*J. Appl. Environ. Biol. Sci.*, 6(3)18-25, 2016
© 2016, TextRoad Publication

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
*www.textroad.com*

# Agricultural Risk Sources and Risk Management Strategies: the Case of Rain-fed Agriculture in Pothwar Region, Punjab, Pakistan

**[1*]Muhammad Qasim and [2*]Najid Ahmad**

[1]Senior Scientific Officer, SSRI (PARC), AARI, Faisalabad, Pakistan
[2]School of Economics, Dongbei University of Finance and Economics, Dalian, China

*Received: October 31, 2015*
*Accepted: January 11, 2016*

## ABSTRACT

Farming being susceptible to the weather conditions is a business activity subject to risky events. The objective of this paper is to explore the agriculture risk sources and risk management strategies for Pothwar region of Pakistan's Punjab. Here the agriculture entirely depends upon rainfall and repeated drought conditions are the major problems of the region. The primary and secondary data are used for the analysis about the agricultural risk sources and risk management strategies in the study area. Exploratory factor analysis (EFA) is used as it is the collection of methods that are used to examine how underlying constructs influence the responses on a number of measured variables. The results show that most important sources that are causing risk for farm households are inadequate extension services and rainfall shortage while crops, animal health problem and lack of farmers' cooperative are less important risk sources. Further, the results show that construction of small dams/turbine schemes, weather forecasting, off-farm income and production diversity are the most important risk management strategies considered by farm households. Overall almost 50 percent of farmers are placed in risk averse category, 31 percent in risk neutral category while 19 percent in the risk seekers category. The results are appealing to policy makers, and research and development planners to mitigate the agricultural risk sources and help the farming community in implementing the risk management strategies suggested by them. The main areas of work include the construction of small dams, improvement in weather forecasting, the research for agricultural diversification and provision of off-farm income opportunities in the study area. This may help in to the rural development of the Pothwar region of Pakistan's Punjab.
**KEYWORDS:** Risk source and strategies, Farmer risky attitude, Off-Farm Income

## 1. INTRODUCTION

Punjab is the largest province of Pakistan having largest irrigated area and major contribution towards the agricultural production. The northern part of this Province is known as Pothwar plateau. The area is characterized by rain-fed agriculture. It is about 250 km long and 100 km wide with elevations ranging from 200 metre along Indus River to about 900 metre in the hills north of Islamabad with an average elevation of 457 metre (Khan, 2002). Pothwar climate comprises of semi-arid in the southwest to the sub-humid in the northeast. The rainfall is erratic with monsoon rains usually accompanied by thunderstorms which occur as heavy downpours resulting in considerable surface run-off and soil erosion. Most of the annual rainfall in the semi-arid region occurs during June to September period around 70% (Ashraf et al., 1999; Ashraf, 2004; Government of Pakistan, 2009). The winter rain occur as the gentle showers for a long period of time and is more effective for soil moisture absorption than that of summer rain. Only 43 of the total area is cultivated (0.77 m ha out of 1.8 m ha) while the remaining is mostly grazing land (Khan, 2002). Almost 10 percent of cultivated area is irrigated, while 90 percent is under rain-fed agriculture (GoP, 2006).

Repeated drought conditions are the major problems in Pothwar region. There is the great risk of crop failure as agriculture mostly depends on rainfall. In most of the areas of Pothwar Region, underground water is very deep as well as in small quantity so it is uneconomical to irrigate the land on large scale. Government has constructed small dams in some areas where they are feasible but these dams cover only the small part of the whole area. Severe weather conditions particularly frost and weather disasters like hailstorms also destroy crops. Due to economic and the political situation of country, crops' insurance is also not in common practice. This leads to further variability in farm income and leave the farming community of the area vulnerable to food insecurity.

The agriculture sector provides part time business opportunities to the majority of rain-fed farm households in Pakistan and particularly in Punjab. Most of them have small landholdings and their livestock helps them to provide daily livelihood through sale of milk. Further, it is the cash deposit for poor farmers in case of disaster. The majority of rain-fed Pothwar farm households are involved in off-farm activities to support

***Corresponding Author:** **Najid Ahmad**, School of Economics, Dongbei University of Finance and Economics, Dalian, China. najid_2iqbal@yahoo.com
**Muhammad Qasim,** Pakistan Agricultural Research Council-Social Sciences Research Institute (PARC), AARI, Faisalabad, Pakistan**.** email: m_qaasim@yahoo.com

their daily household expenditures (Ashraf, 2004 and Hussain, 2004a). The common off-farm income sources are remittances from abroad (unskilled/semi skilled labor in Middle East) as well as low paid jobs in government and private institutions (district courts, district management offices, oil and gas development corporation, security guards in private companies, cement factories, textile industry and coal mines).

The above mentioned facts reveal that the agriculture of the area is of risky nature and the farming community faces multidimensional risk sources for the commodity production and marketing. Different agricultural risk management strategies are very important in the study area to reduce the farm income variability. Keeping in view the risky nature of agriculture and the importance of the agricultural risk management strategies the present study is conducted with the main objectives (1) to find the major agricultural risk sources and coping strategies of farm households in the *Pothwar* region, (2) to estimate the major factors of risk sources and risk management strategies and (3) to suggest recommendations, for improvement in rain fed agricultural production based the risk management strategies suggested by respondents.

The novelty of our work can be judged by several ways: It is the first study of Potwar region of Pakistan's Punjab to investigate factors of risk sources and risk management strategies. Pothwar is the very important region of Pakistan's Punjab characterized with rain-fed agriculture which is usually neglected in the national and provincial agricultural policies. The study findings are supported by primary as well as secondary data as both types of data are used at the same time to fulfill the objectives of the study. The rest of the paper is structured as: In section 2 Materials and Methods. Section three is for Results and Discussion and section 4 concludes.

## 2. MATERIALS AND METHODS

Primary as well as secondary data is used to fulfill the objectives of study. Considering the vulnerability of rain-fed agriculture to weather risks, *Barani* Punjab (*Pothwar*) is selected for survey data collection. We use purposive and stratified random sampling technique to select the sample farmers. At the first stage out of four districts, Rawalpindi and Chakwal are selected for the field survey of respondent farmers. As these districts represent the pure rain-fed conditions of *Barani* Punjab. Further, the reason for selecting these districts is that they cover a range of climate from sub humid to semi arid and arid conditions. The amount of annual rainfall decreases from north east to south west. The area of other two districts i.e. Jehlum and Attock is relatively more supplemented by artificial irrigation and also stretches to hilly patches. At the second stage one sub district Gujar Khan from Rawalpindi (high rainfall) and two sub districts i.e. Chakwal (medium rainfall) and Talagang (low rainfall) are selected from District Chakwal. Most of the other sub districts consist of hilly and forest area, leaving less area for commercial agricultural production. At the third stage 10 villages were randomly selected from each of 3 sub districts. Finally, at the fourth stage within these three sub districts, 7 farm households from each village were selected randomly (convenience sampling) for interview by chance meeting with them at the time of field survey.

We don't use online, telephonic interview or survey monkey or planet survey to gather information. But we ourselves were involved in the data collection process to purify our work. We use Exploratory Factor Analysis (EFA) that is the collection of methods of different risk sources and risk management strategies. In this way, our study captures the most important and large sample size of the country. Our results can be used for the policy purpose for the developing countries.

The secondary data on farm size and crops area production and yield are collected from Punjab Development Statistics and Agricultural Statistics of Pakistan. Primary data are collected through personal interviews with individual farmers using a well defined structured questionnaire with close ended questions. We were involved in the data collection process. Only logistics and transportation support from friends and relatives in the sample villages was taken for finding and reaching the sample farmers. Formal and informal techniques were carried out for the collection of the data. The respondents were probed in different manners to attain reliable data. It was preferred to interview only the household head. Household head in the study area is mostly the eldest male of household. Most of the farm households in the study area consist of nucleus family (male household head with his wife and children). Only when the household head was absent other adult family members actively involved in agricultural production were interviewed to attain required information.

### 2.1 Data Analysis

Exploratory factor analysis (EFA) is used in the study. EFA is the collection of methods used to examine how underlying constructs influence the responses on a number of measured variables. Factor analyses are performed by examining the pattern of correlations (or covariance) between the observed variables. Variables that are highly correlated (high factor loadings either positively or negatively) are likely influenced by the same factors, while those are relatively uncorrelated are likely influenced by some different factors. The general purpose of factor analytic techniques is to find a way of condensing the information contained in a number of original variables into a smaller set of new composite dimensions (factors) with a minimum loss of information (Hair et al., 1987). The primary objectives of an EFA are to determine the number of common factors influencing a set of different variables, the strength of relationship between each factor and the each observed measure of variables.

A Likert-type scale is used to determine risk sources and strategies preferred by farm households in agricultural production in the study area. The scale varied from 1 (strongly disagree) to 5 (strongly agree) which is showing their view about the agreement with the particular risk source and risk management strategy. Factor analysis is conducted by utilizing SPSS software. Considering the research area conditions and agricultural practices, risk sources and strategies are gathered under 19 and 13 variables, respectively. Factors are named on the basis of the strength of their factor loadings with the Likert scale measures of these variables.

## 3. RESULTS AND DISCUSSIONS

The farm size of *Pothwar* region is smaller as compared to that of Punjab province. In *Pothwar* region 64 percent farms are less than 5 acres with only 19 percent farm area while in Punjab province 56 percent farms are below the 5 acres of land with only 16 percent area. It shows the number of small farms and percentage area (under 5 acres) is higher in *Pothwar* region as compared to that of Punjab. Average farm size in Punjab (7.2 ac) is relatively higher as compared to that in *Pothwar* (6.2 ac). The cultivated area as the percent of farm area is higher in Punjab province (92 %) as compared to that in *Pothwar* (78 %). Cultivated area as percent farm area decreases with the increase in farm size from 95 percent to 85.6 percent and 91.3 percent to 61.2 percent in overall Punjab province and *Pothwar* region, respectively.

### 3.1 Risk Sources and Agricultural Risk Management Strategies in Pothwar Region

This section presents the results of the factor analysis of different risk sources and risk management strategies. The data used for this analysis is based on farmers' statements about different variables as risk sources and risk management strategies. The data varied from 1 to 5, namely strongly disagree to strongly agree, collected by using a five options Likert scale. The data regarding the risk sources and risk management strategies purely depends on farmers choices.

#### 3.1.1 Risk Sources

Risk sources are gathered under measures of strength of 19 different variables. The results in table 1 show that the most effective sources causing risk for farm households of the study area, are inadequate extension services (4.91) and Lack of information sources (4.90) followed by the inadequate rainfall (4.87), fluctuation in input costs (4.39), marketing dishonesty (4.33), lack of marketing facilities (4.32), inadequate research activities (4.11), natural disasters (4.09), fluctuation in product prices (4.04) and fluctuation in input prices (4.00). Crops and animal health problem, and lack of farmers' cooperative are least effective risk sources mentioned by sample farmers. According to the farm household heads of the study area international policy change, epidemics, agricultural produce theft, accidents/human health problems, changes in land prices and interest rate fluctuation are not important risk sources affecting their farm income. So, the results show that lack of extension services, information sources and rainfall shortage are the most important risk sources for farm households of the study area.

Factor analysis is conducted to reduce risk sources measures into minimum common risk factors affecting the farm household income. The primary objective of factor analysis was to determine the number of common factors influencing a set of different variables and the strength of the relationship between each factor and each observed measure of the variables. Factor loadings obtained from factor analysis with respect to risk sources considered important by sample respondents are presented in table 1. As a result of factor analysis seven factors with Eigen values greater than one, for 19 risk sources were identified. These seven factors explained almost 68.07 percent of the cumulative variance. Factors in order of importance were imperfect markets risks, catastrophe, lack of information risks, weather and lack of insurance risks, price risks, drought and disease risks, and financial risks.

Factor 1 has strong relationship with marketing dishonesty and lack of marketing facilities with high factor loadings. Due to high factor loadings of these variables this factor was termed as imperfect markets risks. Factor 2 has positive relationship with agricultural produce theft, human health problems and changes in land prices with high factor loadings. Because of inclusion of these variables and their large loadings this factor was referred as catastrophe. The large loadings and inclusion of lack of information sources and inadequate extension services made the factor 3 as lack of information risks. Factor 4 can be termed as weather and lack of insurance risks due to inclusion of severe weather conditions, natural disasters and lack of farmers' cooperatives with high factor loadings. Factor 5 was expressed as price risks because of large factor loadings of fluctuation in input and product prices. Factor 6 was named drought and disease risks due to high factor loadings and positive relationship with risk sources inadequate rainfall and epidemics. Factor 7 was referred as financial risk due to large loadings of fluctuation in interest rate.

**Table 1 Factor Loadings of Risk Sources**

Bartlett's Test of Sphericity: $X^2 = 1279.977$***

| | *Mean** | *Factors*** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Inadequate extension services | 4.91 | .050 | .060 | ***.923*** | -.024 | -.015 | -.050 | -.034 |
| Lack of information sources | 4.90 | .035 | -.034 | ***.930*** | -.094 | -.021 | -.040 | .058 |
| Inadequate rainfall | 4.87 | .120 | -.108 | -.052 | -.001 | .043 | ***.716*** | .045 |
| Severe weather conditions | 4.39 | .330 | -.124 | -.117 | ***.510*** | .057 | .447 | .037 |
| Marketing dishonesty | 4.33 | ***.836*** | -.029 | .207 | .080 | -.018 | .198 | -.075 |
| Lack of marketing facilities | 4.32 | ***.860*** | .000 | .110 | -.025 | -.019 | .172 | .127 |
| Inadequate research activities | 4.11 | -.167 | -.049 | .153 | .337 | .052 | .187 | -.741 |
| Natural disasters | 4.09 | .188 | .099 | .061 | ***.745*** | -.026 | -.142 | -.132 |
| Fluctuation in product prices | 4.04 | .132 | .071 | .037 | .155 | ***.821*** | .020 | -.204 |
| Fluctuation in Input prices | 4.00 | -.012 | -.023 | -.072 | -.054 | ***.870*** | .011 | .144 |
| Change in agricultural polices | 3.50 | -.389 | .330 | .050 | -.327 | -.112 | .489 | -.111 |
| Crops/animal health problems | 3.19 | -.660 | .185 | .158 | -.248 | -.161 | .187 | .244 |
| Lack of farmers' cooperatives | 3.11 | -.021 | -.272 | -.270 | ***.561*** | .141 | -.094 | -.038 |
| International policy change | 2.93 | -.510 | .185 | .215 | -.189 | -.187 | .293 | .169 |
| Epidemics | 2.05 | -.009 | .437 | -.036 | -.202 | .004 | ***.519*** | -.122 |
| Agricultural produce theft | 2.05 | -.111 | ***.839*** | -.009 | -.021 | .070 | .050 | -.011 |
| Human health problems | 2.04 | -.209 | ***.708*** | .038 | .236 | -.063 | -.021 | .188 |
| Changes in land prices | 1.98 | .065 | ***.706*** | .038 | -.308 | .023 | -.049 | .026 |
| Interest rate fluctuation | 1.87 | -.348 | .088 | .188 | .118 | .013 | .155 | ***.697*** |
| Eigen values | | 2.64 | 2.20 | 2.01 | 1.70 | 1.54 | 1.51 | 1.30 |
| Total variance | | 14.08 | 11.60 | 10.53 | 8.93 | 8.12 | 7.94 | 6.83 |
| Cumulative variance | | 14.08 | 25.67 | 36.24 | 45.17 | 53.30 | 61.24 | 68.07 |

*Likert-type scale is used from 1 (Strongly disagree) to 5 (Strongly agree) Source: Author's Survey data 2009

**Factors: 1. Imperfect markets risks, 2. Catastrophe, 3. Lack of information risks, 4. Weather and lack of insurance risks, 5. Price risks, 6. Drought and disease risks, 7. Financial risks

### 3.1.2 Risk Management Strategies

In this study risk strategies is gathered under 13 main variables. The results are reported in table 2 that show that the most affective risk management strategies are small dams construction/ turbine schemes (4.94) and weather forecasting (4.84) followed by the up to date market information (4.82), off-farm income sources (4.82), production diversity (4.80), contract farming (4.68), more crop variety, breeds or dual purpose animals (4.10), keeping debt low (4.01), monitoring of pests, diseases, crops and prices (3.99) and maintaining inputs/feed reserves (3.97). Debt management monitoring is the least effective risk management strategy. Cooperation of farmers and security safeguarding are not important risk management strategies. So, construction of small dams/turbine schemes (4.94) and weather forecasting (4.84) are the most important risk management strategies considered by farm households.

**Table 2 Factor Loadings of Risk Management Strategies**

Bartlett's Test of Sphericity: $X^2 = 196.941$***

| *Risk management strategies* | *Mean** | *Factors*** | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| Small dams/turbine schemes | 4.94 | -.208 | ***.668*** | -.034 | -.071 | .033 | .251 |
| Weather forecasting | 4.84 | -.063 | -.114 | ***.600*** | .084 | .062 | .079 |
| Up to date market information | 4.82 | -.085 | .314 | ***.634*** | .172 | -.043 | -.043 |
| Off-farm income sources | 4.82 | .138 | -.118 | .004 | ***.845*** | .047 | .092 |
| Production diversity | 4.80 | -.199 | .161 | .101 | ***.750*** | -.089 | -.106 |
| Contract farming | 4.68 | .046 | *.512* | -.140 | .062 | ***.615*** | -.011 |
| More crop varieties/animals breeds | 4.10 | .252 | -.061 | ***.664*** | -.130 | -.046 | .008 |
| Keeping debt low | 4.01 | .102 | -.227 | .049 | -.052 | ***.791*** | -.114 |
| Pests, diseases, prices monitoring | 3.99 | ***.593*** | .159 | -.262 | .101 | -.370 | -.039 |
| Maintaining inputs/feed reserves | 3.97 | .025 | .016 | .080 | -.003 | -.100 | ***.875*** |
| Debt management monitoring | 3.44 | *.730* | -.075 | .040 | -.055 | .239 | .310 |
| Cooperation of farmers | 3.12 | ***.665*** | -.112 | .269 | -.085 | .137 | -.321 |
| Security safeguarding | 2.12 | -.121 | -.656 | -.052 | -.071 | .188 | .181 |
| Eigen values | 1.53 | 1.39 | 1.39 | 1.37 | 1.28 | 1.10 | 1.53 |
| Total variance experienced | 11.77 | 10.69 | 10.68 | 10.53 | 9.86 | 8.48 | 11.77 |
| Cumulative variance experienced | 11.77 | 22.46 | 33.13 | 43.66 | 53.52 | 62.01 | 11.77 |

*Likert-type scale is used from 1 (Strongly disagree) to 5 (Strongly agree) Source: Author's Survey data 2009

**Factors: 1. Planning and policy, 2. Infrastructure development, 3. Research and information management, 4. Diversification and off-farm employment generation, 5. Financial management and security and 6. Input management.

Factor loadings obtained from factor analysis with respect to risk strategies are considered important by sample respondents. As a result of factor analysis six factors with Eigen values greater than one for 13 risk

management strategies are identified. These six factors explained almost 62.01 percent of the cumulative variance. Factors in order of importance are planning and policy, infrastructure development, research and information management, diversification and off-farm employment generation, financial management and security, and input management.

Factor 1 is termed as planning and policy because it has positive relationship with variables cooperation of farmers and pests, diseases, prices monitoring with high loadings (0.665 and 0.593). Factor 2 is expressed as infrastructure development as this factor has positive relationship with small dams/turbine schemes (0.668). Because of inclusion of variables to up-date market information, weather forecasting and more crop varieties/animals breeds with large loadings (0.634, 0.600 and 0.664) factor 3 is referred as research and information management. Factor 4 is expressed as diversification and off-farm employment generation due to inclusion and large loadings of off-farm income sources (0.845) and production diversity (0.750). Factor 5 is named as financial management and security because of comparatively large factor loadings of keeping debt low (0.791) and contract farming (0.615). Factor 6 is named input management due to high factor loadings and positive relationship with maintaining input/feed reserves (0.875).

### 3.2 Socio Economic Features by Farmers Risk Attitude Groups

Given that farming is a business activity subject to risky events such as drought, an important factor in understanding the behavior and managerial decisions of farmers is their attitude toward risk. For example, the more risk averse farmer would like to take managerial decisions that emphasize the goal of reducing variation in income rather than the goal of maximizing income. In the literature farmers are divided in to three distinct risk attitude groups on the basis of their risk preferences regarding different farm level decisions (Akcaoz and B. Oykan 2005). Choice under uncertainty is often characterized as the maximization of expected utility. Utility is assumed to be a function of profit with a positive first derivative. The utility function whose expected value is maximized is concave for a risk averse agent, convex for a risk seeker, and linear for a risk neutral agent.

Risk averse is the farmer who always wants to avoid risk by not adopting innovative production activities unless certain compensation is guaranteed in case of crop failure. A risk averse farmer would diversify among a variety of production choices, taking account of their risk features, even though doing so would lower the expected return on the overall portfolio. In crop production choices, a risk neutral farmer would be able to choose any combination of risky production activities and invest exclusively in the asset with the highest expected yield, ignoring its risk features relative to those of other choices. The risk neutral farmer portfolio would have a higher expected return, but also a greater variance of possible returns. Risk seekers/lovers are the farmers who take the challenge of greater income volatility and uncertainty in farm production decisions in exchange for anticipated higher returns. A risk seeker is the farmer who is willing to take big risks to maximize the profits on his investment.

**Table 3 Farm Characteristics of Farm Households by Risk Attitude Groups**

| *Features* | *Risk Attitude Groups* | | | *All* | *F* |
|---|---|---|---|---|---|
| | **Risk averse** | **Risk neutral** | **Risk seekers** | | |
| Percent farmers | 49.52 | 30.95 | 19.52 | 100.00 | -- |
| Age (yrs) | 53.07 | 53.83 | 51.07 | 52.91 | 0.503 |
| Farming experience (yrs) | 29.47 | 30.03 | 31.44 | 30.03 | 0.234 |
| Operational land holding (ha) | 5.19 | 5.24 | 4.96 | 5.16 | 0.037 |
| Education (yrs) | 7.65 | 7.51 | 7.17 | 7.51 | 0.262 |
| Number of adult household members | 5.88 | 5.82 | 6.17 | 5.92 | 0.212 |
| Farmers having off farm income (%) | 91.30 | 90.80 | 80.50 | 89.00 | 1.928 |
| Off-farm income (000 PKR/an) | 269.34 | 262.34 | 170.43 | 247.86 | 3.316** |
| Farm Income (000 PKR/an) | 290.35 | 326.76 | 278.44 | 299.30 | 0.521 |
| Area Wheat (%) | 56.75 | 45.28 | 52.61 | 52.39 | 6.040 |
| Area Chickpea (%) | 5.84 | 5.20 | 4.09 | 5.30 | 0.479 |
| Area Lentil (%) | 3.12 | 4.91 | 4.60 | 3.97 | 0.920 |
| Area Mustard (%) | 1.94 | 3.47 | 9.67 | 3.92 | 20.061*** |
| Area Groundnut (%) | 28.45 | 35.31 | 19.20 | 28.77 | 6.295*** |
| Cropping intensity (%) | 125.34 | 112.48 | 117.62 | 119.85 | 4.199** |

Source: Author's Survey data 2009

Cluster analysis is performed for the seven factors determined from the risk source variables through factor analysis. Three groups of farmers are identified on the basis of this cluster analysis. These three groups of

farmers are named as risk averse, risk neutral and risk seekers according to their risk attitudes towards different risk sources. Overall almost 50 percent of farmers are placed in risk averse category, 31 percent in risk neutral category while 19 percent in the risk seekers category. Same results were shown by Binici (2003) that majority of farmers (are risk averse) are likely to make production decisions that reduce risk, even if the decisions translate into lower income. Average age of risk averse and neutral farmers is higher (53.07 and 53.83) as compared to risk seekers (51.07) while farming experience is smaller in risk averse (29.47 yrs) as compared to that in risk neutral (30.03 yrs) and risk seekers (31.44 yrs). There is not much difference in the education and number of adult household member. More risk averse farm households have some off/farm income source as compared to risk neutral and risk seekers. Farm and off-farm income of risk averse and risk neutral farmers is considerably higher as compared to risk seekers. Percent area wheat, chickpea, groundnut and cropping intensity is also high for risk averse as compared to that of risk seekers group. Higher off-farm income, cropping intensity and area of major crops confirm the risk attitudes of farm households of the study area.

### 3.3 Relevance of Risk Sources and Risk Management Strategies with Past Studies

Block and P. Webb (2001) confirmed that most households did believe that earning income outside of cropping (non farm employment and livestock activities combined) is a key to reducing risk. Rahman (2009) emphasized that the development of the rural infrastructure for improved technical efficiency and also to promote crop diversification by opening up opportunities for technology diffusion, marketing, storage facilities and resource supplies in Bangladesh. Our results are confirmed by the results presented by Rahman (2009).

Overall seven important factors for agricultural risk sources are sorted out by factor analysis. These factors include imperfect markets risks, catastrophe, lack of information risks, weather and lack of insurance risks, price risks, drought and disease risks and financial risks. The six factors are sorted for risk management strategies which include planning and policy, infrastructure development, research and information management, diversification and off-farm employment generation, financial management and security and input management. Akcaoz and Oykan (2005) conducted study in the Cukutova region of Turkey to identify groups of farmers who differ in their risk sources and risk management strategies. On the basis of factor analysis results, risk sources were labeled as environmental, price, catastrophe, input costs, production and technological, political, finance, personal, marketing, health and social security. The important risk strategies were named as diversification, off-farm income, marketing, planning, financing and security. The results of present investigation are in agreement with the results of Akcaoz and Oykan (2005).

Madai (2008) gave an overview of the risk attitudes of Hungarian sheep producers. Results revealed that economies of scale and lack of capital were the major hindrances to continue sheep farming. The most widely applied risk management strategies were the cooperation between farmers and joining to producer groups, which is applied by 74.4 percent of the farmers and scored 3.8. The results of the present study depicted a little different result in this regard. The farm households were indifferent in quoting the lack of farmers' cooperatives as the farm income risk source and formation of cooperative farming as the risk management strategy. The reason for this attitude might be the failure of the past cooperative farming experience in the region. In the above mentioned study farmers view about gathering market information and monitoring as useable tool for decreasing risk is in agreement with farmers' view of the present study. Maldai (2008) revealed that security and safeguarding as risk management strategy for corresponding risk sources got score of 3.8. In contrast farm households in the present study disagree with this risk source (theft of agricultural produce) and risk management strategy (Security safeguarding) and gave only score of 2.05 and 2.12 respectively. The reason may the chance of theft of sheep is comparatively higher as compared to crops and large ruminants. The off-farm income/investment and the debt management monitoring are more important risk management strategies for the farm households of the present study as compared to the Hungarian sheep producers. The reason may be that the sheep farming is the commercial activity and the producers may get enough income from the activity and don't need the off-farm income activities. Moreover, they are able to repay the debt by sale of their sheep products and don't think the debt management as important risk management strategy. The farm households of the present study are producing subsistent agriculture and think the off-farm income activities as very important risk management strategy for smoothening the household consumption expenditure. Moreover the risky nature of the agriculture of the area due to severe weather conditions (particularly the inadequate and erratic rainfall) makes them conscious about the debt. Majority of farm households avoided taking debt/credit from institutional sources having fear of unable to pay back this debt due to crops failure (drought damage).

## 4. Conclusion

The objective of this paper was to find the factors of agriculture risk sources and risk management strategies by utilizing the sample farm level data from Pakistan's Punjab having largest irrigated area and the major contribution towards the agricultural production. The study was conducted in the northern part of this Province i.e. Pothwar plateau. The exploratory factor analysis (EFA) was used because it is the collection of methods that are used to examine how underlying constructs influence the responses on a number of measured variables.

Our results show that the most important risk sources causing variability in farm income of rain-fed farm households in the study area were inadequate extension services, lack of information sources, inadequate rainfall, severe weather conditions, marketing dishonesty, lack of marketing facilities, inadequate research activities, natural disasters and fluctuation in input and output prices. Change in agricultural policies, crops/animal health problem, lack of farmers' cooperative, international policy change, epidemics, agricultural produce theft, accidents/human health problems, changes in land prices and interest rate fluctuation are not important risk sources affecting their farm income. Further the results revealed that the most affective risk management strategies were small dams/turbine schemes, weather forecasting, up to date market information, off-farm income sources, production diversity, contract farming, improved crop varieties/ animal breeds, keeping debt low, monitoring of pests/diseases/prices and maintaining inputs/feed reserves. According to sample respondents debt management monitoring, cooperation of farmers and security safeguarding were not important risk management strategies.

Overall seven important factors for agricultural risk sources are sorted out by factor analysis. These factors include imperfect markets risks; catastrophe; lack of information risks; weather and lack of insurance risks; price risks; drought and disease risks; and financial risks. The six factors are sorted for risk management strategies which include planning and policy; infrastructure development; research and information management; diversification and off-farm employment generation; financial management and security; and input management. On the basis of these factors the farmers were divided in to three categories i.e. risk averse (50 %), risk neutral (31 %) and risk seekers (19 percent). We found that the risk averse farmers opted for higher cropping intensity, higher cropping diversity in form of higher area of cash crops (i.e mustard and groundnut) and higher off-farm incomes. These activities reduce the risk and variability in their income.

Our findings show that as majority of the farmers are risk averse, so, government of Pakistan should introduce and formulate the farm policies that should help to reduce the risk of farmers. Construction of small dams and implementation of scale infrastructure schemes like turbines installation for irrigation purpose at government level may reduce the risk to great extent and enhance the overall productivity of the area. The better weather forecasting and information services provided in time may help the farmers in right decision making and implementation of the crop production technologies accordingly. Keeping in view the importance of weather related information particularly for rain-fed agriculture, government should install small weather stations at least at the circle level where there is the office of agriculture officer of agricultural extension department. This will help farming community to get the localized and latest weather related information. Moreover the coordination between metrological department, agricultural research and extension department may be strengthened for the affective use of weather forecasting information for agricultural crops planning. Effective agricultural extension department in the area may improve the agricultural productivity through dissemination of innovative and improved agricultural production technologies, and agricultural marketing information.

Government can help farmers in enhancing their farm productivity by providing them up to date market information, contract farming opportunities, provision of improved crop varieties seeds, and improved livestock breeds. Production diversity and inclusion of livestock in farm activities may help farmers to reduce their income variability and enhance their profitability. Moreover, off-farm income opportunities provided by the government in collaboration with private sector may also work as coping strategy in the situation of severe drought and complete crop failure. This may help to reduce vulnerability of farm households to drought and other severe weather conditions. Although the results of our study are related to specific region and country but they can be used for the formulation of policies for rain-fed agriculture in developing countries.

## REFERENCES

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. Journal of Arid Environments 62 (2005) 661-675.

Ashraf, M., F. U. Hassan, A. Saleem and M. I. Lone. 1999. Water resources development and its management in the *Barani* areas of Punjab. Naional workshop on water resources achievement and issues in 20th century and challenges for the next mellinum. Proceedings. June 28-30, 1999. Islamabad-Pakistan.

Ashraf, M. 2004. Impact Evaluation of Water Resources Development in the Command Area of Small Dams. Pakistan Council of Resrach in Water. PO Box 1849, Islamabad. Research Report-5 2004. ISBN 969-8469-12-5.

Binici, T., A. Ali Koc, Carl R. ZULAUF and Ahmet BAYANER. 2003. Risk Attitudes of Farmers in Terms of Risk Aversion: A Case Study of Lower Seyhan Plain Farmers in Adana Province, Turkey. Turk J. Agric. For 27 (2003) 305-312 © T.BÜTAK

Block, S. and P. Webb. 2001. The dynamics of livelihood diversification in post-famine Ethiopia. Food Policy 26 (2001) 333–350

Government of Pakistan. 2006. Agriculture Statistics of Pakistan. Ministry of Food, Agriculture & Livestock (Economic Wing) Islamabad, Government of Pakistan.

Government of Pakistan. 2008. District wise Agricultural Statistics of Pakistan 2008. Ministry of Food, Agriculture & Livestock (Economic Wing) Islamabad, Government of Pakistan.

Government of Pakistan. 2009. Pakistan Metrological Department. Government of Pakistan, Islamabad Pakistan.

Government of Punjab. 2009. Punjab development Statistics. Bureau of Statistics Government of Punjab Lahore.

Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1987. Multivariate Data Analysis with Readings. Mcmillan Publishing Company.

Hussain, M. 2004a. Poverty among Farming Community in Marginal Areas of Punjab. Proceedings of National Workshop on Pro-poor Intervention Strategies in Irrigated Agriculture April 23-24. International Water Management Institute (IWMI), Colombo, Sri Lanka.

Kahlown, M. A. M. Ashraf, and A. Ashfaq. 2004. Contribution of Small Dams in Development of Water Resources *Pothwar* Region. Pakistan Journal of Water Resources, vol. 8 (1) January-June, 2004 p 23-38.

Khan, Safder R.A. 2002. *Pothwar*'s Agricultural Potential. Pakistan Agriculture Overview. Daily Dawn, 24 May, 2002.

Madai, Hajnalka. 2008. Risk Sources and Risk Management Strategies Applied by the Hungarian Sheep Producers. University of Debrecen, Centre for Agricultural Sciences and Engineering. Faculty of Agricultural Economics and Rural Development, Department of Farm Business Management and Marketing. Fascicula: Ecotoxicologie, Zootehnie Si Tehnologii De Industrie Alimentara, Vol. Vii, Anul 7, 2008

Rahman, Sanzidur. 2009. Whether crop diversification is a desired strategy for agricultural growth in Bangladesh?. Food Policy 34 (2009) 340–349