

# Income Diversification by Agro-Pastoralists in Cholistan Desert Punjab, Pakistan

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## Abstract

*The pastoralists are economically dependent upon livestock for their income which includes their herds of livestock and the bi-products produced and sold. These nomads keep moving in search of food and forage so they do not completely destroy the natural resource of a particular area. During their journey of searching water, sometimes make them closer to the agricultural land near towns where they used to earn through off-farm activities which include the income earned through their unskilled labor activities. Present study employees the determinants of coping strategies which add in the income diversification decisions by pastoralists. Data was collected from 500 pastoralists' households in the Cholistan desert of Punjab, Pakistan. Results reveal that 56 percent of pastoral households were employed in other income diversification strategies along with livestock rearing activities. Agriculture farming was the most adopted coping strategy followed by labor activity. The multinomial probit regression was employed in this study for analysis. The marginal effects reveal that the variables like age, education of the pastoralists, rising expenditures of the households, number of small animals owned by the household, dependency ratio and higher number of earning members are the driving factors for participation in all income diversification strategies. Likewise, numerous income diversification strategies should be introduced so that agro-pastoralists can add in their income smoothly. Moreover, low interest and soft condition credit arrangement schemes should be initiated for the marginalized population of the Cholistan desert to start their own income-generating sources. The role of government and NGOs for infrastructure improvement is also envisaged which can improve the living of the population.*

**Keywords:** Cholistan desert; income diversification; livestock; bi-products; multinomial probit regression.

**JEL Classification:** J100, D33, E 250

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## 1. Introduction

In rural Pakistan, especially in the desert areas livestock rearing stands as an important proxy of asset holding. This serves as a regular source of earnings for families. This sector has gained importance since it has got status of major sectors in Pakistan agriculture. The livestock sector has employed 35 million rural people in the country (Akhtar et al., 2013). Pakistan lies in the neighborhood of India which is the world's top milk producer and Pakistan got a position of fifth largest in this regard (Government of Pakistan, 2006). The expected demand for livestock seems to increase in the future due to the increase in population. Improvement in the livestock sector can fulfill the calcium and protein requirements of the increased population. The calculated income elasticity of demand for meat and milk is greater than one (Farooq & Ali, 2002). The livestock farmers in the Cholistan desert are not only reliant upon animal husbandry but also acquire land so are called agro-pastoralists. These agro-pastoralists are a crucial part of Pakistan's economy. Their importance in terms of farm earnings along with their risk-averse behavior to add off-farm income in household livelihood can be discussed in detail.

Farming households are a vital part of the agriculture and livestock sector in all countries of the world. The history of the agriculture and livestock sector is as old as the history of mankind is. Many policymakers kept focusing on farming and little attention is paid to off-farm activities. Factually, farming is a complex system but its associated income suffers many fluctuations. Farmers try to cope with the risk arising due to fluctuations in income. Historically, farmers kept focusing on agriculture and livestock for their income and their perception was not to rely upon off-farm activities. Thus, the policymakers only paid attention to the income earned through farming whereas off-farm income remained neglected to be studied. However, the marginal farming households are now diverting their attention towards off-farm activities (Ping et al., 2016). It is indicated that almost half of the rural households' income is derived through off-farm activities in many developing countries of the world (Reardon, 2010). It is anticipated that increasing population and scarce farming sources will increase the off-farm income in rural households (Nazir et al., 2018).

Quite considerably, income diversification is a rural, farming household's strategy to cope with the diminishing marginal returns to farm labor (Nin-Pratt & Mc Bride, 2014). Moreover, income diversification reduces risks associated with farm income and fulfills the rising basic needs of farming households (Estruch et al., 2013). Nonetheless, non-farm income does influence the farm income, as the earnings from non-farm could be utilized on the farm at the time of need and timely benefits can be reaped (De Janvry & Sadoulet, 2001). Hence, off-farm employment is a self-guarding pillar to fulfill household needs (Alasia et al., 2009). Nevertheless, off-farm income is a push factor to boost the rural economy because it acts as a supplementary income source. Off-farm income is significantly adding to farm income (Corsi & Salvioni, 2012). Furthermore, it stabilizes variability in farm income.

The creation of multiple income sources through farming households is called income diversification (Minot et al., 2006). The number of income sources each household acquires at a time is the proxy indicator for income diversification which reflects the number of income-generating activities. In this process farming households increase their monetary rewards from off-farm activities. Likewise, the share of income earned from off-farm activity highlights the vitality of off-farm income in a household's budget (Rizwan et al., 2017). Income diversification typically relates to upsurging the household livelihood in order to avoid the uncertainties associated with farm income.

Marginal farming households have more probability to attain risk-averse behavior and acquire diverse livelihood sources than richer ones (Kahan, 2013). Keeping in view the determinants of diversification, the variables like the use of credit, size of household, gender of household head significantly affect the decision to earn from off-farm activity (Oluwatayo, 2009). Additionally, the factors like age, gender of household head, education of household head, farm size significantly affect the non-farm earning and its impact on farming households' living standards (Awoniyi & Salman, 2008). Those households are more prone to poverty and living in vulnerable conditions which did not earn from off-farm income sources than those farming households that are involved in off-farm income-generating activities (Nazir et al., 2018).

The objectives of the study are twofold: first, to highlight the determinants of income earned through different sources for incorporating the concept of sustainable livelihood. Second, to explore the income diversification strategies which are adopted by agro-pastoralists to prioritize income sources other than livestock rearing, in Cholistan desert Punjab, Pakistan.

## **2. Study area**

Desert covers one-fifth of Earth's land which is geographically 33.7 million square kilometers and almost 1500 million people are residing in them (Brown et al., 2008). The estimated population of the Cholistan desert is 229071 persons with 32140 households, Cholistan desert of Punjab, Pakistan is one of the large deserts in the world and is considered the driest and hottest sandy desert of Pakistan (Ahmad et al., 2012). This desert (Cholistan) is divisible into two demographic regions. The northern area covers the area about 7770 km<sup>2</sup> and the southern region covers 18130 km<sup>2</sup>. Both areas are called lesser and greater Cholistan respectively. The outskirts of the desert are thickly populated than the interior desert. The people of the desert are predominantly pastoralists and practice a nomadic-lifestyle for centuries (Baig et al., 1980).

Generally speaking, economically marginalized people live in the deserts of developing countries and do not have access to basic facilities of life which mainly include freshwater, healthy food, etc. The residents of the deserts also face numerous environmental

challenges (Manoli et al., 2014). The inhabitants of the Cholistan desert are directly dependent upon livestock keeping as their main livelihood activity. The population growth and changing socioeconomic setup are letting them adopt the other coping strategies as the prevailing subsistence livelihoods are under serious threat (Nagmay et al., 2013). Most of the people living in the Cholistan have adopted an agro-pastoral production system and are pursuing a nomadic lifestyle. Agriculture land is adopted by many landless people which is mainly irrigated through rain-fed water. Rainwater is collected in manmade ponds (Kunds) or is locally called 'Tobas'. The people who have adopted a nomadic lifestyle, are landless people, whereas the agro-pastoralists acquire the piece of land. The major source of animal feed in the study area is rangelands and the water requirements of animals are met through 'Tobas' or wells.

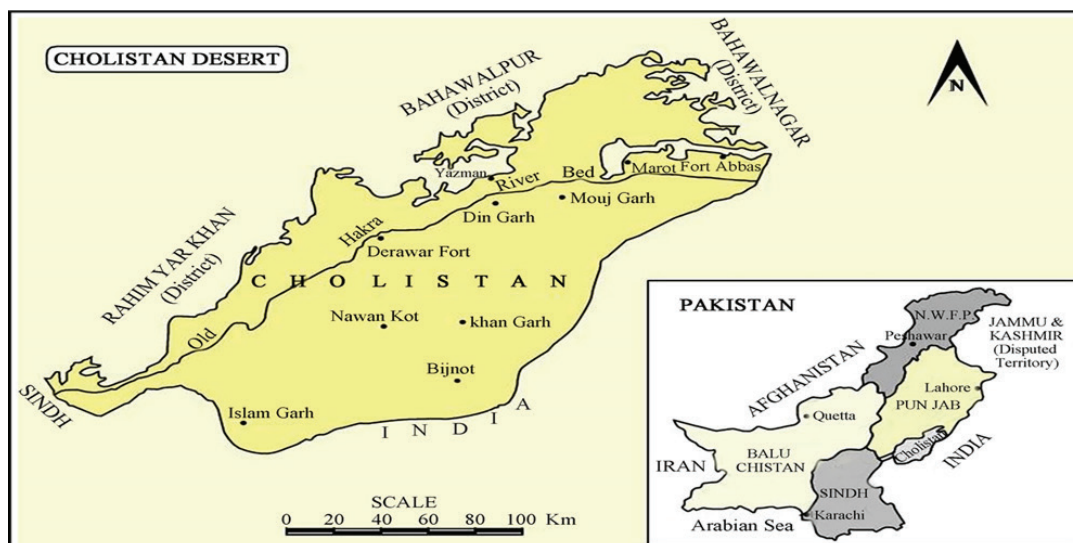


Figure 1: Map of Cholistan

Source: Adopted from (Malik et al., 2017)

The movement in the desert is through camels and jeeps because of no road network in the area. The connectivity of different regions is possible through sandy tracks and routes (Akbar et al., 1996; Arshad et al., 1999). The pastoralists keep migrating throughout the year in search of food and forage. Pastoralists cover many kilometers per year in search of food for livestock.

The agro-pastoralists of the area have their close connection with agricultural land, which is sometimes partly or completely irrigated through the canal irrigation system. The predominantly nomadic people are usually landless or acquire barren lands, so their central activity remains livestock rearing with partial involvement of agriculture-based income (tenant, cotton picking, wheat harvesting, etc.) and off-farm income activities. (GOP, 2012)

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### 3. Sampling and data collection techniques

The Cholistan desert is spread over three districts of Punjab, province of Pakistan which are Rahim Yar Khan, Bahawalpur and Bahawalnagar. The collection of primary data is made through focus group discussions (FGDs) and structured questionnaires. In the first stage, cluster sampling technique was applied and 20 clusters were selected from the Cholistan randomly which ranges upon three districts of Punjab. In the second stage, a systematic random sampling technique was applied to select the households with a random start. Under the systematic random sampling technique, 25 households were selected from each cluster. Data were collected by trained enumerators through a structured questionnaire. Furthermore, a questionnaire was also pre-tested in the field for quality improvement in the survey and to avoid any missing data and relevant attributes. Different questions related to various household characteristics and about income diversification strategies to involve in other than livestock rearing activity were asked during the survey which was conducted from April to June 2019.

#### 3.1 Econometric Approach

The theoretical underpinnings of the study originate from the decision-making theory (Hill & Kau, 1973). Furthermore, the factors affecting the participation of agropastoral households in two more income-generating activities are determined by the multinomial probit model (Xiaoping et al., 2007). In this case the outcome variable  $Y_i$  is polychotomous variable revealing the number of off-farm activities,  $Y_i = X_i' \beta + \varepsilon_i$  equation (1)

$Y_i = (1 \dots m)$  which means  $i$ th agro-pastoral household ( $i = 1 \dots n$ ) whereas  $X_i'$  is a  $1 \times k$  vector of variables that affect the off-farm activity preference.  $\beta$  is the  $k \times 1$  vector of unobserved parameters while  $\varepsilon_i$  is the error term. The Stata statistical software is used to estimate the unknown parameters in equation (1). The pastoralists of the Cholistan desert sometimes do acquire land in the outskirts of the desert and earn income from agriculture

activity. Purposefully, the governmental agencies allot land to pastoralists in different phases which are portrayed in the table (1). The descriptive statistics of the variables are given in Table (2) whereas the composition of off-farm activity involvement is depicted in the table (3).

### **3.2 Variables with their Specifications**

#### **3.2.1 Dependent Variable**

The negative externalities can be harmonized through diversifying income sources (Ullah et al., 2015). The present study reveals that pastoralists adopt the off-farm income-generating activities which are other than livestock rearing, only to manage the discrepancies in household income. It takes the value 1 if the household only depends upon livestock for household livelihood which is also the reference category for the multinomial probit model. The value 2 is assigned when the pastoral household adopts agriculture as earning activity along with livestock whereas attribute 3 is assigned to those households who acquire livestock, agriculture and also perform some labor activity.

#### **3.2.2 Independent Variables**

The questionnaire contained the demographic, social and economic attributes of pastoralists' households. It is depicted that age, gender of household head and education of household head significantly affect pastoralists' decisions to become the potential contributor in risk coping strategies (Abid et al., 2016). Lesser income or high expenditures of households also significantly affect the decision to move towards risk coping instruments (Cohen & Siegelman, 2010). A larger farm size shows a prosperous family especially when the land is not barren but cultivable in the desert area leads to lesser risk management connotation (Ullah et al., 2015). Several dependents and earning members in the pastoral household do determine the decision of pastoral household to fortify the household livelihoods by adding through off-farm income activity. The higher number of earning members provide labor for other earning activities (Beyene, 2008). The distance to transport pick-up point affects the willingness of labor to go to the nearby town to perform labor activities (Iqbal et al., 2016). Livestock heads either in small or large animals are the core assets of agro-pastoralists in the Cholistan desert. Livestock is a shock-absorbent of these households and can be used for generating cash at the time of need (Bekele & Drake, 2003)

## **4. Results and Analysis**

Nomads always give high value to their livestock and those are usually used as an asset and are the predominant determinant of a person's status in the nomadic lifestyle. All livestock is based upon indigenous breeds as it is the only breed that suits the prevailing temperature and environment in the study area (FAO, 1993). The income of females is also an



integral and indigenous part of family income which is generated through livestock bi-products. The pastoralists earn in fairs through their livestock and move it to the places for such earnings. The bi-products sold by pastoralists to the middleman or the nearby clan are usually under-rate than the market rate. The livestock sector enhancement can uplift the socio-economic conditions of the area. People seasonally migrating to lesser Cholistan also participate in cotton picking and wheat harvesting otherwise females remain busy in livestock rearing and preparing the bi-products of it. The livestock herd owners sometimes also own land-holdings in lesser Cholistan. The pastoralists avoid shocks in their livestock-based income through agriculture farming and other off-farm labor activities.

Table1  
*Land Allotment policy*

<b>Scheme</b>	<b>No. of Allottees</b>	<b>Area Allotted (Acres)</b>
Shahi Muzarian Scheme Since 1950-51	170	8500
Grow More Scheme since 1959-60	2091	31041
20-years Temporary Cultivation Scheme Since 1970-71	2038	25475
15 Years Temporary Cultivation Scheme	11598	144112
Years Temporary Cultivation Scheme since 2000	4556	57075
Allotment Balloting 1983 ordered in (2005)	245	3063
Area reserved for Army Welfare Scheme	133	2390
Agri Graduate Scheme (2010)	05	100

Source: Cholistan Development Authority

The Cholistan Development Authority (CDA) and Revenue Board of Punjab set the rules to allot and lease out the land to the peasants of Cholistan. The CDA has been allotting the cultivable land to pastoralists under the guidance of the Government of Punjab since 1950 to date through different allotment schemes which are presented in table-1.

Table2  
*Descriptive statistics*

	<b>Variables</b>	<b>Unit</b>	<b>Mean</b>	<b>SD</b>	<b>Max</b>	<b>Min</b>
Household attributes	Age	Years	39.01	7.318	62	22
	Education	Years	1.20	1.43	Higher Secondary	Illiterate
	No of Children	Numbers	4.33	1.713	10	0
	Dependents	Numbers	7.144	1.86	13	3
	Earning Members	Numbers	2.213	.774	5	1
Income Sources	Livestock Income	PAK Rupees	146966	88320	580000	0
	Livestock Bi-Product Income	PAK Rupees	151709	112208	714000	12080
	Land Income	PAK Rupees	55113	120315	920000	0
	Off-Farm Income	PAK Rupees	34300	61964	200000	0
Assets	Farm Size	Acers	2.908	3.874	16	0
	Livestock Heads (Large)	Numbers	25.471	19.556	105	0
	Livestock Heads (Small)	Numbers	19.944	31.742	225	0
Other Attributes	Expense on Livestock diseases	PAK Rupees	913.33	1613.639	7000	0
	Mortality of Livestock Heads	Numbers	1.48	1.787	10	0

Source: Author's survey Results, 2019

The concept of sustainable livelihood was declared in the advisory panel of the World Commission on Environment and Development which aimed to assist the poor in achieving improvements against poverty indicators (Dixon et al., 2013).

The total human population in the area is 229071 persons. The population consists of diverse tribes and clans acquiring dissimilar languages and traditions. These people migrated from different regions of the sub-continent long ago. In the study area, the average age of respondents is 39 years' average education in years is primary. The respondents are not acquiring education and 53.8 percent reported for no education while 8.5% reported for below primary education and 14.2%, 16.5% and 4.5% reported for primary, secondary and



higher secondary education respectively. Only 1.5% reported for technically educated. The average number of children in the study area is 4.33 while the average no of dependents is 7 persons per family. Farmers in the study area responded to preferring large family sizes to add in the family labor. As the residents of the area are nomadic in their style so getting children admitted to schools and educating them does not entail plausible. They make their children involved in economic activities so they seem uninterested in getting the children educated. A few percentages also reported poverty to be the main cause of low or no education which again primarily involves the reason of children to be economically active at household levels.

Since childhood children remain involved in collecting firewood for cooking purposes as a source of energy and involved in domestic activities. As they grow they are kept busy taking care of livestock and arranging fodder for them as it is the main source of income for pastoral families. In adulthood, they sometimes perform off-farm activities in nearby towns where they stand as unskilled labor or are sometimes accompanying their livestock in greater Cholistan with their elders so acquiring education remains at stake. They are poor in their health due to the low quality of water and are also malnourished. It is overt from the study that 30% of families are nuclear but the mainly prevalent family system is joint and 70% of families in the sample reported that the family system is joint.

Moreover, the income diversification strategy was adopted by respondents and almost half of the population reported acquiring land. As people are living in a joint family system and are allottees of a piece of land through Cholistan Development Authority (CDA) and these allotments are near canal belts adjacent to the desert belt. Mostly these people grow wheat, cotton and partly fodder for animals. Crop yield remains low due to a lack of farm inputs and water shortages. Average farm income is Pak RS 55113/- per anum and average off-farm (labor) income is Pak RS 34300/- per anum so they mostly rely upon their livestock herds for their income and the income earned through annual sale of livestock is Pak RS 146966/- while the average annual earnings from livestock bi-product is Pak RS151709/- Almost one-fourth persons reported for off-farm income which meant they were involved in unskilled labor activities.

Along with the agriculture activity they used to keep participating in labor-based activities like plaster roof making bricks making and these people are not very much keen on finding the economic activity which can add to the financial budget of the family but mainly rely upon their livestock herds. The average land reported by interviewees was 2.8 acres. They used to sell animals annually and keep selling animal bi-products to finance the day-to-day requirements of the family. They keep a few animals in the irrigated area with a few family members while taking the rest to the greater Cholistan with 2 to 3 family members in search of food and fodder (Akhtar et al., 2013). The average herd size for large size animals is approximately 25 and the average herd size for small animal heads is approximately 19 in the Cholistan desert.

The herd of large size animals includes cows and camels while the small animal's heads include goats and sheep. The annual expense upon the livestock disease is Pak RS 913/- which is a meager annual amount of money to be spent upon. The disease is also reported for small and large animals in the desert area which includes Foot and mouth, Black quarter, Warble fly and Ticks for large animals while small animals used to suffer PPR (Peste des Petits Ruminants), CCPP (Contagious Caprine Pleuropneumonia) and Enterotoxemia. Government is providing its medical veterinary services for livestock through dispensaries and most of which are mobile to help in vaccinations while a helpline for the report is also established in the year 2015 for the support of residents. PPR is mostly controlled in the last three years but there is a complaint about other prevailing diseases in the area. Residents of the area seemed fairly satisfied with the veterinary services provided by the government.

Hence, livestock remains the primary occupation of desert residents so they also focus upon the livestock bi-products. They used to sell milk and butter in the livestock bi-product markets. They used to sell the products to a middleman at an underrate than the market rate so the middleman can share the income also. Livestock mortality is also reported in the area. On average 1.48 animals, mortality is recorded per herd in the last year. Drought is also causing the death of livestock units in the rangeland of the desert. 70 % of respondents reported the death of animals due to drought consisting of both water and forage shortages. The rangeland of the study area is around 2.6 million hectares and the livestock population in the study area is 134798 which has a demand of 344409 tons for dry forage but the available forage is 117896 tons creating a shortage of 226513 tons (Akbar et al., 1996). This shortage is increasing day by day and the livestock population may suffer severe degradation which is a threat to the livestock population in the area.

Table 3

*Composition of pastoralists adopting different income management strategies*

<b>Occupations</b>	<b>Frequency (N)</b>	<b>Percent (%)</b>
Livestock Only	194	43.1
Livestock and Agriculture	132	29.3
Livestock and Labor	124	27.6
Total	450	100.0

Table 3 provides the proportion of pastoralists using different risk management tools or coping strategies measured in this study. The multinomial probit estimates emphasized different explanatory variables. The most attractive strategy after involvement in livestock rearing is agriculture which is further followed by labor activity to be adopted as a coping or risk management strategy. These strategies are managed for income diversification by pastoralists in the study area.

Income diversification involves a process of creating multiple income sources (Minot et al., 2006). The proxy indicator in this study is the number of sources of income for each household studied and is the reflection of income-generating activities. Sometimes the time spent upon such income-generating activities other than the sole source of income or the income earned through such sources highlights the off-farm income in household livelihood (Barret et al., 2001; Rizwan et al., 2017). Thus, farmers select a new activity to avoid the risk of weather shocks (Kahan, 2013; Harvey et al., 2014).

Table 4

*Multinomial Probit model estimates for different income coping strategies*

Independent Variables	Agriculture	Marginal Effects	Labor	Marginal Effects
Age	-0.109*** (0.0416)	-0.0076*** (0.0017)	0.203*** (0.0647)	0.0069*** (0.0015)
Education	0.446** (0.223)	-0.029** (0.013)	4.676*** (0.986)	0.1269*** (0.0214)
Gender	0.791*** (0.284)	0.0399** (0.021)	-0.0816 (0.487)	-0.0109 (0.0163)
Distance to transport pick up	0.00275 (0.00288)	0.00035 (0.00022)	-0.0200*** (0.00710)	-0.00059** (0.0003)
Ln annual expenditures	5.504*** (1.382)	0.236*** (0.044)	3.290*** (1.152)	0.0325 (0.0293)
Ln livestock income	-1.226*** (0.423)	-0.039** (0.017)	-1.882*** (0.429)	-0.0396*** (0.0083)
Ln Agriculture income	0.476*** (0.0804)	0.024*** (0.0020)	-0.000124 (0.969)	0.0052** (0.0024)
Large animals	-0.0515*** (0.0127)	-0.0013 (0.00085)	-0.114** (0.0494)	-0.0026*** (0.0010)
Small animals	-0.0166*** (0.00549)	-0.0016*** (0.00042)	0.0676*** (0.0157)	0.0021*** (0.00053)
Dependency ratio	-2.965** (1.395)	-0.226*** (0.068)	7.313* (4.418)	0.2386** (0.0967)
Earning members	1.197*** (0.377)	0.069*** (0.0168)	-0.911 (0.817)	-0.0388*** (0.0149)
Constant	-51.66*** (12.62)		-40.49*** (11.46)	
Wald $\chi^2$	179.94			
Log-likelihood	-438.13			
Prob > $\chi^2$	0.000			

Note: Standard errors are given in parenthesis. \*\*\*, \*\*and \* indicate the significance level at 1, 5 and 10 % respectively

The risk aversion behavior of households in the study area is observed through involvement in the economic activity other than livestock rearing. The uncertainty attached with livestock rearing in the study area is drought and diseases which cause livestock mortality. Natural hazards in the form of droughts occur in desert areas. Historically, the intense spell of drought occurred from 1999 to 2002 which caused huge destructions. This spell of drought caused 120 deaths and affected 2200,000 people in Pakistan (Middleton, 2009). The mortality rate became high in drought conditions and led to malnutrition and lack of water which caused deaths (Schmidt & Doerre, 2011; Khan & Ali, 2015; Ahmed et al., 2004). Moreover, the main factors for farmers' participation in off-farm work are more benefits with lesser risk of investing in other sectors (Killic et al., 2009; Kotu, 2014). The income earned from agriculture and land acquired by pastoralists positively influence the decision to maintain the coping strategy to generate income other than livestock (Nin-Pratt & MCBride, 2014). It is an overt fact that farmers in Asia diversify from low-value crops to high-value crops and keep themselves involved in other farm activities to boost the livable income (Pingali, 2007).

Results obtained from multinomial probit regression are presented in table 4. The test of goodness of fit is realized satisfactory. The majority of the variables show significant results in both activities (agriculture and labor activity) other than livestock rearing. The coefficient of age is significant and negatively affects the agriculture to adopt as a coping strategy while it affects positively when labor activity involvement is materialized. Further, these results coincide with other studies which showed that age has a negative association with the adoption of diversified income (Iqbal et al., 2016; Yusuf et al., 2016).

The coefficient of education is significant and positive in both coping strategies. Moreover, the fact reflects that members with more education may be more capable of managing the on-farm and off-farm income (Ping et al., 2016; Ullah et al., 2016). Similarly, the gender of household head (if male) positively and significantly affects the adoption of agriculture as a coping strategy. Likewise, distance to transport pick up point negatively and significantly affects adoption of labor as coping strategy because movement towards towns for unskilled labor activity performance needs to reach the transport pick up point to move ahead towards the workplace. These results are also supported by another study (Iqbal et al., 2016). Annual family expenditures have a positive and significant effect to adopt both coping strategies.

Furthermore, Income earned through livestock is significant and negatively affects the decision to adopt the coping strategy, these results are akin to another study (Bekele & Drake, 2003). Income earned from agriculture significantly and positively impact the adoption of coping strategy of agriculture to adopt while it is insignificant for labor activity adoption, these results also gained support from a study (Ullah et al., 2015). Income earned from livestock is significant and negative in affecting agriculture and labor activity adoption as a coping strategy. The coefficient for large animal heads and small animal heads is significant

and negatively affects the adoption of coping strategies which coincides with the result of another study (Iqbal et al., 2016).

Dependency ratio negatively and significantly affect agriculture to adopt as a coping strategy which may be due to the reason that number of dependents are under aged to perform farm work while it is positive with significant marginal effects in labor activity adoption. A higher number of dependents have a higher probability to adopt more coping strategies. Similarly, coefficients for earning members are positive and significant in agriculture activity performance while its marginal effects are significant and negative for labor activity participation. Quite clearly, households with a greater number of adults face the constraint of income opportunities but they can be well able to utilize such options of adopting coping strategies (Iqbal et al., 2016). Moreover, it is reported that dependency ratio and earning members increase the probability of farmers' attraction towards coping strategy (Ullah et al., 2015).

## **5. Supporting Institutions**

Many institutions and organizations are working in the Cholistan desert for its development and improvements. A few research institutions are primarily working on livestock-related issues which include the Pakistan Council of Research in Water Resources (PCRWR), Cholistan Institute of Desert Studies (CHIDS), Arid Zone Research Institute (AZRI) and Jojoba Research Stations (JRS). Several NGOs are working for improvement in the education and health of pastoralists and their livestock herds. Bahawalpur Rural Development Project (BRDP) which is a project of the Asian Development Bank is helping the poor in the area through credit facility and a community-based participatory approach is applied upon the inline project through a bottom-up approach. The most responsible institution is Cholistan Development Authority (CDA) which is providing allotment to the residents, providing safe drinking water and water for irrigation. The rulers of Dubai, Abu Dhabi and Qatar have a special association with Cholistan residents. They used to visit the area every year in winter for hunting. They are also contributing in the development of Cholistan through the construction of roads, routes, wells and schools.

## **6. Conclusion**

The results from the multinomial probit model conclude agriculture is the most preferred coping strategy adopted by pastoralists and it is followed by labor activity to be adopted by pastoralists. It is also overt from the study that farm size, earning members in the family, higher dependency ratio and years of education add to involve in the diversified income sources. Far away transport picks up point influences the labor activity involvement negatively. It is suggested that improved infrastructure can add in the involvement in the risk management strategies. Furthermore, it is also suggested that increased government involvement in

taking care of animals from diseases can further add to the income levels of agro-pastoralists of Cholistan. Moreover, the enhancement of education can make pastoralists diversify their income and adopt risk management strategies. Furthermore, it is suggested that government and non-governmental organizations (NGOs) should provide off-farm coping strategies to the pastoralists within the region so that they (agro-pastoralists) can gain better output of their work and alleviation of poverty can be realized in the study area. Low-interest credit should be introduced to the marginalized pastoralists so they can start their own small-scale businesses to avoid the risks attached to livestock rearing.

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