J. Appl. Environ. Biol. Sci., 6(8)47-53, 2016
© 2016, TextRoad Publication

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

Adoption of Off-farm Diversification Income Sources in Managing Agricultural Risks among Cotton Farmers in Punjab Pakistan

Qing Ping[1], Muhammad Amjed Iqbal[2], Muhammad Abid[3], Umar Ijaz Ahmed[4], Adnan Nazir[5], Azka Rehman[6]

[1,2,5,6]College of Economics and Management, Huazhong Agricultural University, Wuhan 430070, Hubei Province, P.R. China.
[3]Research Group Climate Change and Security (CLISEC), Institute of Geography, University of Hamburg, Grindelberg 7, 20144 Hamburg, Germany.
[4]Assiatant Professor, University of Sargodha, Pakistan.

Received: 2016
Accepted: 2016

ABSTRACT

Agriculture is a very risky business and farmers have to deal with various socio-economic and environmental challenges at farm level. Therefore, farmers have to adopt certain management options to cope with those different kinds of risks. Therefore, using cross-sectional data of 210 farm households collected from three cotton districts, this study aims to investigate the effect of perceived risks in farming on farmers' decision to adopt off-farm diversification income sources. This study uses correlation analysis and probit regression model to explore the study objectives. The findings of the study confirms our hypothesis that perception of different kinds of risk leads farmers to diversify their income sources in order to sustain their livelihood in case of loses from agriculture. In addition to perceived risks, the study also found positive association of education, farming experience, risk averse nature of farm household were the other factors that significantly affect the farmers decision to adopt off-farm diversification income sources.
KEYWORDS: risk management, off-farm diversification, probit model, cotton farmers

1 INTRODUCTION

Agricultural production is characterized by various kinds of risks and particularly farmers in developing countries work under more state of risk and uncertainty[1]. These risks may include drought, pest, disease, flood and many others[2].Due to the presence of such risks and unanticipated climate and market conditions, agricultural production is quite unpredictable. Further these uncertainties result in fluctuation in commodity prices[3]. Agricultural risks may adversely affect the livelihoods and agricultural incomes in the developing countries due to their low capacity to manage risks at farm level.

Risk can be described as the chance of decreasing income level up to bottom and a very important component in the farmers' decision making of the choices and level of inputs and outputs. Farmers' decision making under risky conditions is highly influenced by their perceptions and attitude toward risks. It is quite possible that perceiving certain kinds of risks lead farmers to adopt various adaptive measures at farm level to protect their crops and to sustain their livelihood. In general, risk and profit are closely associated. A farmer can increase his profit by taking more and more risk[4]. When, there is unavailability of institutional revolution to manage risks in agriculture like crop insurance, disaster management and backup mortgages to mitigate, the element of risk and uncertainty will be a critical part of the farmer's decision making process [5].

Various studies found that due to risk and uncertainty, farmers prefer to adopt options with low returns but less risk as compared to adopting options such as new technologies which gives them higher returns but with more risk of failure[6]. Not only domestic consumption pattern is oscillated because of the failure to manage with agricultural risks, but it also affects the nutrition, health and education of the household members [7].Hence, risk aversion is found to be a better option to assent lesser expected return to attain lower risk. This projection of attitude of farmers in risky situation depends on how much is known about the individual's willingness to take risks [8]. To clearly understand the risk management behavior at farm level, it is necessary to have information not only about farmers' preferences but also the availability of institutions that facilitate the risk bearing capacity of the farmers[9]. However, to determine the rate of dispersion of new technologies among farmers, the major element is the consideration of the farmer's attitude toward risk. Risk and uncertainty have influence on production and consumption related decision of agricultural household. Several studies concluded that poor farm households are found to be more risk averse in nature [10],[11].

Corresponding Author: Muhammad Amjed Iqbal, PhD Scholar, College of Economics and Management, Huazhong Agricultural University, Wuhan 430070, Hubei Province, P.R. China.
Email: amjadiqbal1775@yahoo.com Tel: 86-13277924096

Hence in agriculture being the backbone of the economy in most of the developing countries like Pakistan[12], producer has to face high level of production, market and financial risks. Due to these risks there is always need to develop number of agricultural risk management approaches and tools[13].Off-farm diversification is also considered as one of the important strategies[14],which are used to tackle the production or yield risks and also to ensure the steady income[15].According to [16],involvement in such type of activities besides a "home plot" of land to get more income is necessary for the development of agriculture and to reduce production risk especially in country side areas and are called non-farm/off-farm activities. Generally in agriculture, the concept of attaining income simply from only agriculture is now shifting to including many other income sources in addition to agriculture. Several studies have accredited off-farm work as a risk lessening approach for all farmers, especially for small farmers. Moreover, income generated from such non-farm activities can help farmers in providing financial assistance to bear family expenses in absence of agricultural income[17].

At farm level, among the various risk management options at farm level, income or livelihood diversification is also considered an important technique used by agricultural households[18], which is mainly include investing in non-farm businesses or doing off-farm jobs in addition to agricultural business. By considering income diversification options, farmer can be able to avoid selling their price at low prices and may be able to get more stable income from a diversified set of enterprises. Further this additional off-farm income may also help farmer to invest other risk management options to reduce various other risks[19]. For instance, the threat of crop disaster because of critical climatic condition or crop disease may be off-set by investing off-farm income in purchasing heat tolerant varieties or investing in installing a tube-well at his farm to avoid water shortage[20].

Several studies narrated significant and rising share of off-farm income in total household income [21],[22]. The main causes for income diversification are the declining farm income and the aspiration to protect against different risks in agriculture like production and market risks [23],[24]. Household are dragged to diversification when return in off-farm employment are more certain and less risky as compared in farming [25]. To contest this entire situation, farmers have to rely on self-strategies. Public institutions are not so developed to help the farmers in the way of providing different facilities like insurance and other consultancy services. So it is good for the farmers to adopt off-farm diversification to manage agricultural risk and income. Many studies like [26], [27]recognized determinants of off-farm diversification for risk management. But information including farmer's behavior toward risk and adoption of off-farm diversification remains mostly unknown so far in Pakistan.

Hence considering this lack, the present study was designed to answer the two research questions

1. To explore the perception of farmers towards risk and risk attitude
2. Factors affecting the adoption of off-farm diversification while observing the risk attitude and risk perception of the respondents

2 MATERIAL AND METHODS

a- Study area description

The study was conducted in Punjab province, Pakistan. It is the most inhabited province of the country [28]. We selected Punjab as study area due to two reasons: First, Punjab contributes about 73% share in total national cotton production and accounts for 80% share of total area under cotton crop[29].Second, cotton crop in the province is highly exposed to various kinds of risks including climatic and environmental disasters since last decade. For instance, continuous floods from 2010 to 2014 affected nearly 11 districts of Punjab province and most of them were cotton growing districts [30],[29].

Overall the province has both hot and cold climate, hot in summer and clod in winter. The average annual minimum and maximum temperature in Punjab ranges from 16.3 to 18.2 °C and 29.3 to 31.9 °C respectively during the period 1970 to 2001. While the rainfall follows a dispersed pattern. More than two-third of the rainfall occurs in monsoon season during June to September [29].

b- Sampling and data collection

Primary data was collected from 210 farm households which were selected through multi-stage sampling procedure. In the first step, Punjab was selected as main study area. In the second step, out of nine administrative units, three regions i.e. Bahawalpur, Dera Ghazi Khan and Multan were selected based on highest contribution to total cotton production in the province. In the third step, one district was selected from each region with highest contribution to total cotton production in the same region. So in total we selected three representative districts Bahawalpur, Muzaffargarh and Vehari for this study. In the fourth step, we randomly selected ten villages from each district. In fifth step we randomly selected 7 farm households from each village which makes the total sample of 210 farm households. A well-structured questionnaire was used for the purpose of data collection from the respondent households. The questionnaire includes information about characteristics of farm households, sources

of income including farm and off-farm, farmer's exposure to various kinds of risks in cotton production. Prior to the start of the survey, a pretesting was done to avoid missing of any important information.

c- Analytical Methods

Probit model was applied to investigate the factors affecting the adoption of off-farm diversification income sources for the respondents. Due to the binary nature of outcome variable, Ordinary Least Square (OLS) regression cannot be applied[31]. The probit model may be written in form of latent variable as:

$$Y^* = \acute{X}\beta + \varepsilon \quad (1)$$

Where, Y^* is a latent variable which represents the benefits that farm household achieved by adopting the off-farm diversification sources. X is the vector of explanatory variables that may affect dependent variable, $\beta_i$is the vector of unknown parameters which are to be estimated and ε_i is the error term. As we cannot observe latent variable, but what we can observe is:

$$Y_{ij} = \alpha + \sum X_i\beta + \varepsilon \quad (2)$$

Where Y_{ij} is the dependent variable (off-farm diversification) having the binary outcome. It shows that households adopt off-farm diversification only if there are some benefits at farm level. Hence, it takes value 1, if Y^* is greater than zero and takes zero, if Y^* is less than zero. $X_i$is the vector of explanatory variables including risk attitude and risk perceptions that may influence farmers' decision to adopt off-farm diversification.

$$Yi = \begin{cases} 1 & if\ Y^* > 0 \\ 0 & otherwise \end{cases}$$

d- Hypothesis Testing for Model Significance

To assess the significance of the model, a global null hypothesis technique was used. For this study a null hypothesis was established by assuming that all coefficient of probit model are equal to zero verses that one of the coefficients is not equal to zero [32].

$H_0 : \beta_i = 0$

H_1 : at least one $\beta_i \neq 0$

This methodology is the same as the F test in the ordinary least square method. From table 2 it can be viewed that the chi-square values for the probit model is 174 and the associated p-values are less than 0.001. So it can be concluded that our model fit significantly. Further the value of pseudo-R^2 which is the measure of the goodness of fit of a model was 0.59. It describes that our model better fit for the variables selected for the study.

e- Explanatory variables

The study use both continuous as well as binary variables. In order to investigate the influence of risk attitude and risk perceptions on the adoption of off-farm diversification we measured risk perceptions and attitude and then used them as independent variables in the model. In addition to these risk variables, we also used other farm households' characteristics such as education, farm experience, family size, location of farm.

f- Risk Perceptions

For the present study, we asked farmers to score different kinds of risks (provided in the questionnaire) exposed to their cotton corp. Afterwards we selected three major risks perceived by cotton farmers that include (i) risk of floods, (ii) risk of pest and cotton disease, and (iii) risk of high input prices.

g- Risk Attitude

An equally likely certainty equivalent (ELCE) model was used to figure out the behavior of farmers toward risks. Certainty equivalents (CE) were derived for a sequence of risky outcomes and match them with utility values [33]. For example the respondents were enquired to recognize the monetarist value of certain outcome that made them indifferent in a choice amid two risky outcomes as total PKR 1 (Total annual household income, say PKR 70,000) and PKR 0 with same probability (in this example the utility associated with PKR 70,000 is 1 and with PKR 0 is 0). Assume that the retort is PKR 36,000; this is the certainty equivalent (CE) of the agriculturalists for the income level of PKR 70,000 and PKR 0 with equal probabilities. The respondent was once more asked to state the monetary values of a sure outcome that make him indifferent between the two risky outcomes of PKR 36,000 and PKR 0 with equal probability. This process continued till appropriate data points were obtained. The similar process is adopted for the other half of income distribution to get the CE and matched them with utility values. The farmer response of PKR 36,000 is the CE for uncertain payouts of PKR 70,000 and PKR 0 with equal probabilities (0.5 each) and utility values for this CE are calculated as

$$U(36{,}000) = 0.5u(0) + 0.5u(70{,}000) = 0.5(0) + 0.5(1) = 0.5$$

After getting quite a few certainty equivalents and matching them with utility values a cubic utility function was applied for estimation of the utility of each individual respondent. The equation of cubic utility function is

$$U(w) = \alpha_1 + \alpha_2 w + \alpha_3 w^2 + \alpha_4 w^3$$

This cubic utility function is related with risk aversion, risk preferring and risk indifferent attitudes [33]. As utility is mostly calculated on an ordinary scale though, the shape of utility function on an ordinary scale can be transmuted into a quantitative measure of risk aversion called absolute risk aversion [34], [35], [36]. The absolute risk aversion is arithmetically written as

$$r_a(W) = -\frac{U'(W)}{U''(W)}$$

$r_a(W)$ is coefficient of absolute risk aversion, U' and U'' are first and second order derivatives of wealth (W) respectively. Following [37] income is substituted for wealth. The coefficient of absolute risk aversion is positive if individual is risk averse, negative if individual prefers risk and zero if individual is indifferent to risk. The risk attitude of the farmers is included in the analysis as 1, if individual reflect risk averse nature and 0, otherwise.

3 RESULTS AND DISCUSSION

3.1 Descriptive Statistics

Table 1 elucidates the descriptive statistics of the variables used in the model. Two kinds of variables were used in the present study. One are the continuous and other are the discrete choice variables. According to the results farmers had 23 years of average farming experience and they were located 11 kilometer on an average distance from the main city. The average farm size in the study area was found 17 acre, further average family members in a household was 9. The results also established that about 67 percent of the farmers show risk averse behavior as they were not ready to utilize any type of opportunity or to use any technology that involves risk element. So majority of the farmers were risk averse in nature as reported by [14].[38] studied farmers decision related to farm production by using income approach and defined risk averse as "A person is described as being risk averse if he prefers a situation in which a given income is certain to a situation yielding the same expected value for income but which involve uncertainty" as also reported by the [11]. Cotton disease and high input prices was perceived as high risk by more than two third respondents and less than two third respondents told flood a high risky elements perceived by them.

Table 1: Depiction of variables used in the model

Variables	Mean	Standard Deviation	Description
Demographic Characteristics			
Education (years)	8.65	3.48	Continuous
Farming Experience (years)	22.24	9.38	Continuous
Location (distance from main city in kilometer)	11.8	4.5	Continuous
Farming area(Acre)	16.95	10.08	Continuous
Family size	8.98	1.37	Continuous
Risk variables			
Risk attitude/Risk aversion behavior	0.67	0.47	Dummy takes the value 1 if farmer has risk averse nature and zero otherwise
Perceived risk of high input price	0.75	0.43	Dummy takes the value 1 if farmer perceive that risk and zero otherwise
Perceived risk of pests and cotton diseases	0.76	0.42	Dummy takes the value 1 if farmer perceive that risk and zero otherwise
Perceivedrisk of flood	0.70	0.45	Dummy takes the value 1 if farmer perceive that risk and zero otherwise

3.2 Empirical findings

A Probitregression model was applied to conclude the factors affecting the farmer's decision related to the involvement in off-farm diversification. Table 2 illustrate that some variables like education, farming experience, risk aversion behavior and risk perception of cotton diseases were affecting significantly to the decision of respondents for adopting the off-farm income sources. The parameter estimates and marginal effects of the variables were given as

Education is an important element for deciding about adoption of off-farm activities. In our study results the coefficient of education variable is highly significant and positively related with the dependent variable. It explain that the probability of household to join off-farm activities to increase income level or to decrease farming risk increases with the increase in the educational background of the respondents (table 2). Marginal effect clarify that an increase in one year of education level would results in 7% escalation in the probability of farmer to go for off-farm income sources. This could be concluded that farmers with more education may be more capable of managing their farm and non-farm income sources as compared to farmers with low education. Moreover, scientists like [39],[21],[40],[41] pointed out the education as one of the main element to go for non-farm sector as a risk management strategy.

Further, farming experience is another important factor for deciding the off-farm activity participation. The coefficient of farming experience is negative and statistically significant at 5 percent level as reported by the [42], [43]. Results reveal that farmers having more farming experience are less likely to adopt off-farm

diversification source of income. This may be due to their inability or hesitation to take part in other businesses as they spent most of their time in farming and my feel that probability of respondents to adopt off-farm income sources decreases with more farming experience. An increase in one year of farming experience of household head would decrease 0.5 percent chances of doing off-farm jobs.

According to the results risk averse attitude of the respondent affected considerably for the likelihood of the off-farm work. It has positive coefficient. Marginal effect implies that farmers having risk averse nature has 1.6 percent more chances to ensure off-farm diversification as risk mitigation strategy for their farming.Similar findings were reported by [41],[19].

As respondents being cotton farmers so they perceived pest and disease a big risk element for cotton crop. So the perception of cotton disease affected significantly for the farmer to off-farm diversification income strategy. Marginal effects narrated in Table 2 show that if the farm household perceived cotton disease a big risk, then its likelihood of doing off-farm work increased by 3.5%. The results are in line with [19].

As described that flood affected cotton crop many times from 2010. So farmers perceived it a big risk for crop. According to the results the coefficient of risk of flood has positive relation with the dependent variable. It infers that farmers who perceived flood a risk for crop their probability of doing off-farm work to manage agricultural risk increases by 1.1%. It is understandable that due to flood there was crop failure and loss of farm income so ultimately there is more likelihood for the household to do off-farm employment or business.

Table 2: Parameter Estimates and Marginal Effects of Probit Model

Explanatory variables	Estimates	Standard Error	Marginal effects	Standard Error
Intercept	-7.878***	1.555		
Education	0.437***	0.069	0.067	0.005
Farming Experience	-0.035**	0.018	-0.005	0.002
Location	-0.007	0.031	-0.001	0.004
Farming area	0.017	0.015	0.002	0.002
Family size	0.158	0.112	0.024	0.017
Risk aversion behavior	1.078 ***	0.333	0.165	0.047
Risk of high input price	-0.274	0.340	-0.042	0.051
Risk of cotton disease	2.313***	0.550	0.355	0.071
Risk of flood	0.730*	0.403	0.112	0.060
N	*210*			
Log likelihood	*-58.671759*			
Chi-square	*173.78*			
F-stat significance	*0.000*			
Pseudo-R^2	*0.5969*			

******, **, * significant at significance level 0.01, 0.05 and 0.1 respectively***

5 Conclusion

Off-farm diversification is an important strategy to ensure the income of agricultural household. Because agriculture is always risky business by nature due to this income of farmer is uncertain. The present study used primary data collected from 210 cotton farmers in Punjab province Pakistan, to explore the main element affecting the farmer decision to involve in off-farm activities to handle risk in farm production. Generally, farmers were aware about different kind of risk to which cotton crop was exposed and they also ranked those risks according to their thought and awareness. Mainly farmer opinion on four types of risk like flood, cotton disease and high input price were judged. Majority of the farmers were risk averse in nature. They were not ready to apply any new technology if it involves risk aspect either it having more chances of getting good production and ensuring higher income. The results of the probitregression model investigated that education, farming experience, risk averse nature were the main factors that were affecting significantly to the farmer decision of involving in off-farm activities. Moreover, the perception of flood and cotton diseases risks were the elements that motivated the farmers to adopt off-farm diversification.

Even though the study was limited to three district but the finding of the study can be applied more widely, particularly in areas where private and public institution role is minimum to spread awareness about risk management strategies and providing different facilities to farmers to manage agricultural risk like crop insurance, credit disbursement etc. Overall these findings may also be useful for other researchers and policy makers to understand how farmer's characteristics, demographic features, risk aversion behavior and perception about different risk play its role in shaping farmers' decision about off-farm work to manage risk in agriculture.

Acknowledgement

The work is supported by Project (NSFC)/National Natural Science Foundation of China (71073064 and 71273106).

4 REFERENCES

1. 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*(4), 661-675.
2. Den, E. M., N.A.M. Noor, and M.R. Zainuddin, 2015. Flood Mitigation Measures and Suggested Improvements in UiTM Pahang. Journal of Applied Environmental and Biological Sciences, 5(5), 57-65.
3. Sookhtanlo, M. and V. Sarani, 2011. Analysis of Factors Affecting on Risk Management of Wheat Production Among Wheat Farmers (Razavieh Region, Khorasan-E-Razavi Province, Iran). AGRIS on-line Papers in Economics and Informatics, *3*(4).
4. Njavro, M. and D. Pleško, 2007. Livestock Insurance As A Risk Management Tool On Dairy Farms. *POLJOPRIVREDA*, *13*(1), 78-82.
5. Wenner, M. 2002. Lessons learned in rural finance. Technical Papers Series, IADB-SDS. Washington, DC.
6. Alderman, H. 2008. Managing Risk to increase Efficiency and reduce Poverty. World Development Report 2008. World Bank, Washington, Dc, 2008.
7. Dercon, S. 2002. Income risk, coping strategies, and safety nets. The World Bank Research Observer, *17*(2), 141-166.
8. Patindol, R. A. 2001. Stochastic Dominance Analysis in the Selection of Risk-efficient Cropping Strategies.
9. Lucas, M. P. and I.M. Pabuayon, 2011. Risk Perceptions, Attitudes, and Influential Factors of Rainfed Lowland Rice Farmers in Ilocos Norte, Philippines. Asian Journal of Agriculture and Development, *8*(2), 61.
10. Iqbal, M. A., Q. Ping, M. Abid, S.M.M. Kazmi, and M. Rizwan, 2016. Assessing risk perceptions and attitude among cotton farmers: A case of Punjab province, Pakistan. International Journal of Disaster Risk Reduction,16, 68-74.
11. Dadzie, S. K. N. and H.D.G. Acquah, 2012. Attitudes toward risk and coping responses: The case of food crop farmers at Agona Duakwa in Agona East District of Ghana. International Journal of Agriculture and Forestry, *2*(2), 29-37.
12. Abdullah, D. Z., S.A. Khan, K. Jebran, and A. Ali, (2015). Agricultural Credit in Pakistan: Past Trends and Future Prospects. J. Appl. Environ. Biol. Sci,*5*(12), 178-188.
13. Iqbal, M. A., Q. Ping, Z. Jun, M.J. Sheikh, and C. Tong, 2015. Risk perception and Management Strategies of Cotton farmers In Pakistan. SYLWAN., 159(11).
14. Qasim, M. and N. Ahmad, 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), 18-25.
15. Valandia, M., R.M. Rejesus, T.O. Knight, and B.J. Sherrick, 2009. Factors affecting farmers' utilization of agricultural risk management tools: the case of crop insurance, forward contracting, and spreading sales. Journal of Agricultural and Applied Economics, *41*(01), 107-123.
16. Man, N. and S.I. Sadiya, 2009. Off-farm employment participation among paddy farmers. In *in the MUDA* Agricultural Development Authority and Kemasin Semerak Granary areas of Malaysia". Asia-Pacific Development Journal.
17. Ellis, F. and H.A. Freeman, 2004. Rural livelihoods and poverty reduction strategies in four African countries. Journal of development studies, *40*(4), 1-30.
18. Tangermann, S. 2011. Risk management in Agriculture and the Future of the EU's Common Agricultural Policy. International Centre for Trade and Sustainable Development. Issue Paper, (34).
19. Ullah, R. and G.P. Shivakoti, 2014. Adoption of on-farm and off-farm diversification to manage agricultural risks: Are these decisions correlated?. Outlook on Agriculture, *43*(4), 265-271.
20. World Bank, 2005 Managing agricultural production risk: Innovations in developing countries. Agriculture and Rural Development (ARD) Department, Repor *No* (32727-GLB), World Bank, Washington, DC.
21. De Janvry, A. and E. Sadoulet, 2001. Income strategies among rural households in Mexico: The role of off-farm activities. World development,*29*(3), 467-480.
22. Babatunde, R. O., F.I. Olagunju, S.B. Fakayode, and A.O. Adejobi, 2010. Determinants of participation in off-farm employment among small-holder farming households in Kwara state, Nigeria. Production Agriculture and Technology, *6*(2), 1-14.
23. Kijima, Y., T. Matsumoto, and T. Yamano, 2006. Nonfarm employment, agricultural shocks, and poverty dynamics: evidence from rural Uganda. Agricultural Economics, *35*(s3), 459-467.

24. Matsumoto, T., Y. Kijima, and T. Yamano, 2006. The role of local nonfarm activities and migration in reducing poverty: evidence from Ethiopia, Kenya, and Uganda. Agricultural Economics, *35*(s3), 449-458.
25. Ibekwe, U. C., C.C. Eze, and D.O. Ohajianya, 2014. Determinants of Non Farm Income among Farm Households in South East Nigeria. *The AYER*, *1*, 32-39.
26. Deressa, T. T., C. Ringler, and R.M. Hassan, R. M. 2010. Factors Affecting the Choices of Coping Strategies for Climate Extremes. IFPRI Discussion Paper 01032.
27. Babatunde, R. O. And M. Qaim, 2009. The role of off-farm income diversification in rural Nigeria: Driving forces and household access. Quarterly Journal of International Agriculture, *48*(4), 305-320.
28. Abid, M., J. Scheffran, U. A. Schneider, and M. Ashfaq. 2015. Farmers' Perception of and Adaptation strategies to Climate Change and their determinants: The case of Punjab Province, Pakistan. Earth System Dynamics. 6, 225-243.
29. GOP, 2013. Agricultural statistics of Pakistan 2012–13. Ministry of Food andAgriculture (economic Wing), Finance Division, Government of Pakistan,Islamabad.
30. NDMA. 2010. National Disaster Management Authority. Annual Report, Available online at http://www.ndma.gov.pk/new/resources/annualreports.php accessed on 10/06/2015
31. Ullah, R., D. Jourdain, G.P. Shivakoti, and S. Dhakal, 2015. Managing catastrophic risks in agriculture: Simultaneous adoption of diversification and precautionary savings. International Journal of Disaster Risk Reduction, *12*, 268-277.
32. Peng, C. Y. J., K.L. Lee, and G.M. Ingersoll, 2002. An introduction to logistic regression analysis and reporting. The Journal of Educational Research, *96*(1), 3-14.
33. Binici, T., A.A. Koc, C.R. Zulauf, and A. Bayaner, 2003. Risk attitudes of farmers in terms of risk aversion: A case study of lower Seyhan plain farmers in Adana province, Turkey. Turkish Journal of Agriculture and Forestry, *27*(5), 305-312.
34. Arrow, K. J. 1964. The role of securities in the optimal allocation of risk-bearing. The Review of Economic Studies, 91-96.
35. Raskin, R. and M.J. Cochran, 1986. Interpretations and transformations of scale for the Pratt-Arrow absolute risk aversion coefficient: Implications for generalized stochastic dominance. Western Journal of Agricultural Economics, 204-210.
36. Pratt, J. W. 1964. Risk aversion in the small and in the large. Econometrica: Journal of the Econometric Society, 122-136.
37. Olarinde, L.O., V.M. Manyong, and J.O. Akintola, 2007. Attitude towards risk among maiz farmers in the dry savanna zone of Nigeria: some prospective policies for improving food production. African Journal of Agricultural Research, Vol 2, No 8, pp399-408.
38. Ellis, F. 2000. The determinants of rural livelihood diversification in developing countries. Journal of Agricultural Economics, *51*(2), 289-302.
39. Gordon, A. and C. Craig, 2001. Rural non-farm activities and poverty alleviation in sub-Saharan Africa. Natural Resources Institute, University of Greenwich.
40. Ashfaq, M., S. Hassan, M.Z. Naseer, I.A. Baig, and J. Asma, 2008. Factors affecting farm diversification in rice-wheat. *Pak. J. Agri. Sci*, *45*(3), 91-94.
41. Kouame, E. B. H. 2013. Risk, risk aversion and choice of risk management Strategies by cocoa farmers in western Cote D'ivoire. *Accessed 29th April*.
42. Beyene, A. D. 2008. Determinants of off-farm participation decision of farm households in Ethiopia. Agrekon, *47*(1), 140-161.
43. Akaakohol, M. A. And G.C. Aye, 2014. Diversification and farm household welfare in Makurdi, Benue State, Nigeria. Development Studies Research. An Open Access Journal, *1*(1), 168-175.