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FARMERS' PERCEPTIONS OF RISK SOURCES AND RISK COPING STRATEGIES IN PAKISTAN

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ABSTRACT

Agricultural risks potentially decelerate the growth of a country and augment poverty level. For understanding farmers' risk behavior and strategies to cope up possible related risks, the association to socioeconomic attributes, perceived risk sources and coping strategies were studied. A total of 480 farmers from the left bank of Indus River (Sindh Province of Pakistan) were interviewed using multistage cluster sampling method through valid and reliable means. Principal component analysis extracted 80% variations for both risk sources and risk coping strategies. While observing the effect of farmers' demographic attributes on risk sources and coping strategies, change in agricultural machinery (Mean=4.25) for risk source, and promotion of products internationally (Mean=4.2) for management strategies were ranked the foremost. However, crop insurance, precautionary saving, off-farm activities and crop diversification were also found significant. From the Goodness-of-Fit indices of CFA, the RMSEA value for risk sources was 0.056 and 0.074 for risk coping strategies indicating that the measurement models are fit and within the required limits and considerably acceptable for a measurement model or structural model. Hence, the outcomes of this study may provide useful insight for policy makers, advisers, for decision making, developers and sellers of risk coping mechanisms.

Key words: Risk sources; Risk coping strategies; Factor analysis; EFA, CFA, Cronbach Alpha.

INTRODUCTION

Environmental and climate change related risks make crop cultivation highly vulnerable, which leads to adverse impact on crop production and ultimately disturbs farmers' livelihood and rural economy (Iqbal *et al.,* 2016). Since, the farmers in developing countries are completely exposed to the uncertainties of environmental hazards mainly due to floods, heavy rains, droughts, hailstorms, earthquakes, pest and diseases infestation, etc., therefore, many farmers are living on the edge of insecurity; sometimes falling just below, and sometimes rising just above the threshold of survival. Farmers do not know whether rainfall will become a blessing or supposed to an evil over a season; they do not know the prices they will receive for produce sold; and whether their crops will be survived by infected pests (Ullah *et al.,* 2014). Consequently, several options are available to manage risks, yet some farmers have developed their own coping strategies based on their perceptions and attitude towards risks (Ullah *et al.,* 2016).

Likewise, risk is understood as a factual incident or actual risk and is quite measurable (Boholm, 2003). Numerous researchers have indicated that farmers carefully manage their high investment activities through which the expected output is riskier and might lead to crop failure (Adebusuyi 2004; Alderman 2008; Isam 2014). These risks are expressively connected with the production, income, price and financial organizations (Ullah and Shivakoti 2014). Generally, it is expressed that proper timing of rain is significant for productivity of crops, otherwise at the time of harvesting it can cause loss in productivity (Özkan *et al.,* 2015). Overall, risk assessment is a three-step process: (i) risk perception, (ii) risk coping and (iii) risk strategies to manage the risks. In agriculture, risk perception is specified as strategic decision making. Generally, risk is characterized into two groups (i) business risk covering of natural, production, price, institutional, market and (ii) individual risks which every so often affects farmers livelihood (Di Falco and Perrings 2005 and Hardaker *et al.* 2004). Furthermore, Anwar *et al.,* (2013) divulged that agriculture is accompanied with infrequent climatic situations, pest infestations and insects, and variance in commodity prices. Climate change and environment related risks make crops exposed (Iqbal *et al.* 2016). Appropriate and specific perceptiveness of risks could also support farmers to evaluate the consequences and likelihood of unveiled risks (Burnett *et al.* 2013). The evaluation of farmer's responses and their perceptions regarding risks are imperative due to its significance in perceiving the decision-making behavior of farmers at the time of confronting uncertain condition (Van Winsen *et al.* 2016; and Kurkalova *et al.,* 2006).

Agriculture sector is the mainstay of Pakistan's economy, and also faces certain climatic variations (Ullah *et al.* 2015). It contributes 19.5 % in GDP, utilizing 42.3% and almost three fourth of the rural people depend directly or indirectly on agriculture (GOP 2016). Rapidly increasing population, decreasing per capita arable land and availability of water are the core dilemmas of agriculture in Pakistan. Shortage of fresh water is the key problem for crops and farmers have to primarily rely on ground water (Erenstein 2009). But the region is greatly vulnerable to natural hazards mainly caused by undesired climate change, floods and droughts (Memon and Thapa 2011; Ahmed 2013; Abid *et al.* 2015). In Sindh, the population density per km^2 is 142 and 7.4 /ha of cultivated area (GOS 2008). In the region, the expanded irrigation facility has captivated an abysmal trail on the productivity and environment of the basin itself due to escalating levels of water-logging and salinity and degradation of deltaic ecology (Memon and Mustafa 2012; Abid *et al.* 2015). Furthermore, agriculture sector of the province faces a higher uncertainty, the rainwater floods maroon the rural settlements, and all agricultural and nonagricultural livelihood activities are interrupted along with the access to social services (LBG-IAC, 2013).

In Pakistan, few similar studies are conducted at farm level, in which data sets were used to identify the perceived importance of multiple risk sources. These include Iqbal, *et al.,* (2016); Ullah, *et al*., (2016) whom identified sources of risk regarding farm level in KPK northern province and cotton farmers in the northeastern Punjab province of Pakistan. They perceived to extreme threat to the viability of their productions relating to disasters and diseases. Though these studies have recognized farmers' sources of risk and indicated how farmers behave under uncertainty, very less work is carried out regarding how farmers perceive risk sources and how they manage it in practice the southeastern province. Thus, the changing trend of climate in Pakistan further predicts inappropriate similar events in future, which invited the researchers to conduct a comprehensive study in Sindh province of Pakistan behavior on this burning issue. Till so far, no study has been conducted and drawn attention towards farmers' risk perceptions and risk coping strategies in the province/region at this level. Hence, this study is therefore designed to fill the research gap by exploring the farmers' perceptions regarding risk sources and risk coping strategies, and determine other factors influencing their decision-making process of risk. Further to reveal the associations amongst perceptions of risk sources and risk coping strategies, the factor scores/regression residuals were employed in OLS regression to see the relationship with farm and farmers' attributes.

This article is segregated into four segments. Segment 2 contains the material and methods, which elucidates the analytical framework, and specifications of models. In segment 3 the results and discussion of the study are elaborated and in segment 4, our results are concluded.

MATERIALS AND METHODS

Data collection and Sampling Strategy: For determining the sample size either for when the population is too large or the figure is unknown formula for shaped by Teddlie, and Yu (2007) was used. Finally, it was decided to administer 480 questionnaires to conduct this study. In this regard, the maximum sample size of 480 respondents was considered to study at 95% confidence level, and ±4.475 margin of error.

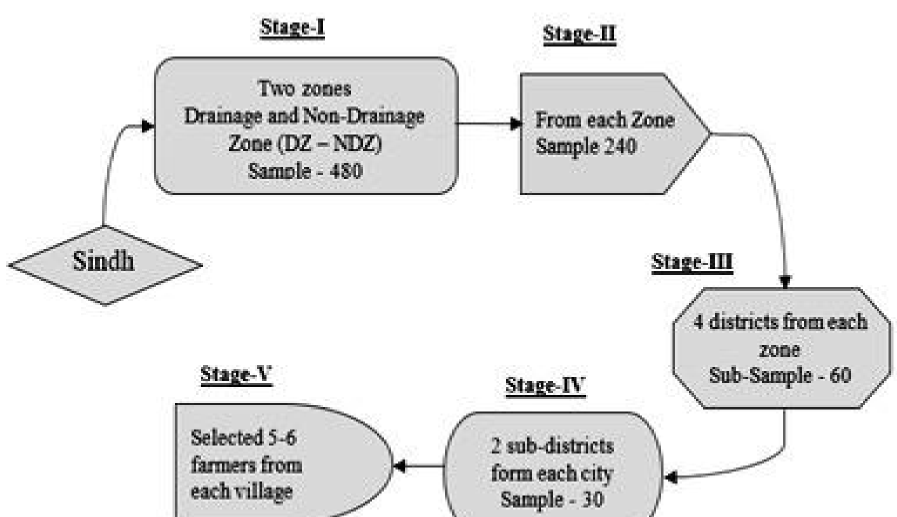

Figure 1. Sampling stages for selecting farmers in the study

$$n_0 = \frac{Z^2 pq}{e^2} = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.04475)^2} = 480 \quad \text{.... (1)}$$

Where, n_0 = Sample Size, Z^2 = Abscissa of the normal curve that cuts off an area at the 95%. $Z = 1.96$, e = desired level of precision. $e = 0.05$, p = estimated proportion of an attribute that is present in the population, $p = 0.5$, $q = 1-p$, hence $q = 0.5$ respectively.

Further farm level cross sectional data was collected from 480 farmers using multi-stage stratified cluster sampling technique (**Error! Reference source not found.**). In the first stage, we selected the study area, by using the drainage area map of Sindh given by the SIDA (Sindh Irrigation and Drainage Authority). In the second stage left bank of Indus is divided into two zones existing drainage (LBOD) and (non-drainage) proposed drainage areas. In the third stage four districts from each zone were selected, keeping in view both heterogeneity and homogeneity in some attributes. In the fourth stage, two sub districts (*Talukas*) were selected. In the fifth stage, 5 to 6 farmers from each village were interviewed. Overall 480 and precisely from each zone 240 farm household were interviewed. Prior starting the study, enumerators were trained off-field and in-field about the study intentions, questionnaire and data collection methods were explained briefly. Further, questionnaire was pre-tested in the field, not only to fulfill the reasons of in-field training for interviewers, but likely for improving the quality of survey and to avoid missing any important data. The interviews were conducted basis of research ethics and on shared research principles (Abid *et al.* 2016). Casual settlements were adopted, prior starting farmers interview by clarifying the intentions of the study. Using interviewing method, 55 questions related to different risks sources, and 43 questions related to different types of coping strategies they prefer to cope with risk sources, their income sources and various other farm household characteristics were asked to rate through a valid and reliable 5 points (Strongly Disagree to Strongly Agree) Likert scale (Preston and Colman 2000).

Attributes of the study area: Specifically, Sindh province was selected for the data collection, because it has vast network of irrigation and drainage that falls into the Arabian Sea (Azad, 2003). Sindh province lies between the north latitude 23–35° and 28–30, and east longitude 66–42 and 71–01°. Area of the province spreads over 44,016 miles^2 almost 17.7 % of the total area of Pakistan 307,376 miiles^2. It is roughly 360 miles in length, and mean width of approximately 174 miles, in some areas it swells almost to 273 miles (Kazi 2014). The provinces climate is typically dry and hot, placing it in the arid subtropical zone. The plain of Sindh alluvial is segregated into three zones: the upper, middle, and the lower zone. In summer, the upper zone records the maximum temperatures reaching more than 52°C, where dust storms are common and winters are cold at 6°C temperature. In the middle zone, which stretches between Sukkur and Hyderabad, as the term implies, the maximum temperature is lower than the upper zone, but higher than the lower zone. The weather is usually hot during the day, and the nights are mostly much calmer and pleasing. The lower zone lies between Hyderabad and the Arabian Sea is very humid, and winds blow from the southwest in the summer and winds from northeast in the winter seasons are common.

Analytical Procedure

Factor Analysis

Prior to conduct statistical analysis, the Confirmatory Factor Analysis (CFA) was applied using AMOS software to validate the constructs. Confirmatory factor analysis is a tool to establish the validity and reliability of a scale (Kalk *et al.*, 2014). It is generally part of a procedure of Structural Equation Modelling (SEM) (Beavers *et al.,* 2013), but also used for a variety of purposes, such as psychometric evaluation, the detection of method effects, construct validation, evaluation of measurement invariance and convergent validity (Marsh *et al.* 2014). The factor analysis technique was adopted as given by Bergfjord (2009); and Ahsan (2011). The factor analysis model reveals the variation and co-variation in a set of observed latent variables which explain the variance of original variables (Hair *et al.* 2009).

The Heywood case is given as $\theta jj < 0$, $\hat{\eta}_i$ are the factor scores and factor determinacy quantity of factor scores; correlation between η_i and $\hat{\eta}_i$. The information in a reduced number of factors, the *Kaiser criterion* of (eigenvalue $\geq$ 1) was a checkpoint to decide which factors are to be excluded (Schönrock-Adema *et al.* 2009). Sources and strategies were divided into different factor clusters according to rotated component matrix table or orthogonal varimax rotation table. In factor analysis technique values of loadings more than 0.30 reflect as significant loadings in factors. However, loadings of $\geq$ 0.40 are judged as more significant factors and loadings >0.50 are assumed very significant (Akcaoz and Ozkan 2005). Since, the researchers were not interested in developing SEM, this study considered ≥0.40 factor loadings for illustrating important factors. Standardized factor scores for each farmer were also saved to use in regression. Kaiser-Mayer-Olkin (KMO) value that is a measure of sampling adequacy was 0.842 for risks sources and 0.793 for risk management strategies. Both values were more than 0.70 exhibiting that the arrangement of correlation was pretty compact and factor analysis was quite eloquent (Beavers *et al.* 2013).

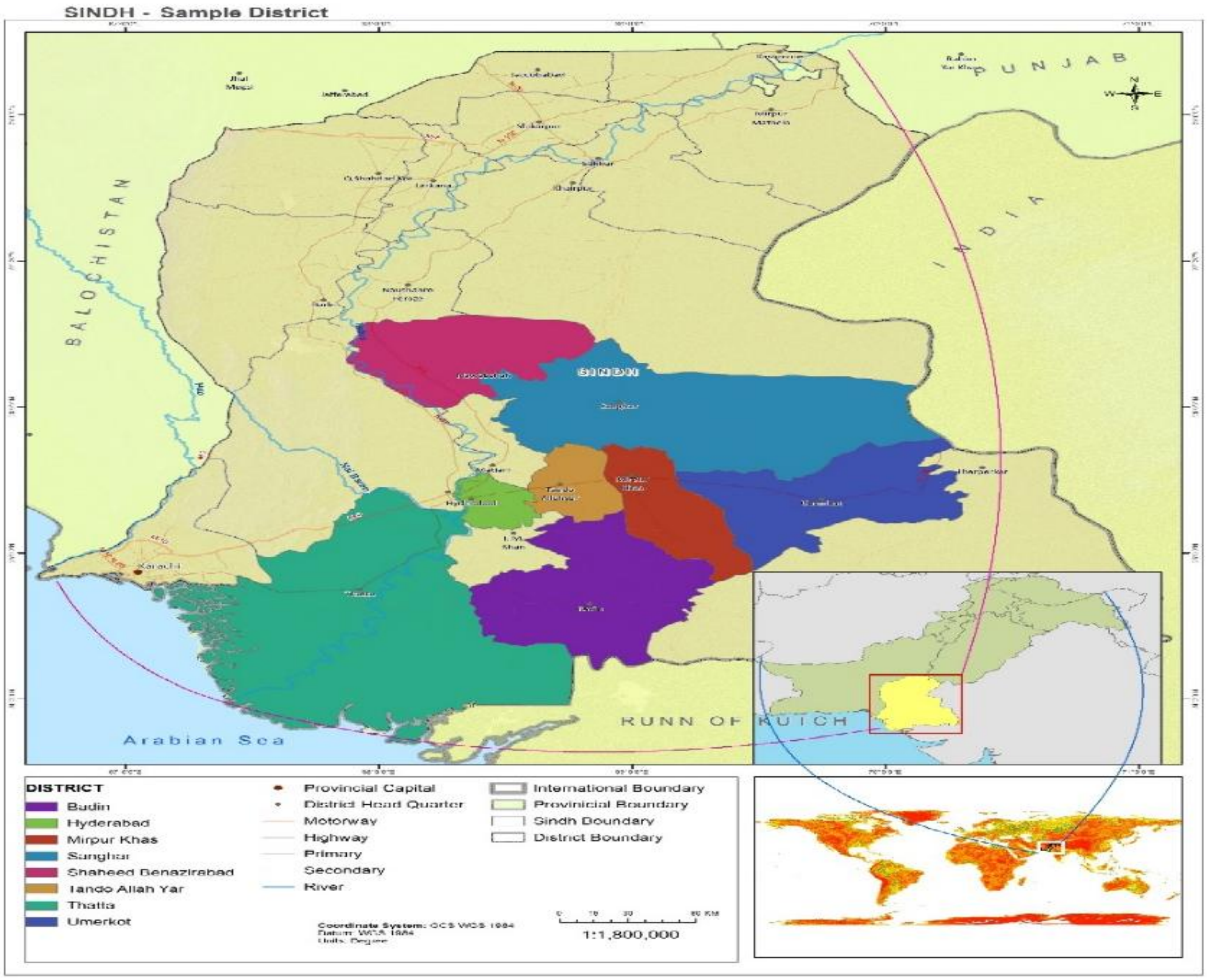

Figure 2. Sample study districts in Sindh province, Pakistan (World map source: ESRI, 2015).

Cronbach's Alpha

For determining the reliability of the data, Cronbach's alpha test was applied Table ***1***. The internal consistency of reliability is based on the extent of response to a certain question and similarly for others (Spiliotopoulou 2009). Whereas, the Cronbach's alpha was tested and reliability of data was 0.655 to 0.966, where majority of the construct variables ranged between 0.8 to 0.9 levels, which is considered excellent reliability.

Further, the homogenous factor scores achieved from the regression analysis were regressed on farms' and farmers' demographic attributes to determine the impact of these attributes on the farmers' perceptions of risk sources and coping strategies. Precisely, the regression models are solved in the following equations:

Table 1. Reliability analysis for the risk factors.

Risk	Factors	Items	Cronbach Alpha
Sources	Production & Labour	3	0.903
	Natural	3	0.889
	Finance & Management	6	0.896
	Technology	2	0.776
	Social & Institutional	3	0.948
Management Strategies	Capital Management	2	0.655
	Research & Development	2	0.966
	Diversification	3	0.849
	Information & Management	3	0.777
	Wealth management	3	0.806

$$FRS_{it} = \alpha_0 + \alpha_{Age} + \alpha_{Education} + \alpha_{Farming\ Exp} + \alpha_{Farm\ Size} + \alpha_{Family\ Size} + \alpha_{HH\ Distance} + \alpha_{HHStatus} + \alpha_{Credit} + \alpha_{Remittances} + \alpha_{Crop} + \alpha_{Livestock} + \alpha_{Diversification} + e_t \quad \text{...... (2)}$$

$$FCS_{it} = \beta_0 + \beta_{Age} + \beta_{Education} + \beta_{Farming\ Exp} + \beta_{FarmSize} + \beta_{Family\ Size} + \beta_{HH\ Distance} + \beta_{HHStatus} + \beta_{Credit} + \beta_{Remittances} + \beta_{Crop} + \beta_{Livestock} + \beta_{Diversification} + \varepsilon_t \quad \text{....... (3)}$$

Hence, FRS_{it} in equation (2) indicates the homogenous factor scores for risk sources factors (*i = 1,2, 3..., n*), obtained from the factor analyses of risk sources. Likewise, FCS_{it} in equation (3) represents the homogenous factor scores for risk coping strategies respectively.

CFA relationship of Risk Perceptions: In contrast, CFA was also applied by inserting all (AVE ≥ 0.4) related factor, including items in their respective construct categories and performed correlation to demonstrate the discriminant validity. The correlations between each of the two factors were in between +1 to -1 to achieve discriminant validity; however, a correlation of 0.85 or larger an absolute value between variables is discouraged (Schreiber, *et. al.,* 2006).

Table 2. Correlation of Factors.

Latent	Factors	Correlation (≤ .85)
Risk Sources	Technical-Production	-.07
	Technical-Natural	.30
	Technical-Social and Institutional	.23
	Technical-Finance and Marketing	-.33
	Production-Natural	-.25
	Production-Social and Institutional	-.19
	Production-Finance and Marketing	.72
	Natural-Social and Institutional	.54
	Natural-Finance and Marketing	-.55
	Social and Institutional-Finance and Marketing	-.44
Risk Coping Strategies	Research & Development-Wealth Management	.15
	Research & Development-Capital Management	.57
	Research & Development-Diversification	-.44
	Research & Development-Information Management	-.47
	Wealth Management- Capital Management	-.04
	Wealth Management-Diversification	-.04
	Wealth Management-Information Management	-.03
	Capital Management-Diversification	-.48
	Capital Management-Information Management	-.55
	Diversification-Information Management	.69

All the correlation estimates presented in Table **2** after performing third order CFA explain factors' discriminant validity. Likewise, Schreiber *et. al.,* (2016) was of the opinion that when the correlation between two factors are or very close to one or minus one, it is considered to have poor discriminant validity, however, a correlation of less than 0.85 is considerably accepted. Hence, third order CFA was applied by placing all the related factors, including their items and applied correlation to demonstrate the discriminant validity.

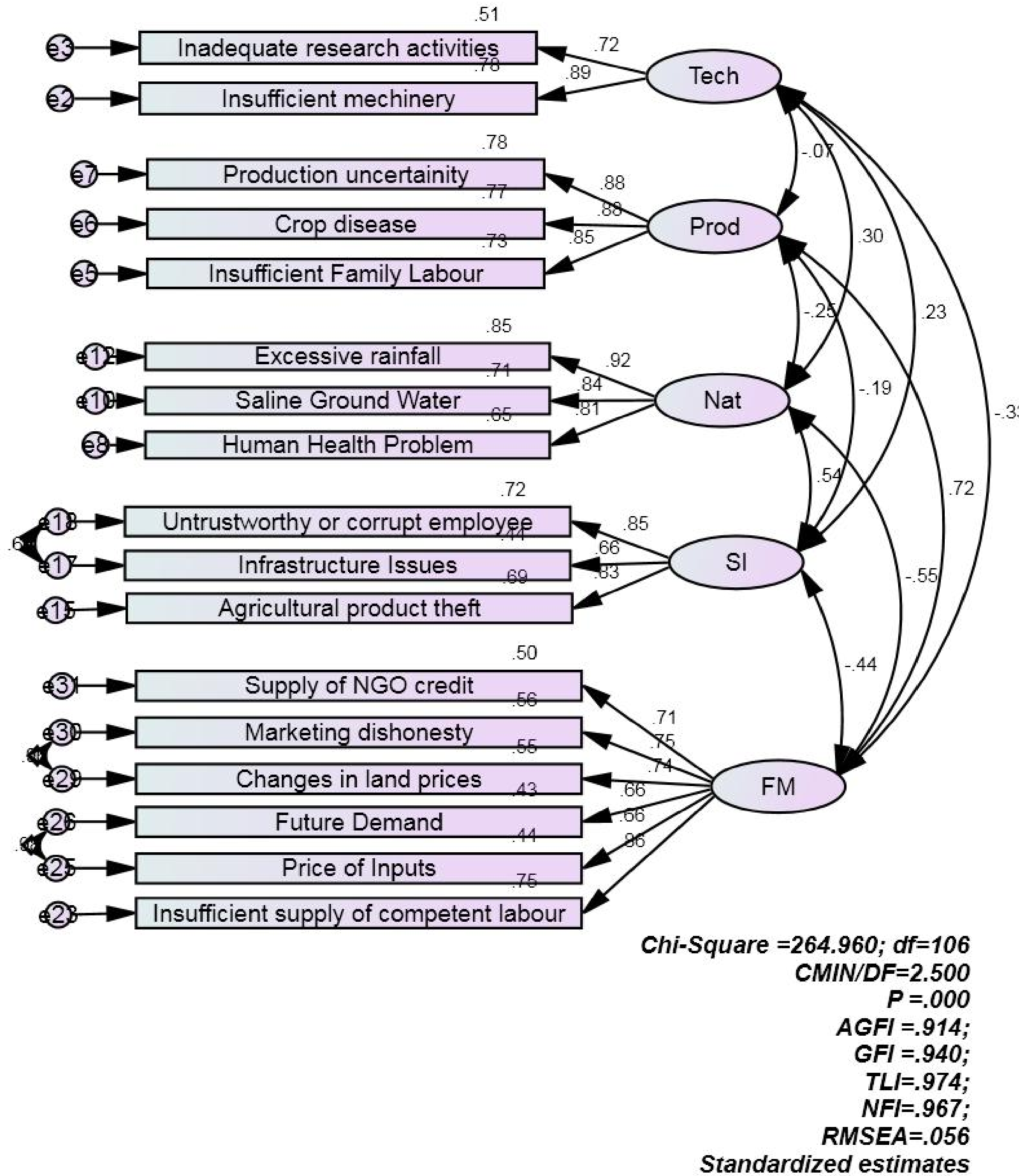

Figure 3. Correlation of Risk Source through CFA.

Albeit, being concerned about the Goodness-of-Fit indices (model fit), which determines the degree to which the proposed model predicts (fits) the observed covariance matrix (Ho 2006). Model fit is determined by fit indices which includes; chi-square (χ^2), relative χ^2 (χ^2/df), RMSEA, GFI, AGFI, and TLI. Figure 3 depicts the measurement model emerged as a result of several adjustments made from confirmatory factor analysis (CFA). The Goodness-of-Fit indices are under the suggested limits and as follows; Chi-square (χ^2) 264.960, *df*= 106, Relative χ^2 (χ^2/df) 2.500, p = 0.000, AGFI = .914, GFI = .940, TLI = .974, and RMSEA = .056. From these Goodness-of-Fit indices, it concluded that the measurement model is fit and within the required limits and considerably acceptable for a measurement model or structural model.

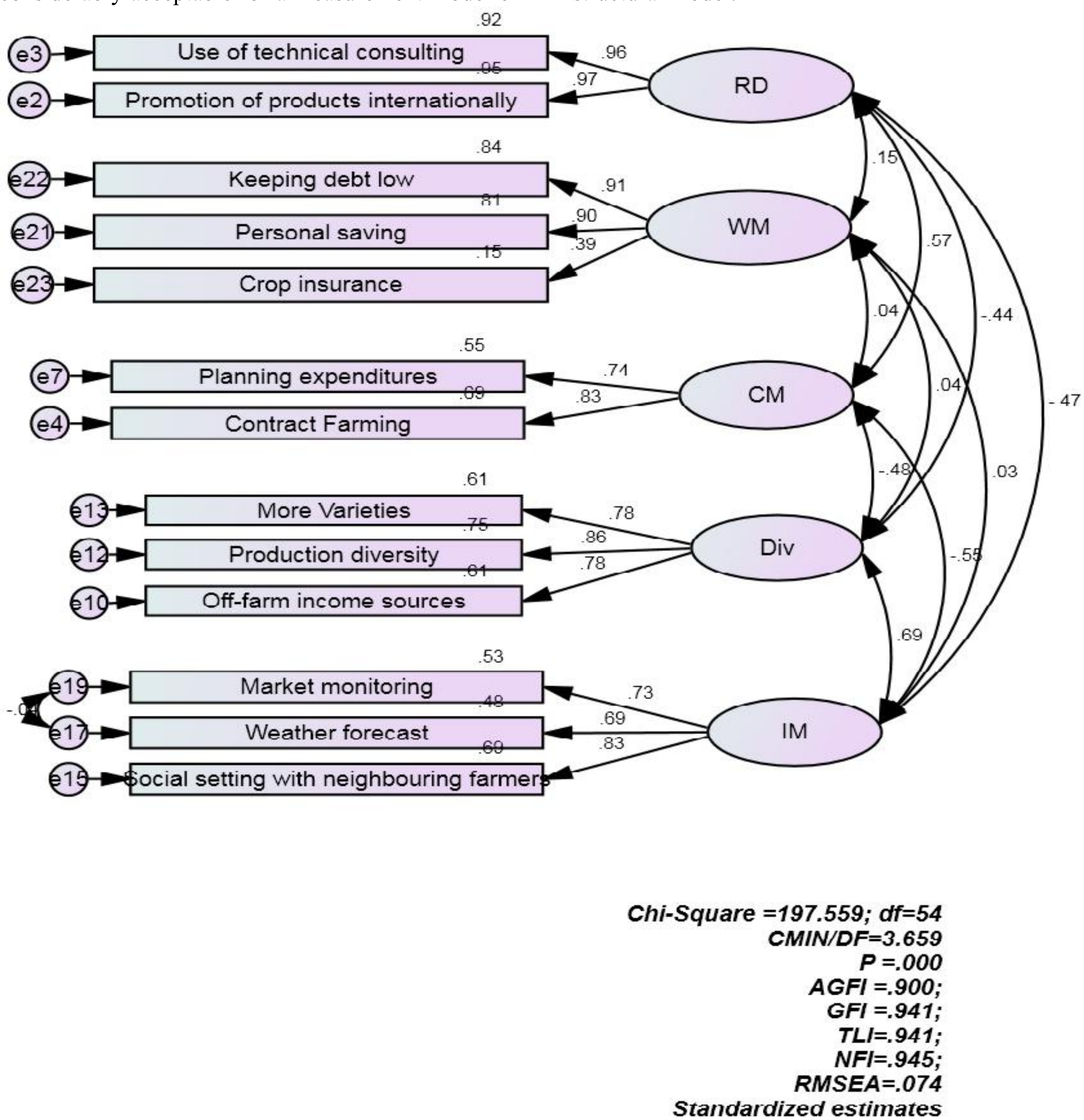

Figure 4. Correlation of Risk Coping Strategies through CFA

Figure 4 depicts the measurement model emerged as a result of several adjustments made from confirmatory factor analysis (CFA). The Goodness-of-Fit indices are under the suggested limits and as follows; Chi-square (χ^2) 197.559, *df*= 54, Relative χ^2 (χ^2/df) 3.659, p = 0.000, AGFI = .900, GFI = .941, TLI = .941, and RMSEA = .074. From these Goodness-of-Fit indices, it concluded that the measurement model is fit and within the required limits and considerably acceptable for a measurement model or structural model.

RESULTS AND DISCUSSION

Table 3 presents all independent variables included in the regression analysis. The mean age of farmer was 42 years with 8 years of education and a household size of 9 members. Likewise, the farming household owned 43 acres of land, and had 22 years of farming experience. The distance from output market was about 11 km approximately. Results further indicated that 55 percent farmers were full time farmers and about 70 percent had access to credit. Also, 23 percent had other income sources like remittances from the family member working in different areas.

Table 3. Explanatory variables used for OLS regressions.

Explanatory Variables	Mean	SD	Description
Age of Farmer (years)	42.22	12.86	Continuous
Education (Years)	8.36	3.43	Continuous
Farming experience (years)	22.73	9.93	Continuous
Farm size (acres)	43.09	85.21	Continuous
Family Size (No.)	9.04	1.45	Continuous
Distance from output Market	11.20	5.78	Continuous
HH Farming Status	0.55	0.50	Binary value is 1 if full time farmer 0 otherwise
HH uses Credit	0.70	0.46	Binary value is 1 if have access to credit and 0 otherwise
Remittances	0.23	0.42	Binary value is 1 if Remittances and 0 otherwise
Crop income (Annual)	1464146	3428572	Continuous
Livestock Income (Annual)	96566	74735	Continuous
Off-farm Income / Diversification (Annual)	243617	232676	Continuous

Source: Own survey 2016

Risk Sources Perceptions

EFA estimates for farmer's perceptions regarding risk sources: Farmers' perceptions for 17 risk sources factor matrix and descriptive statistics are revealed in

Table 4. Farmers were probed for scoring for each source of risk on a Likert scale from 1 (strongly disagree) to 5 (strongly agree) (Rao *et al.,* 2006) to utter how realistically they considered each risk source for farming. The farmers' risk sources gradings are given in downwards order respectively. Further the significant factor loading items having value >|0.40| are accounted as significant factors (Akcaoz and Ozkan 2005; Van Winsen *et al.* 2016; Ping *et al.* 2015). The descriptions of factors from 1 to 5 are also specified in *Production and Labour, Finance and Management, Social and Institutional, Natural, and Technology* respectively.

Insufficient machinery was found the most imperious risk source with 4.25±0.803 and inadequate research facilities with a mean value of 4.23±0.789 were ranked as key technological risk source. Likewise, Isam, (2014); Ping, *et al.* (2015); Saqib *et. al.,* (2016) have indicated advanced machinery and adequate research facilities as a source of technological progress. Furthermore, crop disease and production uncertainty in risk source were ranked 2nd and 3rd with mean value of 4.24±0.675 and 4.238±0.657. Likewise, Usman *et al.,* (2012); Khaliq, Matloob, and Chauhan, (2014) also indicated that crop diseases and weeds were the main constraints for production uncertainty of cereal crops in Pakistan. Similar findings were also indicated in several studies (Isam 2014; Ping *et al.* 2015; Saqib *et.al.,* 2016). Henceforward, insufficient family labour (4.231±0.704) and insufficient supply of competent labour (3.83±0.963) significant in *production and labour* and in *finance and management* factors. In addition, the variable of future demand of different crops was (3.99±0.919) and variation in prices of inputs was (3.98±0.925). Also, supply of NGO credit (3.83±1.09), Changes in land prices (3.54±1.359), marketing dishonesty (3.49±1.413), as risk sources reside significantly in finance and management factor. These findings coincide with Abid *et al.,* (2016). The following source of risk is agricultural product theft (3.727±0.686), untrustworthy or corrupt employee (3.715±0.684), are the social and institutional risk sources that draw the farmers towards a risk outcome. Furthermore, excessive rainfall (3.685±0.626), Saline ground water (3.696±0.655), and human health problem (3.727±0.716) are the risk sources for *Natural* factor that are uncontrollable. These findings also coincide with Akcaoz and Ozkan, (2005); and Van Winsen *et al.* (2016). Followed by, the risk sources were confined in five factors using principal component extraction method. The eigenvalues were >1, with a total cumulative variance 80.75% of these five factors. Though, variance ≥ 59.85 is satisfactory in social science (Ahsan, 2011).

Table 4. Descriptive statistics and EFA factor loadings of risk sources.

KMO sampling Adequacy = 0.816		Bartlett's Test of Sphericity $\chi2$ = 9154.61***					
RISK SOURCES	**Mean**	**SD**	**1**	**2**	**3**	**4**	**5**
Insufficient machinery	4.254	0.803	0.005	-0.058	0.103	0.145	**0.858**
Crop disease	4.244	0.675	**0.882**	0.194	-0.014	-0.086	0.038
Production uncertainty	4.238	0.657	**0.891**	0.175	-0.03	-0.053	-0.022
Inadequate research activities	4.233	0.789	-0.028	-0.066	0.155	0.014	**0.849**
Insufficient Family Labour	4.231	0.704	**0.878**	0.132	-0.019	-0.058	-0.036
Future Demand	3.990	0.919	0.204	**0.878**	-0.234	-0.125	0.038
Price of Inputs	3.983	0.925	0.21	**0.877**	-0.228	-0.128	0.041
Insufficient supply of competent labour	3.835	0.963	**0.542**	**0.492**	-0.145	-0.304	-0.213
Supply of NGO credit	3.833	1.093	0.592	**0.440**	0.04	-0.18	-0.065
Infrastructure Issues	3.785	0.771	0.03	-0.096	**0.889**	0.12	0.122
Agricultural product theft	3.727	0.686	-0.053	-0.173	**0.926**	0.216	0.099
Human Health Problem	3.727	0.716	-0.105	-0.129	0.129	**0.869**	0.043
Untrustworthy or corrupt employee	3.715	0.684	-0.046	-0.163	**0.933**	0.205	0.113
Saline ground water	3.696	0.655	-0.129	-0.161	0.2	**0.842**	0.099
Excessive rainfall	3.685	0.626	-0.094	-0.190	0.211	**0.87**	0.11
Changes in land prices	3.567	1.363	0.346	**0.644**	-0.044	-0.241	**-0.407**
Marketing dishonesty	3.535	1.373	0.358	**0.638**	-0.043	-0.248	**-0.408**
Eigenvalues			*6.729*	*2.843*	*1.543*	*1.482*	*1.133*
Percentage of the total variance			*39.582*	*16.721*	*9.075*	*8.715*	*6.663*
Cumulative percentage of total variance			*39.582*	*56.304*	*65.379*	*74.094*	*80.757*

Note: Loadings >0.4 are given in Bold. Factor columns 1,2,3,4,5 respectively are named as, *Production and Labour, Finance and management, Social and Institutional, Natural,* and *Technology* respectively.

Relationship of perception of risk sources and farm and farmer's characteristics: While determining the association of various farmer's characteristics with perception of risk sources, five factors or independent variables obtained significant scores over dependent variable during OLS regression analysis. Hence,

Table 5 exhibits that the farm experience, family size, crop income, income from livestock revealed significant relationship with *production and labour* factor scores. However, age, education, farm size, distance from output market, farming status, HH uses credit, other sources of income and off -farm income were found non-significant. It may be perceived that importance of these non-significant indicators was comparatively less in the study area, as also indicated by Abid *et al.,* (2015). Regarding *social and institutional* factor scores, education, distance from output market, and livestock income had positive relation. This indicates that farmers have high perceptions of these factors regarding *social and institutional* risks as compare to credit accessibility, farming status, and other sources of income. Likewise results were also reported in numerous studies (Lien *et al.* 2006; Ahsan 2011; Gebreegziabher and Tadesse 2014). Furthermore, farming experience and other sources of income had positive relation with *natural* factor score, while, other variables had weak relations with *natural* risk factor scores. Similar findings were also revealed by Ahsan, (2011), and Gebreegziabher and Tadesse, (2014). However, age, farming status, livestock income and off-farm income had relation with *production and labour* risk factor score. Likewise, Van Winsen *et al.* (2016) and Gebreegziabher and Tadesse, (2014) indicated production risk as an important risk factor. Furthermore, *technological* risk factor score had significant relation with farm size and HH uses credit. Hence, current findings coincide with prior studies (Saqib *et. al.,* 2016 and Gebreegziabher and Tadesse 2014). Albeit, in overall variables used in the models were significant with at least one of the dependent variable. Likewise, Van Winsen *et al.* (2016) and Lien *et al.,* (2006) also revealed similar outcomes related to risk perception attributable to dissimilar perceptions of risk sources from farmer to farmer.

Table 5. OLS regression for farmers' attributes in relation to factor residuals of risk sources.

Independent Variables	Production and Labour	Finance and Management	Social and Institutional	Natural	Technology
Age of farmer	.002	.001*	-.004	.000	.002
Education	-.003	-.006	.007*	-.012	.017
farming experience	.009*	.003	.000	-.012**	.000
Farm size (acres)	.001	-.002	.001	-.001	.001*
Family size (number)	.058*	.030	-.012	.013	.002
Distance from output market	-.003	.008	-.018**	.011	-.003
Farming status	.050	.298***	-.081	.058	.094
HH uses credit	.078	.059	.068	.106	-.051*
Other income sources/ Remittances	-.019	-.076	.017	.166*	.058
Crop income (Annual)	$-1.47\times10^{-08*}$	4.23×10^{-08}	3.49×10^{-09}	2.601×10^{-08}	-2.176×10^{-08}
Livestock Income (Annual)	$1.549\times10^{-06**}$	$2.76\times10^{-06***}$	$-1.974\times10^{-06***}$	-1.677×10^{-06}	7.77×10^{-07}
Off-farm Income (Annual)	2.00×10^{-07}	$3.85\times10^{-07**}$	5.548×10^{-08}	1.426×10^{-08}	3.711×10^{-07}
Durbin-Watson	***1.666***	***2.065***	***1.907***	***1.606***	***1.610***

Note: *Significance level is indicated * Significant level: P ≤ 0.10. *** Significant level: P ≤ 0.01. ** Significant level: P ≤ 0.05.*

Risk Coping Strategies

EFA estimates for farmer's perception of risk coping strategies:

Table **6** depicts the perceptions of risk coping strategies, from which 13 foremost perceptions, and were then organized according to mean score in descending order. Promotion of products internationally (4.20±0.679), was ranked as the most significant strategy amongst the farmers, followed by the use of technical consultant (4.18±0.701) for farming were also perceived commonly as risk management strategy amongst the farmers. These findings can be coincided with Iqbal *et al.,* (2016); Ullah, *et al.,* (2016). Farmers' perceptions about having crop insurance (3.956±0.552) was the 3rd most significant strategy amongst the farmers. In literature, insurance against production loan as risk management strategy is also reported in numerous studies (Shen *et al.* 2015; Burns and Prager 2016; Pasaribu and Sudiyanto 2016). Though, Pasaribu and Sudiyanto (2016) concluded that the Indonesian farmers have adopted crop insurance policy, as an effective coping strategy. Likewise, farmers perceived that the personal saving (3.935±0.565) and keeping debt low (3.931±0.576) are also important risk coping strategies in farming and fall in *wealth management* factor. In number of studies (Akcaoz and Ozkan 2005; Lien *et al.* 2006; Aditto *et al.* 2012; Qasim 2012) revealed that the farmers are suffering financially because of the diminishing purchasing power. In this case, off-farm income is a likely way to overcome these risky issues. Likewise, in line with farmers also perceived off-farm income (3.727±0.734) as the key risk coping strategy. Similarly, farmers perceived for production diversity (3.696±0.65). Additionally, another perceived risk coping strategies for farmers was growing more varieties (3.638±0.694) and collectively were grouped in *diversification* factor. However, Aditto *et al.,* 2012; Qasim, (2012) noted likewise opinions that production diversity is an important risk management strategy for the farmers in developing economy. Furthermore, weather forecast (3.727±0.686), market monitoring (3.55±0.931) and social setting with neighboring farmers (3.23±1.118) were the next risk coping strategies were exposed by the farmers and were assembled in *information management* factor. Likewise, Iqbal *et al.,* (2016) summarized in their studies that capital management and information management were important coping strategy for risks in agriculture sector. In *Research and Development* factor, planning of expenditures (3.494±0.675) and contract farming (3.535±1.373) were prevailed as key risk coping strategies. In general majority of the farmers rely on contract farming in the sense of availing fertilizer, seed and other inputs from commission agents on credit and market their produce to the agent on harvesting (Ping, *et al.,* 2015). Henceforth, through factor analysis for risk coping strategies of farmers, five factors were confirmed with eigenvalue higher than 1 and explaining a cumulative variance of 80.74%.

Table 6. Descriptive statistics and EFA factor loadings of risk coping strategies.

KMO sampling Adequacy = 0.754			Bartlett's Test of Sphericity χ2 = 4603.76***				
RISK STRATEGIES	**Mean**	**SD**	**1**	**2**	**3**	**4**	**5**
Promotion of products internationally	4.200	0.679	-0.198	-0.174	0.090	**0.905**	0.200
Use of technical consulting	4.188	0.701	-0.196	-0.154	0.090	**0.908**	0.205
Crop insurance	3.956	0.552	-0.167	0.271	**0.510**	-0.215	0.530
Personal saving	3.935	0.565	0.052	0.003	**0.975**	0.103	0.000
Keeping debt low	3.931	0.576	0.054	-0.003	**0.974**	0.103	-0.003
Off-farm income sources	3.727	0.716	**0.834**	0.190	0.037	-0.110	-0.155
Weather forecast	3.727	0.686	0.212	**0.831**	0.082	-0.031	0.037
Production diversity	3.696	0.655	**0.805**	0.267	0.030	-0.205	-0.146
More Varieties	3.638	0.694	**0.818**	0.273	0.006	-0.120	-0.012
Market monitoring	3.550	0.931	0.271	**0.701**	0.012	-0.239	-0.158
Contract Farming	3.535	1.373	-0.128	-0.378	-0.077	0.226	**0.741**
Planning expenditures	3.494	0.675	-0.113	-0.074	0.037	0.355	**0.807**
Social setting with neighbouring farmers	3.421	1.057	0.309	**0.763**	-0.040	-0.146	-0.205
Eigenvalues			*4.721*	*2.391*	*1.369*	*1.093*	*0.922*
Percentage of the total variance			*36.312*	*18.393*	*10.535*	*8.405*	*7.093*
Cumulative percentage of total variance			*36.312*	*54.705*	*65.239*	*73.645*	*80.738*

Note: Loadings >0.4 are given in Bold. Factors 1,2,3,4,5 respectively are named as, *Diversification, Information management*, *Wealth Management, Capital management, Research and Development,* and respectively.

Relationship of farmer's attributes and risk coping strategies: The relationship between farmers' background and farmers' risk coping strategies were identified using multiple OLS regression models as reported in **Table 7**. Results indicate that *diversification* risk factor was associated with farming experience, farm size, HH uses credit and livestock income. These outcomes coincide with Gebreegziabher and Tadesse, (2014) Abid, *et al.,* (2016); Ping, *et al.,* (2016). Further results divulged that farm experience, farming status and livestock income contribute imperatively. However, these variables significantly regressed with *capital management* risk factor. Similar findings can be seen in Gebreegziabher and Tadesse, 2014; Ping, *et al.,* (2015); Abid *et al.,* (2016). Moreover, age, distance from output market, and HH uses credit were significantly associated with *research and development* factor scores. The farming HH use credit as a development factor, generally for buying farm machinery and other essentials and are dealt seasonally. Similar findings were also revealed by Rizwan, *et.al.,* (2017). Furthermore, the *information management* risk factor was significantly associated with farm size, crop income, and livestock income respectively. However further results indicate that more educated farmers can distinguish *wealth management* as a vital strategy. Similar findings were also revealed in many previous studies (Ahsan and Roth 2010; Gebreegziabher and Tadesse 2014). Moreover, off-farm income, and livestock were also considered important to *wealth management* risk strategy. Similar outcomes can be reveal by Ahsan and Roth, (2010), Gebreegziabher and Tadesse (2014) and Iqbal, *et al.,* (2016).

Table 7. OLS regression for farmers' attributes in relation to factor residuals of risk coping strategies.

Independent Variables	Diversification	Information Management	Wealth management	Capital Management	Research & Development
Age of grower	5.19×10^{-04}	-0.00264	-0.00166	-2.71×10^{-04}	$1.37\times10^{-04*}$
Education	-0.00762	0.00521	0.01897^{*}	9.68×10^{-04}	-0.01893
Farming experience	-0.00875^{*}	-0.00241	-0.00348	0.01501^{*}	-6.41×10^{-04}
Farm size (acres)	-0.00101^{*}	4.32×10^{-04}	-7.89×10^{-05}	-4.89×10^{-04}	-4.39×10^{-04}
Family size	0.01341	-0.06047^{**}	0.06572^{*}	-0.00392	0.03196
Distance from output market	0.00953	-0.00924	-0.00568	0.0066	0.00396^{*}
Full/part time farmer?	0.01118	-0.1167	-0.06102	0.1589^{*}	0.15415
HH uses credit	0.11662^{*}	-0.01919	-0.02356	0.03188	0.14994^{*}
Other income sources	0.12705	0.0704	0.15341^{*}	-0.11336	-0.0223
Crop income (Annual)	2.63×10^{-08}	$1.41\times10^{-08**}$	-1.81×10^{-09}	2.70×10^{-08}	2.22×10^{-08}
Livestock Income	$-1.77\times10^{-06***}$	$-3.54\times10^{-06**}$	$3.61\times10^{-06***}$	$8.96\times10^{-07*}$	4.47×10^{-07}
Off-farm Income	-8.87×10^{-08}	-5.85×10^{-08}	2.95×10^{-07}	$3.65\times10^{-07*}$	2.27×10^{-07}
Durbin-Watson	***1.618***	***1.888***	***2.149***	***1.298***	***1.812***

Note*: Significance level is indicated* * *Significant level:* $P \leq 0.10$. *** *Significant level:* $P \leq 0.01$. ** *Significant level:* $P \leq 0.05$.

Conclusion: This study was established to seek the farmers' perceptions of risk sources and coping strategies in connection with their background. Based on the results of this study and previous available literature, the researchers conclude that there is slight variation of farmers' perception in Sindh province regarding risk sources and risk coping strategies. Since, the findings of this study indicated that the key risks sources have conveyed significant changes in agricultural machinery, price of farm equipment, and absence of farmer's cooperative, private capital resources and human health issues, therefore, crop insurance, market information, off-farm income sources, and production diversity are supposed to effective risk coping strategies among the farming communities of Sindh province of Pakistan. Nevertheless, to a certain degree there are disagreements between risk sources and coping strategies, mainly due to illiteracy and lack of adequate capital. Therefore, farmers are certain for insurance against their produce, and market them by avoiding agents and inadequate storage facilities to store and sell the produce at better prices. It is therefore suggested that the farm advisories must be established/activated to make them (farmers) aware about possible risks that may disturb their agricultural economy. In addition, aligned coping strategies of prevailing risks should also be communicated to the local farmers to enhance their agricultural output and overall income.

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REFERENCES

Abid, M., J. Scheffran, U. A. Schneider and M. Ashfaq, (2015). Farmers' perceptions of and adaptation strategies to climate change and their determinants: The case of Punjab province, Pakistan. Earth Syst Dynam., 6(1), 225–243.

Abid, M., J. Schilling, J. Scheffran and F. Zulfiqar (2016). Climate change vulnerability, adaptation and risk perceptions at farm level in Punjab, Pakistan. Sci Total Environ, 547 (February), 447–460.

Adebusuyi, B. S. (2004). Stabilisation of commodity market of interest to Africa. Workshop on Constraints to Growth in Sub-Saharan Africa. Proceedings of the Intergovernmental Group of Twenty-Four, Pretoria, South Africa.

Aditto, S., C. Gan, and G. V. Nartea (2012). Sources of risk and risk management strategies: the case of smallholder farmers in a developing economy. Ch-20, *Risk Management-Current Issues and Challenges*. InTech Publishers, Rijeka, Croatia.

Ahmed, Z. (2013). Disaster risks and disaster management policies and practices in Pakistan: A critical analysis of Disaster Management Act 2010 of Pakistan. Int J Disast Risk Re, (4), 15–20.

Ahsan, D. A. (2011). Farmers' motivations, risk perceptions and risk management strategies in a developing economy: Bangladesh experience. J Risk Res, 14 (3), 325–349.

Ahsan, D. A., and E. V. A. Roth (2010). Farmers' Perceived Risks and Risk Management Strategies in an Emerging Mussel Aquaculture Industry in Denmark, Mar Resour Econ, 25(3), 309–323.

Akcaoz, H., and B. Ozkan, (2005). Determining risk sources and strategies among farmers of contrasting risk awareness: A case study for Cukurova region of Turkey. J Arid Environ. 62(4), 661-675.

Alderman, H. (2008). Managing risk to increase efficiency and reduce poverty. Background Paper for the World Development Report. Washington, DC.

Anwar, M. R., D. L. Liu, I. Macadam, and G. Kelly (2013). Adapting agriculture to climate change: a review. Theor Appl Climatol, 113(1-2), 225-245.

Azad, A. (2003). Sindh water resources management: issues and options. Food and Agriculture Organization of the United, Nations–Rome, Investment Centre Division, FAO/World Bank Cooperative Programme.

Beavers, A. S., J. W. Lounsbury, J. K. Richards, S. W. Huck, G. J. Skolits, and S. L. Esquivel, (2013). Educ Res-UK, 18(6).

Bergfjord, O. J. (2009). Risk perception and risk management in Norwegian aquaculture. J Risk Res, 12(1), 91–104.

Boholm, Å. (2003). The cultural nature of risk: Can there be an anthropology of uncertainty?. Ethnos, 68(2), 159-178.

Burnett, E., N. Kearney, B. Johnston, J. Corlett, and S. MacGillivray (2013). Understanding factors that impact on health care professionals' risk perceptions and responses toward Clostridium difficile and meticillin-resistant Staphylococcus aureus: A structured literature review. Am J Infect Control, 41(5), 394-400.

Burns, C., and D. Prager (2016). Do Direct Payments and Crop Insurance Influence Commercial Farm Survival and Decisions to Expand? Proceedings, Annual Meeting, Agricultural and Applied

Economics Association. Boston, Massachusetts (No. 235693).

Di Falco, S., and C. Perrings, (2005). Crop biodiversity, risk management and the implications of agricultural assistance. Ecol Econ, 55(4), 459-466.

Erenstein, O. (2009). Comparing water management in rice–wheat production systems in Haryana, India and Punjab, Pakistan. Agr Water Manage, 96 (12), 1799–1806.

ESRI, 2015. Geographic Information System. National geographic world map, sources: Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI. Environmental Systems Research Institute. California, USA.

Gebreegziabher, K., and T. Tadesse (2014). Risk perception and management in smallholder dairy farming in Tigray, Northern Ethiopia. J Risk Res, 17(3), 367–381.

Government of Pakistan (GOP) (2016). Economic Survey, Economic Affairs Division, Government of Pakistan. Islamabad.

Government of Sindh (GOS) (2008). Development Statistics of Sindh, Sindh Bureau of Statistics, Government of Sindh.

Hair, J. F., W. C. Black, B. J. Babin, and R. E. Anderson (2009). Multivariate Data Analysis 7th Edition Pearson Prentice Hall.

Hardaker, J. B., J. W. Richardson, G. Lien, and K. D. Schumann (2004). Stochastic efficiency analysis with risk aversion bounds: a simplified approach. Aust J Agr Resour Ec, 48(2), 253–270.

Ho, R. (2006). Handbook of univariate and multivariate data analysis and interpretation with SPSS. CRC Press, Tylor and Francis Group.

Iqbal, M. A., Q. Ping, M. Abid, M. K.S. Muhammad, and M. Rizwan (2016). Assessing risk perceptions and attitude among cotton farmers: A case of Punjab province, Pakistan. Int J Disast Risk Re, 16, 68–74.

Isam, A. M. (2014). Risk attitude, risk perceptions and risk management strategies: an empirical analysis of Syrian wheat-cotton and pistachio farmers. PhD Thesis, Department of Agricultural Sciences. Georg-August-University, Göttingen, Germany.

Kazi, A. (2014). A review of the assessment and mitigation of floods in Sindh, Pakistan. Nat Hazards, 70(1), 839–864.

Khaliq, A., A. Matloob and B. S. Chauhan (2014). Weed management in dry-seeded fine rice under varying row spacing in the rice-wheat system of Punjab, Pakistan. Plant Prod Sci, 17(4), 321–332.

Kurkalova, L., C. Kling, and J. Zhao, (2006). Green subsidies in agriculture: Estimating the adoption costs of conservation tillage from observed behavior. Can J Agr Econ, 54(2), 247-267.

Lien, G., O. Flaten, A. M. Jervell, M. Ebbesvik, M. Koesling, and P.S. Valle (2006). Management and risk characteristics of part-time and full-time farmers in Norway. Appl Econ Perspect P, 28 (1), 111–131.

Louis Berger Group and Indus Associated Consultants (LBG-IAC) (2013) Regional Master Plan for left bank of Indus, Delta and coastal zone, (SIDA) Sindh Irrigation and Drainage Authority. Hyderabad, Sindh.

Marsh, H. W., A. J. S. Morin, P. D. Parker, and G. Kaur (2014). Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. Annu Rev Clin Psycho, 10, 85–110.

Memon, J. A., and G. B. Thapa, (2011). The Indus irrigation system, natural resources, and community occupational quality in the delta region of Pakistan. Environ Manage, 47(2), 173-187.

Memon, J., and U. Mustafa (2012). Emerging Issues in the Implementation of Irrigation and Drainage Sector Reforms in Sindh Province of Pakistan. In 28th AGM & Conference of PSDE Pakistan Institute of Development Economics (PIDE). Islamabad, Pakistan.

Özkan, Ş., R. J. Farquharson, J. Hill, and B. Malcolm (2015). A stochastic analysis of the impact of input parameters on profit of Australian pasture-based dairy farms under variable carbon price scenarios. Environ Sci Policy, 48, 163-171.

Pasaribu, S. M., and A. Sudiyanto, (2016). Agricultural Risk Management: Lesson Learned from the Application of Rice Crop Insurance in Indonesia. In: Kaneko S., M. Kawanishi (Eds) Climate Change Policies and Challenges in Indonesia. Springer, Tokyo.

Ping, Q., M. A. Iqbal, M. Abid, U. I. Ahmed, A. Nazir, and A. Rehman (2016). Adoption of Off-farm Diversification Income Sources in Managing Agricultural Risks among Cotton Farmers in Punjab Pakistan. J. Appl. Environ. Biol. Sci, 6(8), 47–53.

Preston, C. C., and A. M. Colman, (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. Acta Psychol, 104(1), 1-15.

Qasim, M. (2012). Determinants of Farm Income and Agricultural Risk Management Strategies: The Case of Rain-fed Farm Households in Pakistan's Punjab. PhD Thesis, Department of International

Rural Development, Kassel University Press GmbH, Germany.

Rao, K. D., D. H. Peters, and K. Bandeen-Roche, (2006). Towards patient-centered health services in India—a scale to measure patient perceptions of quality. Int J Qual Health C, 18(6), 414-421.

Rizwan, M., Z. Deyi, A. Nazir, U. Ijaz, and Y. Zhu (2017). Risk Perceptions and Management Strategies of Rice Growing Households: Evidence from a Developing Country, J. Appl. Environ. Biol. Sci, *7*(3), 15–26.

Saqib, S.E., M. M. Ahmad, S. Panezai, and I. A. Rana, (2016). An empirical assessment of farmers' risk attitudes in flood-prone areas of Pakistan. Int J Disast Risk Re, 18, 107-114.

Saqib, S.E., M. M. Ahmad, S. Panezai, and U. Ali, (2016). Factors influencing farmers' adoption of agricultural credit as a risk management strategy: The case of Pakistan. Int J Disast Risk Re, 17, 67-76.

Schönrock-Adema, J., M. Heijne-Penninga, E. A. Van Hell, and J. Cohen-Schotanus, (2009). Necessary steps in factor analysis: enhancing validation studies of educational instruments. The PHEEM applied to clerks as an example. Med Teach, 31(6), e226–e232.

Schreiber, J. B., A. Nora, F. K. Stage, E. A. Barlow, and J. King, (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. J Educ Res, 99(6), 323-338.

Shen, Z., M. Odening, and O. Okhrin, (2015). Can expert knowledge compensate for data scarcity in crop insurance pricing? Eur Rev Agric Econ. 43(2), 237-269.

Spiliotopoulou, G. (2009). Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. Aust Occup Ther J, 56(3), 150-155.

Teddlie, C., and F. Yu (2007). Mixed methods sampling: A typology with examples. J Mix Method Res, 1(1), 77-100.

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

Ullah, R., G.P. Shivakoti, and G. Ali (2015). International J. Disaster Risk Reduction Factors effecting farmers' risk attitude and risk perceptions: The case of Khyber Pakhtunkhwa, Pakistan. Int J Disast Risk Re, 13, 151–157.

Ullah, R., G.P. Shivakoti, F. Zulfiqar, and M. A. Kamran (2016). Farm risks and uncertainties: Sources, impacts and management. Outlook Agr, 45(3), 199–205.

Usman, K., I. Ullah, S. M. Khan, M. U. Khan, S. Ghulam, and M. A. Khan (2012). Integrated weed management through tillage and herbicides for wheat production in rice-wheat cropping system in northwestern Pakistan. J Integr Agr, 11(6), 946–953.

Van Winsen, F., Y. de Mey, L. Lauwers, S. Van Passel, M. Vancauteren, and E. Wauters (2016). Determinants of risk behaviour: effects of perceived risks and risk attitude on farmer's adoption of risk management strategies. J Risk Res, 19(1), 56-78.