



Research Paper

Determinants of Crop Diversification in Mixed Cropping Zone of Punjab Pakistan

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Received 24 September 2017; Accepted 11 October, 2017

Agriculture income is part and parcel of every household's income in all over the country, especially in rural areas. But agriculture has become very risky due to its whole dependence on nature and market conditions. Crop diversification is a low cost, self-motivated protective measure against climate changes and market conditions to reduce income fluctuations. Multiple stage sampling technique was used to select 100 crop growers for an interview in district Faisalabad. Widely used Herfindahl index (HI) was applied to calculate the farmer's diversification level. Sampled farmers were classified by cluster analysis into low and high diversified farms. The socio economic characteristics of farmers were compared by statistical analysis such as independent t test etc. and determinants of the crop diversification index were analyzed by Tobit model. Highly diversified farmers were found younger (36 years) as compared to low diversified farmers (45.6 years)

and mostly high diversified farmers were having off-farm source income as compared to low diversified farmers. The result of econometric model depicts that the education and farm size positively and significantly affect the crop diversification. Similarly, the ownership of farm machinery enhance the diversification level of farms in crop cultivation. The self-owned operated farms will be less likely to be diversified in crop cultivation than another form of tenure types like renter and shareholder. Farmers should be educated about the benefits of crop diversification and farmers should also rent or share the land when it looks necessary to increase farm size for enjoying long term benefits of farming.

Key words: Crop diversification, cluster analysis, Tobit model, Herfindahl Index, Faisalabad, Pakistan

INTRODUCTION

Pakistan economy consists of three broad sectors namely as agriculture industrial and services sector. The agriculture sector is important because Agriculture income is part and parcel of almost every household's income in Pakistan and most of the population (62-64%) still live in rural areas (Pakistan Bureau of Statistics, 2017). Therefore, agriculture is the main source of income for a large part of the population (42.3 %). Agriculture is also playing a prime role in the development of the country by providing the raw material for value addition, and reducing unemployment. Since 1947, the share of agriculture in GDP of Pakistan has been decreasing but still, it has a prime share (19.5 %) in

country's GDP after services sector (59.9 %) (The Government of Pakistan, 2016). Agriculture consists of many subsectors like crop, livestock, forestry, and fishing. The livestock sector is the biggest sub-sector with its contribution of 11.39 percent in GDP and crop sector lay at 2nd position with a total contribution of 6.81 percent of GDP (The Government of Pakistan, 2017).

Crop sector includes main crops also known as cash crops (cotton, wheat, sugarcane, rice, and maize) and other crops also termed as grain crops in the country like gram, rapeseed/ mustard seed, barley etc. Crop sector has key importance not only in agriculture but also in overall country's economy because this sector is the

Share of different subsectors in agriculture

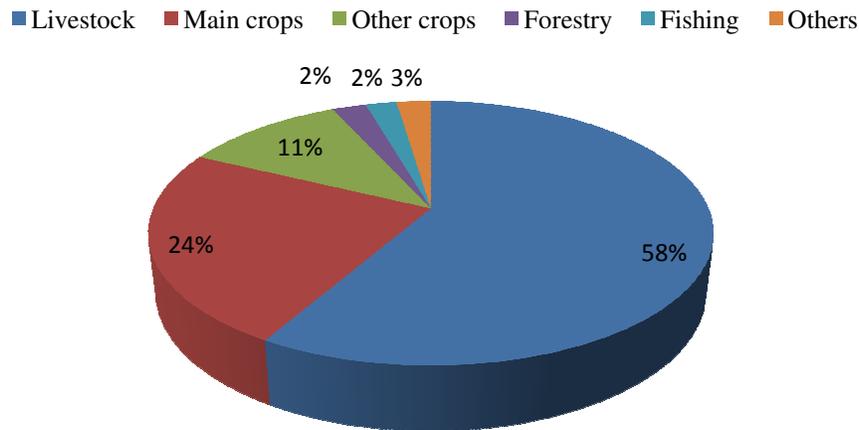


Figure 1. Share of different subsectors in agriculture (The Government of Pakistan, 2017).

main source of foreign exchange of country. Cotton and cotton manufacturers have a giant share in exports of the country which is almost 58 percent of total exports. Pakistan is the 4th largest producer of cotton (The Government of Pakistan, 2017) and 5th largest sugarcane producer (FAO, 2010) in the world. Rice and wheat are also equally important because they are used as main staple food in the country as Pakistan is the 6th largest country in the world having a population of 208 million and which is increasing at annual growth rate of 2.13 (Pakistan Bureau of Statistics, 2017). Figure 1 shows the share of different subsectors in agriculture.

As the population of Pakistan is increasing at a rapid pace so farmers, as well as Government, will have to take innovative measures in agriculture especially in crop sector to fulfill the needs of food of the large population. But, Agriculture especially crops cultivation has become very risky because of climate changes (droughts, unusual precipitation, insect pest attacks and market conditions (price fluctuations). Due to these risks, the farmers have to deal with certain problems like income variability. The decision taken in one season can affect the farmer's income in next season. Crop diversification is one way to counter these risks and income instability (Ashfaq et al., 2008; Kahan, 2008; Ceyhan et al., 2003). Crop diversification is self-motivated low-cost protective measure against certain risks to decrease income invariability. Crop diversification is defined as "cultivation of more than one crop in the certain area in form of rotation or intercropping at any given time" (Makate et al., 2016). Farmers and farm enterprises can choose to cultivate certain crops for cultivation to decrease income variability (Mishra and El-Osta, 2002). Crops diversification is a cheaper way of overcoming income uncertainties caused by market conditions as well as

climate changes (Joshi et al., 2005). On the other hand crop diversification also increase soil fertility and brings yield stability in crop production (Lin, 2011). Crop diversification is used as an important tool for the price as well as output invariabilities. The advantages of crop diversification, as well as enterprise diversification, could only be utilized if there are enough resources, heterogeneity in the soil to support different crops at one time. At the same time, the success of crop diversification depends upon the skills of handling a diversified farm (Jill and Erin, 2005). Crop diversification offers a larger variety of crops to expand production and lesser risk than single crop (Imbs and Wacziarg, 2003). Crop diversification has a lot of advantages over traditional single crop system at one point in time in the certain area. These advantages are (1) higher agriculture income (2) efficient use of labor and resources (3) high returns to labor (4) decrease in pest attacks (Behera et al., 2007; Mehta, 2005). Although there are numerous advantages of crop or enterprise diversification these advantages can be minimized under certain conditions. For example, if a lot of farmers are adopting same cropping changes, the advantages of the price of the certain product will quickly vanish due to its supply increase in the market (Ashfaq et al., 2008).

There are certain socioeconomic (age, awareness, education, media access), environmental (flood, drought, frequency of precipitation), institutional (laws, technical support) and cultural or regional (rituals, willingness to change) and economic factors (farms size, income, market condition) which affect enterprise diversification in each country and region. Although, a lot of studies have been conducted (Mishra and El-Osta, 2002; Asante et al., 2017; Thapa et al., 2017; Abro et al., 2016; Belay et al., 2017; Khalid et al., 2016) to determine the factors

affecting crop diversification in different countries of the world but there is no such comprehensive study in Pakistan on diversification at farm level as well as in cash crops (cotton, rice, wheat, sugarcane, maize), and Farmers of one country could behave differently under same circumstances. Therefore this study is planned to determine the factors influencing the behavior of farmers toward crop diversification at the farm for sustainable farm profitability.

MATERIALS AND METHODS

Study area

The study area Faisalabad is located in the rolling flat plains of northeast Punjab between longitude 73°74 east, latitude 30°31.5 North (Haq et al., 2016). The study area (Faisalabad) is the third populous city of Pakistan also known as Manchester of Pakistan due to its industrial importance. The area consists of 6 tehsils showed in (Figure 2) and 287 union councils. More than 52 percent of the population in the study area is residing in rural areas the total area of Faisalabad is 5856 Sq.Km. The literacy rate in district Faisalabad is over 60 percent (Pakistan Bureau of Statistics, 1998). Faisalabad is a mix cropping zone (Hussain et al., 2011; Shahbaz et al., 2017) and 80 percent of the total area is irrigated. Although all crops are cultivated in the study area the main crops include wheat, rice, maize, sugarcane, and cotton (Agriculture Statistics, 2017).

Sampling and data collection

Multiple stage sampling technique was used to select the study area and collection of data, as used by many researchers (Abid et al., 2015; Saguye, 2016). In the first step, Faisalabad district was selected as study area due to its characteristic for mixed cropping. In 2nd step 4 tehsils (Samundari, Tandlianwala, Jarawalan and Chuk Jhumra) were selected based on their agriculture share in the district. In 3rd step, from each tehsil 5 union councils were chosen for data collection randomly. In Pakistan, a union council consists of 4 to 8 villages. So in the 4th step, from each selected union council 1 representative village was with the consultation of agriculture officer appointed there chosen and in the last step from each selected village 5 farmers were chosen randomly. The data were collected from 100 farmers through a well-prepared questionnaire.

Methodology

Crop diversification index was used to measure the extent of crop diversification in the study. The crop

diversification index (CDI) was attained by subtracting Herfindahl index (HI) from one. The value of crop diversification index remains between 0 and 1. If the value of crop diversification index is 0 or near to 0 it shows farmer is specialized. On the other hand, the value near to 1 indicates how much a farmer is diversified (Malik and Singh, 2002). A similar method was used by Sichoongwe et al. (2014) to calculate CDI. The CDI was calculated by following formula.

$$S_i = \frac{P_i}{\sum_{i=1}^n P_i}$$

Where

S_i = *i*th crop proportion

P_i = *i*th crop area

$$\sum_{i=1}^n P_i = \text{total area under all crops}$$

$i = 1, 2, 3, 4 \dots$ (No. of crops)

$$\text{Herfindahl inde (HI)} = \sum_{i=1}^n P_i^2$$

$$\text{Crop diversification index (CDI)} = 1 - \text{HI} = 1 - \sum_{i=1}^n P_i^2$$

After calculating crop diversification index (CDI) cluster analysis was used to divide farmers into two groups as low and high diversified farms. The descriptive analysis was used to investigate the socio economic characteristics of those groups. T-independent test and chi square (χ^2) was used to check significance level of discreet and nominal explanatory variables respectively. Tobit model was applied to assess the extent of influence different factors on crop diversification. The crop diversification index was used as a dependent variable to see the influence of different explanatory variables on crop diversification. A similar model was used by Dube et al. (2016) to assess the influence of certain socioeconomic characteristics on crop diversification. The general form of the model used to assess the determinants is

$$\text{CDI} = \beta_0 + \beta_1 X_1 + u_1$$

Where

CDI = Crop diversification index (dependent variable)

β_0 = Constant or intercept or

β_1 = Probability of crop diversification due to X_1 or coefficient

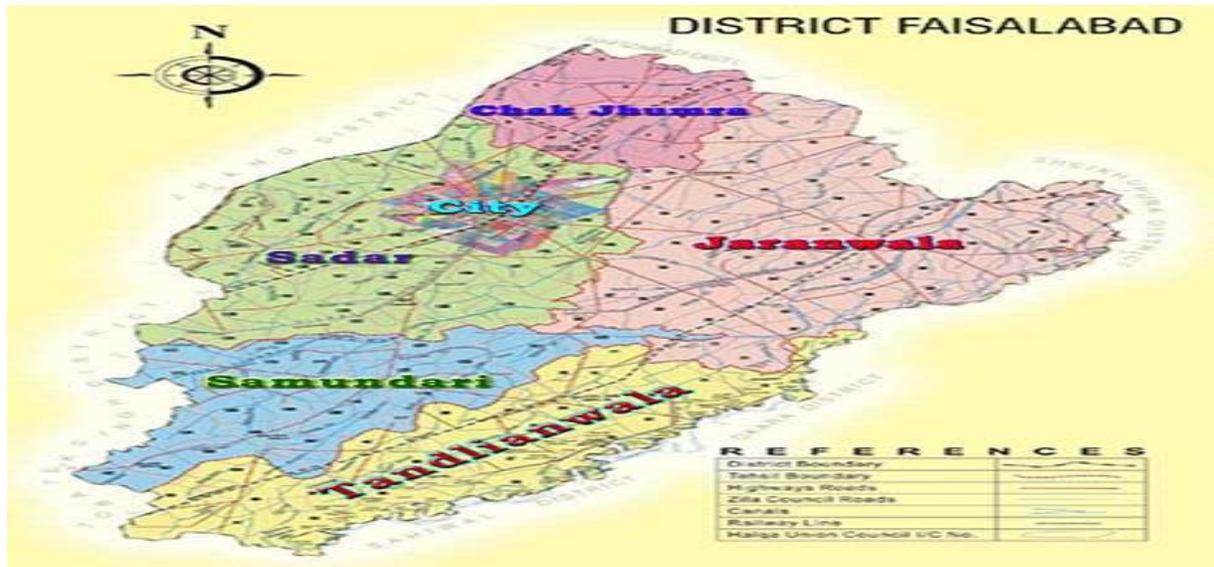


Figure 2. Map of the study area.

Table 1. Classification of farmers based on cluster analysis.

Proportion of each crop in total area	Low diversified farmers	Highly diversified farmers	p-value
Sugarcane (%)	56.18	33.88	0.00***
Wheat (%)	27.72	37.93	0.10*
Maize (corn) (%)	4.86	11.38	0.63
Cotton (%)	0.44	2.07	0.03**
Rice (%)	3.21	3.84	0.73
Berseem/ sorghum (%)	10.12	37.81	0.00***
Crop Diversification Index	0.55	0.68	0.00***

***, **, * significant at 1%, 5% and 10% respectively.

X_i = Factor affecting crop diversification (independent variable or explanatory variables)

u_i = Error term

RESULTS AND DISCUSSION

Classification of sampled farmers

Crop diversification could not be only defined on the basis of a number of crops cultivated but also the proportion of land devoted to each crop should be taken into account. For example, if a farmer is cultivating two crops and 95 percent of the total cropped area is devoted to one crop at the farm then it will not be considered as crop diversified farm (Joshi et al., 2003). So cluster analysis was used to divide sampled farmers into two groups on the basis of the proportion of land devoted to each crop and the diversification scores. Cluster analysis

provides homogeneous groups of farmers in the same cluster (Hair et al., 1998). Table 1 shows that most of the low diversified farmers devoted more than 50 percent of their cropped area to a single crop sugarcane and this difference of land devoted to sugarcane was also found statistically significant. On the other hand, high diversified farmers are cultivating sugarcane, wheat, and berseem/ barley almost on equal proportions of land. Descriptive analysis showed that most of the farmers in the study area are highly diversified. Out of 100 interviewed farmers, 60 farmers were highly diversified. Although 40 percent of total sampled farmers were also cultivating more than one crop they were devoting more of the area to a single crop (Table 2).

Pakistan has two cropping seasons (Rabi & Kharif) (The government of Pakistan, 2017) and (Table 3) shows that the operational land holding is almost same at both farms but sown area in both seasons by the farmer of groups are different in acres. The land allocation to sugarcane (7.22 acres) by low diversified farmers was

Table 2. Descriptive statistics of sampled farmers.

Farmers	Frequency	Percent
Low diversified farmers	40	40.0
Highly diversified farmers	60	60.0
Total	100	100.0

Table 3. Land Allocation under crops by farmers.

	Low Diversified Farmers		Highly Diversified Farmers		All		p-value
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	
Operational Land Holding	12.85	11.66	11.50	8.27	12.04	9.74	0.50
Sugarcane (acres)	7.22	6.22	3.90	2.76	5.23	4.74	0.00***
Cotton (acres)	0.06	0.32	0.24	0.74	0.17	0.61	0.15
Rice (acres)	0.41	1.10	0.44	1.17	0.43	1.14	0.90
Maize (acres)	0.63	1.02	1.31	1.52	1.04	1.38	0.02**
Sorghum (acres)	0.76	1.06	2.95	2.46	2.07	2.28	0.00***
Area Sown in Kharif (acres)	9.08	6.95	8.83	5.76	8.93	6.23	0.85
Fallow Land (%)	23.95	23.53	18.11	21.24	20.45	22.26	0.20
Wheat (acres)	3.56	2.83	4.36	3.25	4.04	3.10	0.21
Bar seem (acres)	0.54	0.72	1.40	1.01	1.06	1.00	0.00***
Area sown in Rabi (acres)	11.32	8.33	9.66	5.88	10.32	6.97	0.25
Fallow Land (%)	2.50	33.39	8.22	20.99	5.93	26.64	0.30

***, **, * significant at 1%, 5% and 10% respectively.

greater than the other crops those were allocated very low land. The highly diversified farmers were sowing more crops at farm land and leave the less fallow area in Kharif season. In Rabi, the fallow area was high than low diversified farmers which may due to fact that farmers were only cultivating fodder crops or wheat with standing crop sugarcane at the farm. The crops were devoted large farm area in every season than low diversified farmers. The share of fallow land in the total operational land was much greater in Kharif season than rabi season. The reason may be the weather is very hot in Pakistan and water availability is limited in the country through the irrigation system. So it becomes impossible to cultivate the whole area.

Socio economic characteristics of classified farmers

Table 4 shows the different characteristics of both low diversified and highly diversified farmers. Comparative study revealed that highly diversified farmers are younger (36 years) than low diversified farmers (45.6 years). The average age of highly diversified farmers is also less than the overall average age of the farmers in the study area. The difference of age between both groups was also statistically significant. Similarly, highly diversified farmers were more educated as compared to low diversified farmers and this difference between groups was also statistically significant. Experience in agriculture and farm size was found statically insignificant. Only 29 percent of total farmers had off farm income source. Chi square (X^2) results show that a farmer with off farm income source is more likely to have diversified crop as compared to a farmer with no off farm income source. This difference of off farm income source was statistically significant.

Overall percentage of farmers was not having tractor ownership. These results are not in line with Bashir et al. (2012) who described that high percentage of farmer in study area has tractor ownership.

Determinant of crop diversification

Table 5 shows the determinants of crop diversification. The results of the study indicate a negative relationship between age and crop diversification. The reason could be that younger farmers are more innovative, risk takers and strong in physical activities at the farm while older farmers take agriculture just a simple way of life (FAO, 2012). The age was also found statistically significant. Similar results were obtained by Sichoongwe et al. (2014). Similarly, education and farming experience had a positive and significant effect on crop diversification. An educated farmer is more likely to understand the market condition and can act as a good tackler of the impact of the uncertain event. The results showed that as the farm size increases the probability in engaging crop diversification. There are a lot of previous studies (Weiss and Briglauer, 2000; Benin et al., 2004; Mwangi et al., 2011; Mishra and El-osta, 2002; Fetien et al., 2009; Culas and Mahendrarajah, 2005) which showed a positive relationship between farm size and crop diversification. Dummy variables were used for off farm income source, tractor ownership, and tube well, and hired labor. If a farmer had off farm income, tractor ownership, tube well ownership value 1 was assigned to that farmer for each variable separately otherwise 0. Similarly, a person not using family labor value 0 was assigned in that case otherwise 1. The analysis revealed that a farmer with a tractor is more likely to have

Table 4. Socioeconomic characteristics of sampled farmers.

Characteristics/ Groups	Low diversified farmers	Highly diversified farmers	All	P-value
Farmer Age (years)	45.6	36.0	39.8	.000***
Education (years)	6.05	9.3	8.0	.001***
Farming experience (year)	18.3	20.9	19.9	.25
Family size (Persons)	6.0	6.8	6.5	.13
Farm size (Acres)	11.2	10.0	10.5	.42
Off farm income source				
No (%)	97.5	2.5	71	0.00***
Yes (%)	53.3	46.7	29	
Ownership of tractor				
No (%)	62.5	37.5	53	0.12
Yes (%)	46.7	53.3	47	

***, significant at 1%.

Table 5. Determinants and extent of crop diversification.

variables	Coefficients (β)	Std. Error	T	P-Value
Age of farmer (X1)	-0.00335	0.000604	-5.54	0.000***
Education (X2)	0.00387	0.00174	2.22	0.029**
Farming experience(X3)	0.00183	0.000599	3.07	0.003***
Family size (X4)	0.00325	0.002322	1.40	0.165
Farm size (X5)	-0.00202	0.000984	-2.06	0.043**
Family labor (X6)	0.0528	0.0059	0.89	0.373
Off farm income source (D1)	0.03274	0.01586	2.06	0.042**
Tractor ownership (D2)	0.06414	0.01593	4.02	0.000***
Tube well ownership (D3)	0.01279	0.0157	0.81	0.418
Dummy land tenure ship (D4)	-0.0234	0.01238	-1.89	0.062*
Dummy hired labor(D5)	0.0152	0.0153	1.00	0.321
Constant	0.6415	0.04	16.01	0.000***

LR chi2 = 128.95, Prob. > chi2= 0.000, Log likelihood= 143.61 ***, **, * significant at 1%, 5% and 10% respectively.

diversified farm as compared to the non-tractor holder. Ashfaq et al. (2008); Mesfin et al. (2011) also found that presence of own agricultural equipment such as tractor increases the probability of crop diversification. While all other dummy variables of off farm income source, tube well ownership family were found statistically insignificant.

Conclusion

Agriculture is a vital sector of Pakistan's economy due to its large share of GDP and employment. With the passage of time agriculture sector is becoming risky due to its direct interaction with climate changes and market uncertainties. On the other hand population of the country is increasing at a rapid pace so agriculture will have to keep improving continuously to fulfill the needs of the large population. The agriculture sector and the farmers engaged in farming are facing many problems; income instability is one of them. Farmers need to take some protective measure to decrease income fluctuation. Crop diversification is low-cost measure against income fluctuations. Crop diversification not only decreases

income instability also increases soil fertility and brings resource efficiency. The study showed that highly diversified are more educated as compared to low diversified farmers. Moreover, education of farmers is directly related to crop diversification. The data also revealed that literacy rate is also low (60 %) in the study area. So government needs to take concrete steps to increase the literacy rate of farmers in the study area which is also a 3rd largest city in the country. The analysis depicted that an owned farmer is less likely to have diversified farm as compared to other forms of tenure types like renter and shareholder The analysis also found that a farmer having own agricultural equipment such as tractor is more likely to adopt crop diversification. Therefore, the government needs to provide such equipment to the farmers in order to increase crop diversification in the agriculture sector.

REFERENCES

- Abid M, Scheffran J, Schneider UA, Ashfaq M (2015). Farmers' perceptions of and adaptation strategies to climate change and their determinants; the case of Punjab province, Pakistan. *Earth Systems Dynamics*, 5:1359-1406.
- Abro AA, Atique Z, Panhwar IA (2016). Does Diversification towards

- Oilseeds Production reduce the Import burden in Pakistan?. Sukkur IBA Journal of Management and Business, 3(1): 1-12.
- Agriculture statistics of Pakistan, (2010). Crops area and production by districts (1981-82 to 2008-09). Downloaded from <http://www.pbs.gov.pk/content/crops-area-and-production-districts-1981-82-2008-09>.
- Asante BO, Villano RA, Patrick IW, Battese GE (2017). Determinants of farm diversification in integrated crop–livestock farming systems in Ghana. *Renewable Agriculture and Food Systems*, 1-19.
- Ashfaq M, Hassan S, Naseer MZ, Baig IA, Asma J (2008). Factors affecting farm diversification in rice–wheat. *Pak. J. Agri. Sci*, 45(3):91-94.
- Bashir A, Haq US, Abbas M, Munir MA, Afzal A (2012). Impact of sugarcane mills development activities on cane production in Punjab. *Pakistan Journal of Agricultural Research*, 25(1):21-27.
- Behera UK, Sharma AR, Mahapatra IC (2007). Crop diversification for efficient resource management in India: problems, prospects, and policy. *Journal of sustainable agriculture*, 30(3):97-127.
- Belay A, Recha JW, Woldeamanuel T, Morton JF. (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. *Agriculture & Food Security*, 6(1):24.
- Benin S, Smale M, Gebremedhin B, Pender J, Ehui S (2004). The Determinants of Cereal Crop Diversity on Farms in the Ethiopian Highlands. Contributed paper for the 25th International Conference of Agricultural Economists. Durban, South Africa.
- Ceyhan V, Bozoglu M, Cinemre HA (2003). Measuring yield and price risks for dairy farms and designing risk management strategies: the case of Tonya, Turkey. BODENKULTUR-WIEN AND MUNCHEN. 54. 215-220.
- Culas R, Mahendrarajah M (2005). Causes of diversification in agriculture over time: Evidence from Norwegian farming sector. Paper prepared for presentation at the 11th Congress of the EAAE (European Association of Agricultural Economists), 'The Future of Rural Europe in the Global Agri-Food System', Copenhagen, Denmark, August 24-27, 2005.
- Dube L, Numbwa R, Guveya E (2016). Determinants of crop diversification amongst agricultural cooperators in Dundwa agricultural camp, Choma district, Zambia. *Asian Journal of Agriculture and Rural Development*, 6(1):1.
- FAO (2010). Crop Production. Food and Agriculture Organization of the United Nations. <http://www.fao.org/docrep/018/i3107e/i3107e.PDF>.
- FAO (Food and Agriculture Organization). (2012). *Sustainable Crop Production Intensification*. Twenty-third Session. Rome, Italy.
- Fetien A, Asmund B, Melinda S (2009). Measuring on farm diversity and determinants of barely diversity in Tigray: Northern Ethiopia. <http://www.climatetechwiki.org/content/crop-diversification-and-new-varieties>.
- Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL (1998). *Multivariate data analysis* Upper Saddle River, NJ: Prentice hall.5(3):207-219.
- The government of Pakistan, (2016). Economic survey government of Pakistan. Finance Division, economic advisor's Wing, Islamabad.
- The government of Pakistan, (2017). Economic survey government of Pakistan. Finance Division, economic advisor's Wing, Islamabad. http://www.finance.gov.pk/survey/chapters_17/02-Agriculture.pdf.
- Haq US, Ceyhan V, Boz I, Shahbaz P (2016). Effect of Different Crop Management System on Technical Efficiency in Sugarcane Production in Faisalabad, Punjab Region of Pakistan. *Journal of Biology, Agriculture, and Healthcare*. ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) Vol.6, No.12 2016.
- Hussain A, Bashir A, Anwar MZ, Mehmood I (2011). Agricultural productivity and rural poverty in the rice-wheat and mixed-cropping zones of the Punjab. *Pak. J. life Soc. Sci*, 9(2), 172-178.
- Imbs J, Wacziarg R (2003). Stages of diversification. *The American Economic Review*, 93(1):63-86.
- Jill LC, Erin OS (2005). Land use and income diversification: Comparing traditional and colonist population in the Brazilian Amazon. *Agricultural Economics*, 32(3):221-237.
- Joshi PK, Gulati A, Birthal PS, Twari A (2003). Agricultural diversification in South Asia: Patterns, determinants, and policy implications Discussion Paper No. 57. Markets and Structural Studies Division. Washington D.C.: International Food Policy Research Institute.
- Kahan D (2008). Managing Risk in Farming. Farm management extension guide 3. Food and Agriculture Organization of the United Nations Rome 2008. Pp. 29-87.
- Khalid MA., Usman A, Singh A (2016). The Determinants and Extent of Crop Diversification among Farmers with Small-Sized Land Holdings. *International Journal of Innovative Research and Development*, 5(6). 537-546.
- Lin BB (2011). Resilience in agriculture through crop diversification: adaptive management for environmental change. *BioScience*, 61(3):183-193.
- Makate C, Wang R, Makate M, Mango N (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. *SpringerPlus*, 5(1):1-18.
- Malik D, Singh I (2002). Crop Diversification-An Economic Analysis. *Indian Journal of Agricultural Research*, Pp.61-64.
- Mehta R (2005). An analysis of crop diversification. National Conference on Agriculture for Kharif Campaign-2005, 22-23 March, New Delhi, India.
- Mesfin W, Fufa B, Haji J (2011). Pattern, Trend and determinants of crop diversification: empirical evidence from smallholders in eastern Ethiopia. *Journal of Economics and Sustainable Development*, 2(8):78-89.
- Mishra A, El-Osta H (2002). Risk Management through Enterprise Diversification. A farm level Analysis. Paper presented at AAEA meetings in Long Beach, CA, U.S.A. Mtonga, E. M. (2012). Cooperatives and Market Access in Zambia. Discussion Paper.
- Mwangi JK, Gicuru KKI, Augustus SM, Obedy EG, Sibiko KW (2013). Factors influencing diversification and intensification of horticultural production by smallholder tea farmers in Gatanga District, Kenya. *Current Research Journal of Social Sciences*, 5(4):103- 111.
- Pakistan Bureau of Statistics (1998). Faisalabad district at a glance. Downloaded from <http://www.pbs.gov.pk/sites/default/files//tables/District%20at%20a%20glance%20Faisalabad.pdf>.
- Pakistan Bureau of Statistics (2017). Provisional summary results of Census 2017. Retrieved from <http://www.pbs.gov.pk/content/provisional-summary-results-6th-population-and-housing-census-2017>.
- Saguye ST (2016). Determinants of smallholder farmers' adoption of climate change and variability adaptation strategies. *Journal of Environment and earth science*. 6(9): 147-161.
- Shahbaz P, Haq US, Boz I, Khalid BU (2017). Mixed Farming and its impact on Farm Income; A study in District Faisalabad, Punjab Pakistan. *IJRDO-Journal of Agriculture and Research*, 3(8):15-25.
- Sichoongwe K, Mapemba L, Ng'ong'ola D, Tembo G (2014). The determinants and extent of crop diversification among smallholder farmers: A case study of Southern Province, Zambia. (Malawi strategy support program. International food policy and research institute. Working paper 05 Pp.1-10.
- Thapa G, Kumar A, Joshi PK (2017). Agricultural diversification in Nepal: Status, determinants, and its impact on rural poverty. International food policy and research institute. South Asia office Pp. 1-43.
- Weiss CR, Briglauer W (2000). Determinants and dynamics of farm diversification. Working paper EWP 0002. Department of Food Economics and Consumption Studies, University of Keil, Germany.