total agricultural production of the country (Government of the Punjab, 2018). The share of the Punjab province in total production of cotton crop is 64.0%. Cotton is widely grown in southern region of the Punjab.

Research design

Cross-sectional Survey Research Design was used. This design allows collection of data from different groups of respondents at one point in time. Mix method approach was adopted keeping in mind the complexities of present research study. Personal face-to-face interviews were conducted for the collection of Quantitative data. For supporting qualitative data, focus group meetings and key informant interviews were conducted to collect qualitative data.

Sampling procedure

Both probability (Simple Random Sampling) and non-probability (Purposive Sampling) sampling procedures were used in the current research study. List of top ten (10) cotton growing districts of the Punjab was prepared. From that list three (03) districts were selected through Simple Random Sampling technique. List of farmers using differed ICT tools in the selected districts was obtained from Directorate of Agricultural Information, Lahore. The validity of the lists were first check from NADRA and then from Agriculture Extension Department of the respective District. Cotton growers using ICTs was selected through Purposive Sampling procedure. From the list of each district respondents were selected through Simple Random Sampling technique using web link random.org. The targeted study districts are hereby highlighted on the map of the Punjab as shown in Fig. 2.

Sample size

The population from which the sample was selected as the units of analysis covered all cotton growers within randomly selected districts. In order to ensure generalization of the present research, a sample size of four hundred (400) cotton growers were selected. The said sample size was calculated by using the formula framed by Fisher (Fisher *et al.*, 1998) as given below.

$$n = \frac{pqZ^2}{d^2} \& n^1 = \frac{1}{\frac{1}{n}+\frac{1}{N}}$$

The Fisher formula comprises of two parts; the first part of the formula was used for computing sample size for an infinite population. The result of that first part of formula was then used into the 2nd part of formula for computing sample size of the known/finite population.

$$n = \frac{pqZ^2}{d^2}$$

Where:

n = sample size for infinite population

Z = 1.96 (at 95% Confidence level)

p = estimated proportion of cotton growers (0.1)

q = 1-p d = precision of the estimate at 5% (0.05)

The sample size will be;

$$n = \frac{(1.96)^2 \ 0.1 \times 0.9}{(0.05)^2}$$

n = sample size for infinite population n =138

The adjusted sample size for the finite population of cotton growers in the selected districts is:

$$n^1 = \frac{1}{\left(\frac{1}{n} + \frac{1}{N}\right)}$$

n^1 = adjusted sample size

n = estimated sample size for infinite population

N = Finite population size

$n^1 = \frac{1}{\left(\frac{1}{138} + \frac{1}{8,148}\right)}$ ≈ 132 household respondents will be selected from District Muzaffargarh

$n^1 = \frac{1}{\left(\frac{1}{138} + \frac{1}{5,212}\right)}$ ≈ 134 household respondents will be selected from District Bahawalpur

$n^1 = \frac{1}{\left(\frac{1}{138} + \frac{1}{2,980}\right)}$ ≈ 132 household respondents will be selected from District Khanewal.

Total sample size obtained was 398. However, the sample size was increased to four hundred (400) for easy data collection and analysis.

Research instruments

Structured interview schedule was used for quantitative data collection. For obtaining qualitative data interview guide was used. Reliability of interview schedule was measured through SPSS. The Value of Cronbach's Alpha of Items on Likert Scale was 0.773. According to Hair *et al.* 1998, the value of Cronbach's Alpha of Items on Likert Scale should be 0.7 of higher.

It mean than internal consistency of the research instrument used in the present research was good and acceptable and the statements of all the variables on likert scale are found to be reliable. Content Validity of both the research instruments was checked through panel of experts and then by pre-testing (by conducting interviews from 50 Cotton growers).

Data analysis

The collected data were analyzed using SPSS. Descriptive statistics were used for the interpretation of data.

Results and discussion

Section-I: Socio-economic characteristics of respondents

Age

Data regarding present age (at the time of data collection during the year 2018) is tabulated in Table 1. Data presented in Table 1 shows that, nearly half (49.3%) of respondents were with age upto 35 years. This indicates that majority of the population in rural areas of the study districts were fall in category of young. Young people tend to adopt latest technologies at higher rate as compared to old age group.

Table 1. Frequency and percentage of respondents according to their age.

Age	Frequency	Percentage
Upto 35 Years	197	49.3
36 Years to 45 Years	85	21.3
46 Years to 55 Years	101	25.3
56 Years and Above	17	4.3
Total	400	100.0

The results of present study are in line with the findings of Iqbal *et al.* (2018) who concluded that average age of respondents in cotton growing districts (Khanewal, Vehari, Bahawalpur, Bahawalnagar, Muzaffar Garh and RajanPur) was 46 years. The data also indicates that only 4.3% of respondents were fall in category of 56 years or above. This shows that proportion of old age group in the targeted study districts was very low. In contrast with the findings of the present study, Naveed and Anwar (2015) reported

that majority (39.2%) of respondents are in the age group of 36-45 years. They studied the information needs of cotton growers in district Bahawalpur (one of the leading cotton producing districts of the Punjab and also one of the targeted districts of present research).

Educational level

Education is one the most important and significant socio-economic factors that play key role in the adoption of improved agricultural technologies by the farmers. The data concerning educational level of respondents is presented in Table 2.

Table 2. Frequency and Percentage of respondents according to their educational level.

Educational level	Frequency	Percentage
Illiterate	109	27.2
Upto Primary	108	27.0
Matriculation	100	25.0
Intermediate	49	12.3
Graduation or Above	34	8.5
Total	400	100.0

Data tabulated in Table 2 presents the educational status possessed by the respondents at the time of data collection. The data indicate that 27.2% of respondents were illiterate. This indicates that high level of illiteracy is still prevalent among rural households in the targeted research area. On the other hand 72.8% of respondents were found literate. Among literate respondents majority (27.0%) of the respondents possessed educational level upto primary (5 years of schooling) and only 8.5% had educational level graduation or above. This shows that in rural areas of the targeted study districts in particular and generally in all the districts of the Punjab, higher level education (University level) is not so common.

Table 3. Frequency and Percentage of respondents according to their family land holding.

Size of family land holding	Frequency	Percentage
Upto 5 Acres	142	35.5
6 to 10 Acres	160	40.0
11 Acres or Above	98	24.5
Total	400	100.0

This may be due to the non-availability of higher educational institutions in rural areas.

This has been noticed that all the public and private sector universities and higher degree awarding institutions are located in urban localities.

In connection with findings of the present study Naveed and Anwar (2015) reported that in district Bahawalpur (one of the leading cotton producing districts of the Punjab province), among literate cotton growers, majority (31.6%) had education upto eight years (middle) of schooling. Educational status of farmers plays key role in adoption of improved agricultural technologies as reported by Bakhsh *et al.* (2005) while identifying factors effecting yield of cotton in district Sargodha (Punjab province).

Size of family land holding

Land holding serves as one of the prime physical assets for farmers in the whole world but particularly in developing and low income countries like Pakistan.

The data regarding size of family land holding of respondents in the targeted research areas was collected and presented in Table 3.

Table 4. Mean and SD of production risks.

Production Risks	Mean	SD
High/Low rainfall	4.14	0.508
Flood	4.13	0.589
High/Low Temperature	4.02	0.557
Drought	3.77	0.609
Hail storm	3.69	0.772
Wind Storm	3.69	0.729
Overall Mean	3.90/5.00	0.627

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

The data tabulated in Table 3 shows that majority of the respondents (40.0%) possessed agricultural land ranging between 6-10 acres in the targeted population. Only 24.5% of respondents had agricultural land upto 11 acres. This indicates that small landers are in majority in the targeted districts of the present study like other parts of the country.

Section II: Agricultural risks and management strategies

Typology of risks being faced by Cotton growers

Different types of risks are being faced by cotton growers in the research area. These risks are divided into eight different categories as explained by different researchers researched on agricultural risks and management strategies adopted by farmers in different regions of the globe. These risks are illustrated in the Fig. 3 given below.All of the above mentioned risks are hereby explained on the basis of self-perception of respondents in the research area one by one in the proceeding sections.

Production risks

Production risks are also referred to as weather related risks. Mean and SD of different production risks is presented in Table 4.

Table 5. Mean and SD of biological risks.

Biological Risks	Mean	SD
Insect attack	4.14	0.594
Disease attack	4.00	0.619
Rodents	3.63	0.556
Overall Mean	3.93/5.00	0.590

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

Data presented in Table 4 shows that among different types of production related risks being faced by cotton growers in the research area “high/low intensity of rainfall” is on the top with highest mean value ($\bar{x}$ = 4.14/5.00 and SD 0.508). The production risk which is ranked at the last was “wind and storm” with lowest mean (($\bar{x}$ = 3.69/5.00). Overall mean value of all the production risks were 3.90/5.00, shows that majority of the respondents “agreed” regarding prevalence of production risks in the targeted research area. In connection with these findings, Qasim and Ahmad (2016) reported that weather related risk sources like inadequate rainfall ($\bar{x}$ = 4.91/5.00), severe weather conditions ($\bar{x}$ = 4.39/5.00) and natural disasters ($\bar{x}$ = 4.09/5.00) are the leading risk sources for farmers of Pothwar (rain-fed) region in the Punjab province of Pakistan. They concluded that weather is the major source of production risks for Pakistani farmers.

All the production risks are mainly related to weather, which is beyond human control as climatic events are natural.

Table 6. Mean and SD of input risks.

Input risk	Mean	SD
Shortage of Fuel (Diesel) & Electricity	4.32	0.735
Adulteration in pesticides	4.24	0.760
Non-availability of fertilizers at the time of peak season	4.19	0.769
Shortage of certified seed	4.17	0.777
Irrigation water shortage	4.05	0.769
Adulteration in fertilizers	4.03	0.847
Overall Mean	4.17/5.00	0.776

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

Adverse climatic conditions and production risks lead to low crop production. Several research studies shows that variation in temperature and humidity are the leading sources of production related risks faced by farmers in different regions of the world (Van Asseldonk and Lansink, 2003; Richards *et al.*, 2004; Musshoff*et al.*, 2006 and Cafiero *et al.*, 2007).

Table 7. Mean and SD of market risks.

Market risk	Mean	SD
Middleman monopoly	4.30	0.729
Fluctuations in the prices of inputs	4.26	0.743
Fluctuations in market rates of cotton	4.20	0.757
Buyers monopoly	4.00	0.653
International gambling in cotton market	3.97	0.833
Lack of main cotton market in area	3.94	0.585
Money inflation	3.90	0.573
Overall Mean	4.08/5.00	0.696

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

Biological risks

Biological risks are the major sources that significantly associated with production of field crops. These risks are closely linked with production risks. In this regard Miller *et al.*, (2004) reported that raise the intensity of production risks. Biological risks prevail at each and every step of production technology of each crop (Ashraf *et al.,* 2013). The data regarding biological risks was collected and their mean and SD is tabulated in Table 5 given below.

Table 8. Mean and SD of harvesting and transportation risks**.**

Harvesting and transportation risk	Mean	SD
Less availability of labour (other than picking)	3.41	1.034
Non-or less availability of skilled labour (other than picking)	3.41	0.985
Non-availability of mechanical pickers	3.41	1.084
Contamination in cotton during picking	3.37	1.110
High costs of picking	3.34	1.098
Non-availability of skilled pickers	3.32	1.098
Contamination during transportation	3.31	1.098
Shortage of skilled spraying labour	3.29	1.132
Inappropriate handling and storage of cotton	3.19	1.204
Overall Mean	3.34/5.00	1.094

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

The data regarding biological risks as presented in Table 5 shows that "insect attack" is on the top with highest mean ($\bar{x}$ = 4.14/5.00 and SD 0.594). Overall mean value of biological risks was 3.93/5.00 with SD 0.590. This show that high majority of the respondents were agreed regarding occurrence of biological risks in the research area.

Table 9. Mean and SD of human risks.

Human risks	Mean	SD
Illiteracy	4.48	0.671
Limited access to Extension & Advisory Services	4.39	0.764
Lack of interest in farming	4.37	0.787
Small landholdings	4.31	0.787
Poverty & Food Insecurity	4.31	0.848
Poor Health Conditions/Illness	4.27	0.801
Lack of technical knowledge	4.22	0.850
Lack of skills	4.20	0.830
Produce got theft	3.81	0.518
Overall mean	4.26/5.00	0.762

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

Input risks

In agricultural production inputs play an eminent role. Timely application of inputs to the respective crops enhances its production. Farmers mostly face input related risks due to limited of non-availability of inputs like seed, fertilizers, irrigation water and pesticides (Khan *et al.*, 2013). Different types of input related risks were identified in the present research and presented in table 6 with mean values and SD.

Table 10. Mean and SD of financial risks.

Financial risks	Mean	SD
Poor net return from crop	3.62	1.095
High prices of inputs	3.51	1.004
High interest rates gained by local agri. Dealers/investors	3.44	1.070
Black marketing of inputs	3.41	1.075
No other income source except farming	3.14	1.245
High interest rate upon loan	3.12	1.165
Sluggish cooperative societies system	2.84	1.178
Overall Mean	3.30/5.00	1.119

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

The data tabulated in Table 6 regarding input related risks being faced by cotton growers in the research area shows that "shortage of fuel & electricity" is on the top with highest mean ($\bar{x}$=4.32/5.00) and 0.735 SD. On the other hand "adulteration in fertilizers" is placed at the end on the basis of lowest mean value ($\bar{x}$ = 4.03/5.00) among all the input related risks. The overall mean value of all the input related risks was found to be 4.17/5.00 (SD 0.766) shows that large majority of the respondents were "agreed" regarding occurrence of input related risks in the research area. In connection with present findings, Rahman *et al.*, (2019) concluded that irrigation water availability and timely application of balanced fertilizers are the main contributors towards better crop production in Pakistan.

Table 11. Mean and SD of Legal/Institutional Risks.

Legal/institutional risks	Mean	SD
Uncertain financial policies (credit, saving and insurance)	3.19	1.146
Uncertain land policies and tenure system	3.18	1.109
Uncertain trade and market policies	3.16	1.204
Uncertain monetary and tax policies	3.11	1.141
Political instability	3.07	1.100
Lack of policies for land reforms	2.96	1.242
Irrelevant agricultural policies	2.88	1.218
Corrupt patwar system	2.78	1.213
Non-existence of effective farmers union	2.74	1.210
Overall Mean	3.01/5.00	1.176

Scale: 1 = S. Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = S. Agree.

Table 12. Mean and SD of Risk Management Strategies being adopted by respondents.

Risk Management Strategies	Mean	SD
Adoption of multiple income sources	3.58	1.163
Obtained loan from Banks	3.34	1.158
Sale of physical/financial assets	3.27	1.204
Sharing of information within farming community	3.26	1.185
Adopt conservation agricultural technologies	3.22	1.214
Ensure timely supply of inputs	3.20	1.166
Use of ICTs for updated market information	3.18	1.221
Crop insurance policies	3.10	1.120
Personal insurance policies	3.09	1.169
Adopt suitable prevention measures against insect/pest attack	3.08	1.154
Contract farming	3.06	1.152
Growing crops other than cotton having high economic return	3.05	1.168
Pest control using biological methods	3.05	1.186
Maintaining feed/inputs reserves	3.05	1.127
Use of ICTs for weather forecast	3.04	1.169
Cooperation of farmers	3.04	1.228
Growing multiple crop varieties	3.03	1.154
Crop diversification	3.02	1.163
Establish strong linkages with Extension	2.95	1.159
Small dams/turbine scheme	2.80	1.245

Scale: 1 = V. Low, 2 = Low, 3 = Neutral, 4 = High, 5 = V. High.

Market risks

Different market oriented risks are being faced by Pakistani farmers like other farm producers of majority of the low income countries especially with agrarian nature of economy. According to the report of SDPI (2018), small land holders in Pakistan face multidimensional types of risks like climate related, market oriented and institutional ones. Different types of market oriented risks prevail in the research area with their respective mean values are presented in Table 7 given below.

Data presented in Table 8 shows that among market related risks being faced by cotton growers of the

targeted research area "monopoly of the middleman" is on the top with highest mean (4.30/5.00) and SD 0.729. On the other hand market risk which is placed at the end on the basis of lowest mean value ($\bar{x}$ = 3.90/5.00) was "money inflation". Similar nature of market related risks were also discussed by Qasim and Ahmad (2016). Overall mean value (4.08/5.00) indicate that majority of the respondents agreed regarding presence of market related risks in the research area.

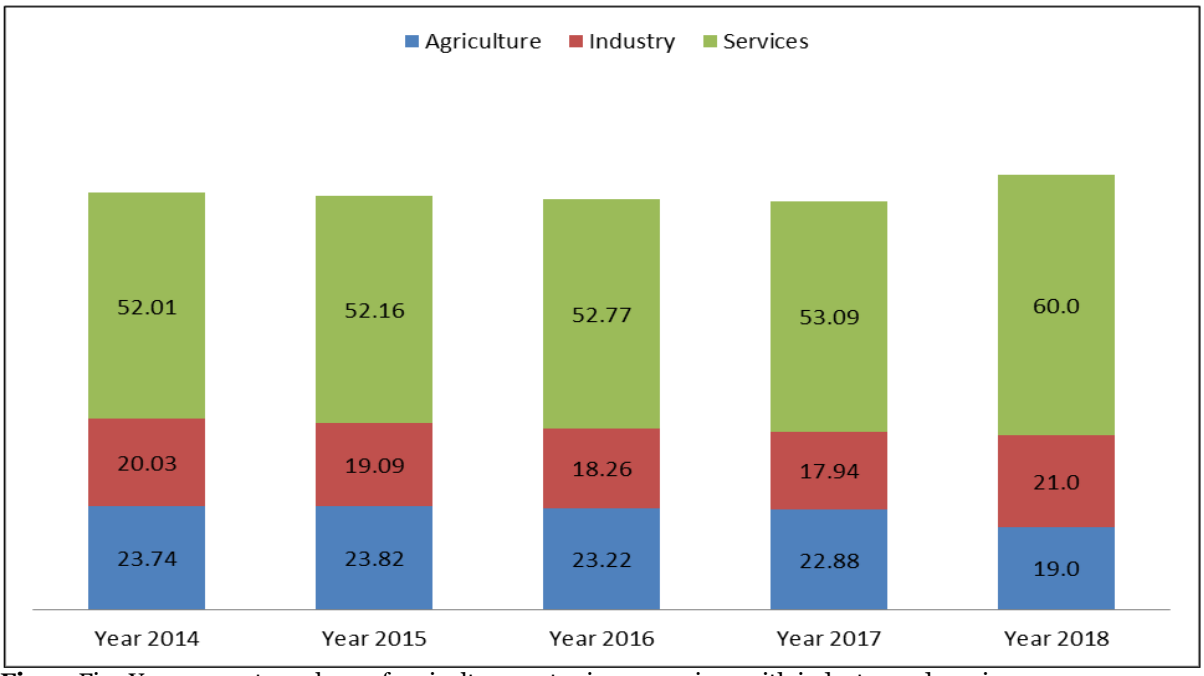

Fig. 1. Five Year percentage share of agriculture sector in comparison with industry and services.

Harvesting & transportation risks

Farmers of the research also face harvesting and transportation oriented risks. These risks are hereby identified and present in Table 8 with their respective mean values. The data placed in table 8 shows that "less availability of labour and mechanical pickers" is on the top with highest mean ($\bar{x}$ = 3.41/5.00). During qualitative discussion it was also noted that during peak season of cotton picking shortage of labour is one the major issues being faced by cotton growers in the whole cotton belt. Harvesting & transportation risk which is placed at the end on the basis of lowest mean vale ($\bar{x}$ = 3.19/5.00) among other risks was "inappropriate handling & storage".

Over all mean value of the all the harvesting related risks was 3.34/5.00 with 1.094 SD.

Human risks

Respondents identified some types of human related risks. According to Shadbolt (2009), human risks are more severe and uncertain than production and market risks. The mean and SD of these human related risks which are being faced by the cotton growers of the targeted research area are presented in Table 9. The data presented in table 9 shows that out from different types of human risks "illiteracy" is on the top with mean value 4.48/5.00 and "produce got theft" is on the bottom with lowest mean vale 3.81/5.00. Overall mean value of all the human risks was 4.26/5.00 and SD 0.762.

Financial risks

Financial capital is very much important for secure livelihoods. Cotton growers of the research area also facing numerous financial risks as tabulated in Table 10 given below.

The data presented in Table 10 regarding financial risks indicate that "poor net return from cotton crop" is on the top with maximum mean value 3.62/5.00. On the other hand "sluggish cooperative society

system" is placed at the bottom with lowest mean ($\bar{x}$=2.84/5.00). Overall, mean value of all financial risks was 3.30/5.00.

Legal/institutional risks

Cotton growers of the research area also face some legal or institutional related risks. These legal or institutional risks are ranked below in Table 11 on the basis of their mean value.

The data regarding legal/institutional related risks as presented in Table 11 shows that "uncertain financial policies (credit, saving, and insurance)" is placed at rank 1st on the basis on highest mean ($\bar{x}$ = 3.19/5.00). "Non-existence of effective farmer unions" is placed at the end due to the lowest mean ($\bar{x}$ = 2.74/5.00). Overall, mean value of all risks in the list of legal risks was 3.01/5.00.

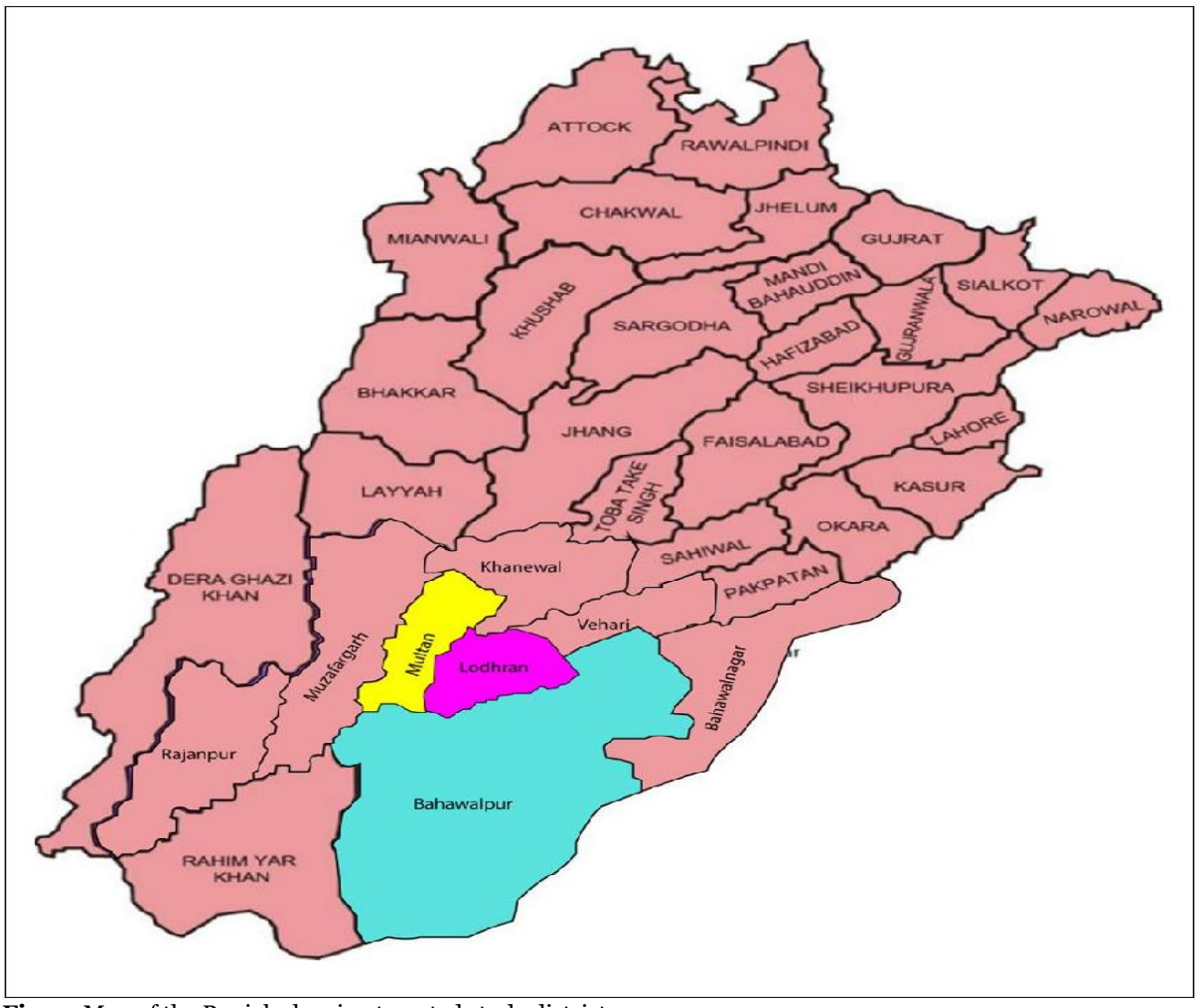

Fig. 2. Map of the Punjab showing targeted study districts.

Risk Management Strategies being adopted by Cotton growers

Risk management is essential for better crop production and ultimately for better livelihood strategies. This has been noted that better risk management strategies adopted by the farmers play significantly role in boosting crop productivity (Word Bank, 2005). In the research area cotton growers adopt variety of risk management strategies. The adoption level of these strategies was measured on five point likert scale. These management strategies were ranked on the basis of their respective mean value and presented in table 12 presented below.

The data presented in Table 12 shows that multiple risk management strategies are being adopted by cotton growers to minimize the risks involved in cotton production. Out from these wide variety of risk

management strategies "adoption of multiple income sources" is on the top with highest mean ($\bar{x}$ = 3.58/5.00). This shows that large majority of respondents adopted multiple income source strategy to cope with risks for better livelihoods. On the other hand considerable number of respondents adopted "small dams/turbine scheme" as strategy to minimize the risks with lowest mean ($\bar{x}$=2.80/5.00). Similar nature of risk management strategies were also reported by different research studies being conducted in different parts of Pakistan and rest of the world as cited by Jianjun *et al.,* 2015; Ullah *et al.,* 2015; Qasim & Ahmad, 2016; Iqbal *et al.,* 2016; Iqbal *et al.,* 2018; SDPI, 2019 and any others).

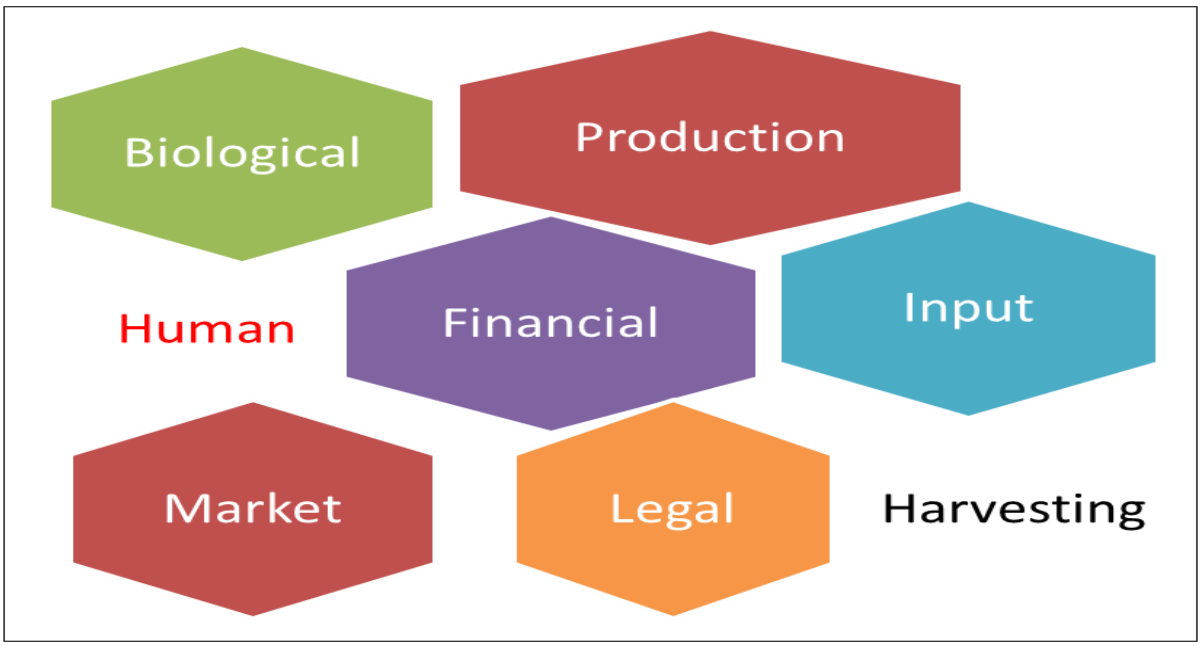

Fig. 3. Typology of risks faced by cotton growers in the research area.

Conclusion

It was concluded that majority of respondents belong to middle age category (upto 35 years) with education up to matriculation. Small size of land holding is very much common in the area like other parts of the country among production risks "high/low rainfall" was on top. Among biological risks "insect attack" was on top. Among input risks "shortage of electricity and fuel" was on top. Among market risks "monopoly of middleman" was on the top. Limited availability of skilled labour was on the top among harvesting & transportation risks. Among human risks "illiteracy" was on the top. Among financial risks "poor net return from cotton crop" was on the top. Overall rating of agricultural risks that were being faced by cotton growers of the targeted research areas shows that "Human Risks" is on the top with highest mean value (4.26/5.00). Among variety of risk management strategies "adoption of multiple income sources" was on the top with highest mean (3.58/5.00). Based on the findings it is recommended that cotton growers should adopt technology based risk assessment methods to minimize risks. They should also develop strong and viable linkages with extension and research organizations and follow recommended production technologies. It was also suggested that skill enhancement training programs for family labour should be initiated.

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References

Arbuckle JG, Jr. Morton LW, Hobbs J. 2015. Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk. Environment and Behavior **47(2),** p 205-234.

Ashraf S, Iftikhar M, Khan GA. 2013. Decisive analysis of risks in agriculture: implications for agricultural extension for sustainable management. Spanish Journal of Rural Development IV **(3),** p 41-52.

Bakhsh K, Hassan I, Maqbool A. 2005. Factors effecting cotton yield: A case study of Sargodha (Pakistan). Journal of Agriculture and Social Sciences **1(4),** p 332-334.

Berchoux T, Watmough GR, Hutton CW, Atkinson PM. 2019. Agricultural shocks and drivers of livelihood precariousness across Indian rural communities. Landscape and Urban Planning **189,** p 307-319.

Cafiero C, Angelucci F, Capitanio F, Vollaro M. 2007. Index based compensation for weather risk in the Italian agriculture: A feasibility study based on actual historical data. Paper presented at the 101st EAAE Seminar "Management of Climate Risks in Agriculture", Berlin, Germany, 5-6 July.

Cianchetta AN, Davis RM. 2015.Fusarium wilt of cotton: Management strategies. Crop Production **73,** p 40-44.

Duong TT, Brewer T, Luck J, Zander K. 2019. A global review of farmers' perceptions of agricultural risks and risk management strategies. Agriculture, **9(10),** p 2-16.

Fahad S, Wang J, Khan AA, Ullah A, Ali U, Hossain MS, Khan SU, Huong NTL, Yang X, Hu G, Bilal A. 2018. Evaluation of farmers' attitude and perception toward production risk: Lessons from Khyber Pakhtunkhwa Province, Pakistan. Human and Ecological Risk Assessment: An International Journal **24(6),** p 1710-1722.

FAO. 2010. The State of Food Insecurity in the world, Economic and Social Development. Department of the Food and Agriculture Organization of the United Nations Rome, October 2010. http://www.fao.org/3/a-i1683e.pdf

Hair JF, Anderson RE, Tatham RL, Black WC. 1998. Multivariate data analysis, Prentice Hall International Upper Saddle River, New Jersey.

Hardaker JB, Huirne RB, Anderson JR, Lien G. 2015. Coping with risk in agriculture: applied decision analysis (3rd edition), CABI Publishing, Wallingford, UK. P 296.

Iqbal MA, Ping Q, Abid M, Kazmi SMM, Rizwan M. 2016. Assessing risk perceptions and attitude among cotton farmers: A case of Punjab province, Pakistan. International Journal of Disaster Risk Reduction **16,** p 68-74.

Iqbal MA, Ping Q, Zafar MU, Abbas A, Bashir MK, Ali A, Kousar R. 2018. Farm risk sources and their mitigation: A case of cotton growers in Punjab. Pakistan Journal of Agricultural Sciences **55(3),** p 677-684.

Jianjun J, Yiwei G, Xiaomin W, Nam PK. 2015. Farmers' risk preferences and their climate change adaptation strategies in the Yongqiao District, China. Land Use Policy **47,** p 365-372.

Khan FZA, Sagheer M, Hassan M, Gul HT, Hassan F, Manzoor SA, Wahid A. 2013. Agricultural Dynamics in Pakistan: Current Issues and Solutions. Russian Journal of Agricultural and Socio-Economic Sciences **8(20),** p 20-26.

Kouser S, Qaim M. 2014. Bt cotton, damage control and optimal levels of pesticide use in Pakistan. Environment & Development Economics,

19, p 704-723.

Meraner M, Finger R. 2017. Risk perceptions, preferences and management strategies: evidence from a case study using German livestock farmers. Journal of Risk Research **21,** p 1-26.

Musshoff O, Odening M, Xu W. 2006. Modeling and pricing rain risk. Paper presented at the International Association of Agricultural Economists Conference, Gold Coast, Australia. 10.22004/ag.econ.25386

Naveed MA, Anwar MA. 2015. Understanding cotton growers' information needs from Rural Bahawalpur. Pakistan Journal of Information Management and Libraries **16,** p 21-28.

Okunmadewa F. 2003. Risk, vulnerability in agriculture: concept and context. Ph.D. Dissertation, Department of Agriculture Economics, University of Ibadan, Nigeria.

Pervez AKMK, Gao Q, Uddin E. 2016. The management of agricultural risk in Bangladesh: A proposed process. Asian Journal of Agricultural Extension, Economics & Sociology **12(1),** p 1-13.

Qasim M, Ahmad N. 2016. Agricultural Risk Sources and Risk Management Strategies: the Case of Rain-fed Agriculture in Pothwar Region, Punjab, Pakistan. Journal of Applied Environmental and Biological Sciences, **6(3),** p 18-25.

Rehman A, Chandio AA, Hussain I, Jindong L. 2019. Fertilizer consumption, water availability and credit distribution: Major factors affecting agricultural productivity in Pakistan. Journal of the Saudi Society of Agricultural Sciences **18(3),** p 269-274.

Richards TJ, Manfredo MR, Sanders DR. 2004. Pricing weather derivatives, American Journal of Agricultural Economics N°86: p 1005-1017.

SDPI. 2018. Risk Management Practices of Small Farmers: A feasibility study for introducing R4rural resilience initiative in Punjab. Sustainable Development Policy Institute, Islamabad, Pakistan. http://hdl.handle.net/11540/8149

Shadbolt NM. 2009. How Risky is your Business? Proceedings of South Africa Large Herds Conference.

Sookhtanlo M, Sarani V. 2011. Analysis of Factors Affecting on Risk Management of Wheat Production Among Wheat Farmers (Razavieh Region, Khorasan-E-Razavi Province, Iran). AGRIS online Papers in Economics and Informatics **3(4),** p 11-17.

Tadesse A, Demssie T, Kuma B. 2016. Household Food Insecurity and Associated Factors among Households in Sodo Town, 2015. Food Science and Quality Management **56,** p 10-20.

Tangermann S. 2011. Risk management in agriculture and the future of the EU's common agricultural policy. ICTSD Programme on Agricultural Trade and Sustainable Development, Issue Paper No. 34. ICTSD International Centre for Trade and Sustainable Development, Geneva, Switzerland. http://www.ictsd.org

Ullah R, Shivakoti GP. 2014. Adoption of on-farm and off-farm diversification to manage agricultural risks: are these decisions correlated? Outlook Agriculture **43(4),** p 265-271.

Ullah R, Jourdain D, Shivakoti GP, Dhakal S. 2015. Managing catastrophic risks in agriculture: Simultaneous adoption of diversification and precautionary savings. International Journal of Disaster Risk Reduction **12,** p 268-277.

Asseldonk MV, Oude Lansink AGJM. 2003. Weather Based Index Insurance to Hedge Temperature Exposure of Greenhouse Horticultural Farms. Risk and Uncertainty in Environmental and Natural Resource Economics. Edward Elgar,

Cheltanham p 235-249.

Wang W, Jin J, He R, Gong H. 2017. Gender differences in pesticide use knowledge, risk awareness and practices in Chinese farmers. Science of the Total Environment, 22-28, p 590-591. https://doi.org/10.1016/j.scitotenv.2017.03.053

World Bank 2005. Agriculture Investment Sourcebook. Module 11, Managing Agricultural Risk, Vulnerability and Disaster. Washington, DC.

Zulfiqar F, Ullah R, Abid M. 2016. Cotton production under risk: a simultaneous adoption of risk copping tools. Natural Hazards **84(2),** p 959-974.