DETERMINANTS OF FOOD SECURITY AND PROSPECTS OF CROP DIVERSIFICATION IN RURAL REGIONS OF PUNJAB, PAKISTAN

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ARTICLE INFO

ABSTRACT

Pakistan is an agricultural economy, yet achieving food security has become indispensable. This study aimed at measuring the influence of different factors on the state of food security among rural households and prospects of crops diversification in tackling the food insecurity. This study was conducted in the Punjab province of Pakistan. Through multi-stage random sampling, 40 households were chosen randomly, making a total sample size of 200 families from the five districts. Face-to-face interviews assisted researchers in collecting data. OLS regression model was used to examine the elements contributing to food insecurity. Of the total respondents, 56.6% were aged between 40-60 years. The majority of respondents (65%) had less than 5 acres of land, accentuating subsistence farming. More than half (53.6%) had at least five years of schooling, indicating a miserable educational situation for participating farmers. Among total population only 23.49% of farmers have practically adopted crop diversification. Age, land size, access to credit and crop diversification were statistically significant (P<0.05) with FCS and negatively associated with HFIAS. Findings imply that farmers were small landholders with poor education and inadequate access to services such as credit. Therefore, the majority of farmers were found food insecure according to the FCS score. The findings indicate a great prospect of crop diversification among farmers in the region to expedite the income-generating process to structure farmers' food security. The pre-defined and revamped roles of institutions like Public Sector Agricultural Extension could serve the purpose.

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INTRODUCTION

There were 7.7 billion people on this earth by the mid of 2019. Since 2007, one billion were added to the world's total population, and since 1994, two billion humans have been added to the entire chunk of the population (UNO, 2019). This implies that over time, the population growth rate is escalating at a pace. In the meantime, they are asking for more food and nutrition to survive. Food insecurity has prevailed globally irrespective of developed, developing, and least developing nations' status on food growth rate and population increase. Inadequate availability of food, shrinking crop production, and farmlands, and the mounting ratio of hungry people are expediting followed by the gradual rise of poverty, malnutrition, and food insecurity in rural and urban zones (Vaitla *et al.*, 2015; Massawe *et al.*, 2016; Maxwell *et al.*, 2014). Food security is defined as food provided to every individual at any time, with

sufficient resources to purchasing food that must be healthy and nutritious, and of good quality and quantity (Muhoyi *et al.*, 2014). Globally many countries like America, Africa are adopting multiple strategies to achieve food security like plans to raise "agricultural productivity; enhance employment opportunities and income circulation programs; interventions to increase human capital; and food-based distribution programs" (Rose, 2008). This indicates how important the issue is and how important it is to plan and execute the planned interventions to produce enough food for the forthcoming generations.

Pakistan was the 6th most populous country entailing 220,892,340 people (Government of Pakistan, 2020)and now it has become the 5th populous nation approximate population of over 220 million. Most of the households in Pakistan are food insecure (Ahmed *et al.*, 2015; Munawar *et al.*, 2013). The Food Insecurity Experience Scale (FIES) estimates indicate that 63.1% of families in Pakistan were food secure, 18.3% relentlessly food insecure, 11.1% and 7.6% were mild and moderate food deficient, respectively (Section *et al.*, 2019). Of the 120 districts of Pakistan, 80 have been reported as food insecure (Abdullah *et al.*, 2019).

The majority of the population across Pakistan live in rural regions and mainly depend upon the agriculture sector for meeting their dietary needs. In the recent past, the agriculture sector in Pakistan is observing a gradual decline. For example, the contribution of Agriculture to GDP has reached 19.5% (Government of Pakistan, 2020). During 2019-20, the agriculture sector of Pakistan marked a growth of 2.67%, which was considerably higher than the growth achieved in the previous year. Nevertheless, the production is still below the potential for many reasons like climate change, insect's pest infestation and diseases outbreak, and water shortage (Aslam, 2016).

Several studies such as Khan *et al.* (2013); Aslam (2016); Khan *et al.* (2020); Rehman *et al.* (2015) found that Inadequate access and management of water, natural events, and many other socio-economic related challenges are pressuring the production of crops (Azam and Shafique, 2017). Farmers' access to markets in Pakistan is found bearish, whereas the extended role of the middleman costs the farmers in many ways (Akbar *et al.*, 2020). For these various reasons, the production of major and minor crops remains lower than the potential. The ultimate benefits of the farmers are compromised,

pushing them to poverty and food insecurity. The fluctuating agriculture dents national economic growth as well. Currently, the growth rate is slipping, and the prevailing instability can further slowdown the factor production. The farmers could be vulnerable to more acute poverty and a state of food insecurity (Azam and Shafique, 2017). A recent study Khan *et al.* (2020) found that the decline in agriculture as witnessed right now in Pakistan negatively influenced the vast areas, including economy, industry, and business. Most importantly, the massive intensification in product prices could anticipate a key mammoth challenge to the country's household livelihoods. The homes already falling in a vivacious poverty circle could become poorer and food insecure.

Improvement in agriculture accentuates the alleviation of poverty and attaining food security. Several studies have associated the alleviation of poverty and ensuring food security with the expansion of the agricultural sector. A recent study argued that agriculture's direct and indirect growth effect on poverty alleviation was substantial (Giuliani, 2012). Agriculture was prominent in pulling poor people out of poverty (Christiaensen *et al.*, 2011). The development of agriculture is associated with mitigating poverty among rural people in the long run (Liu *et al.*, 2020). This development may continue impacting the poor for many years to come (Bhutto and Bazmi, 2007). This is a notion of how important it is to develop the agriculture sector to break the poverty circle and ensure food security (Gassner *et al.*, 2019). Cervantes-Godoy and Dewbre (2010) viewed the agriculture sector as a critical source to reduce poverty. Thus, a favorable policy and adoption of site-specific and latest approaches could revamp the crops' production process and help farmers obtain maximum net benefits to sustain their livelihoods (Ahmed *et al.*, 2015).

In this pressing need, adopting the latest production techniques like crop diversification, climate-smart agriculture, and resource use efficiency can increase farm production, ultimately boosting food security and improving rural livelihoods (Abro, 2012). This implies that developing, least developing, and slow-growing countries by collaborating can expedite the agricultural production process and increased agricultural productivity to ensure self-sufficiency in food, which is the first constituent of achieving food security (Mozumdar, 2012). This study analysed the food security situation among rural households. Different

factors hampering the state of food security among rural households and the prospects of crop diversification in rural regions to increase the income of farmers are also explained.

METHODOLOGY

Study area and sample collection
A multi-stage stratified selection method was applied to select the respondents to complete this study. In the first stage, the research team decided Punjab province purposefully out of four regions of Pakistan. Punjab is the largest province of Pakistan. It is divided into five agroecological zones. About 44.15% population of Pakistan lives in Punjab (Ishaq *et al.*, 2018). So, it will be easy to generalize results. In the second stage, out of 36 districts of Punjab, five districts, such as Rawalpindi, Rahim Yar Khan, Mianwali, Sheikhupura, and Faisalabad, were selected to help a stratified purposive sampling technique (Figure 1). According to the selection criteria, one district was chosen from each zone, considering the homogeneousness in per year production of five main crops (cotton, sugarcane, wheat, maize, and rice). At the third stage, one village from each selected district was nominated, keeping in view similarity in demographic attributes, social norms, and family setup. At the fourth stage, the 40 households from each village were determined arbitrarily, making a sample size of 200 farming households from the selected five villages.

Data Collection
The questionnaire was designed and pre-tested under the supervision of experts and a team of researchers. Necessary changes were made after pre-testing. Face-to-face interviews were conducted with household heads to reduce error and ambiguity. Due to Pakistani culture's social restrictions, our data collection team comprised three females to hold discussion sessions with female household heads during data collection.

Data Analysis
Collected data were analyzed using STATA software. Descriptive statistics calculated the frequency distribution, mean and standard deviation. The OLS regression model was applied to study the consequence of diverse aspects of household food security. The description of variables is given in Table 1. Food Consumption Score (FCS) and the Household Food Insecurity Access Score (HFIAS) were calculated to

foresee crop diversification prospects in the region. The crop diversification index was used to anticipate the interest of farmers towards multiple cropping.
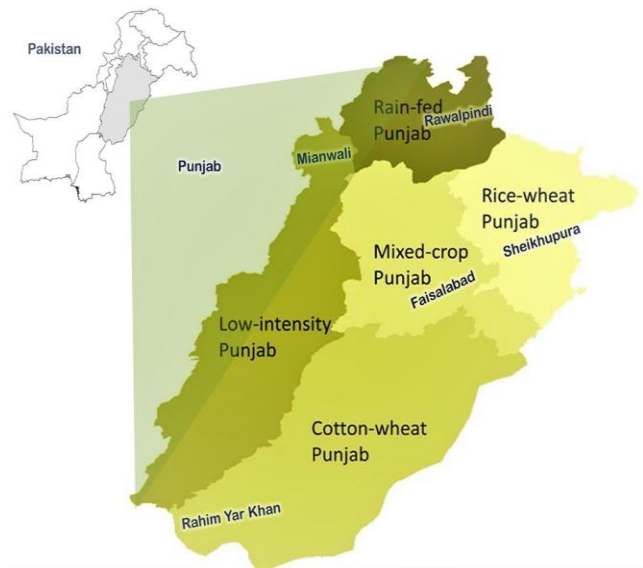

Figure 1. Agroecological zones of Punjab province with selected Districts.

Food Consumption Score (FCS)
The World Food Program (WFP) established Food Consumption Score in 1996. Food consumption scores are estimated based on food frequency, dietary diversity, and the nutritional significance of nine unique meal groups. That nine special meal groups with their weight in the score is given Table 2. The FCS was aimed at transmitting the quality and volume of diet at the domestic level. FCS score is calculated from the meal-type and nutritional value and the consumption rate of specific food groups for seven consecutive days. For example, food groups with high nutrition foods, such as meat and dairy products, are given higher weight than less nutritious ones like tubers and sugar. Based on the FCS score, a household's food consumption pattern is categorized into three groups: (i) poor, (ii) marginal (iii) acceptable. The food consumption score is an alternate index used to calculate household caloric intake and availability. Dietary recall questions were used to acquire statistics on food intake every day in Pakistan. The participants of this study were asked about the rate of consumption of mentioned food groups during the last week. FCS was calculated with the help of the formula proposed by "the Emergency Food Security Assessment Handbook" (World Food Programme, 2009).

In the method, FCS is calculated by multiplying the weight for each food group/type with the number of days specific meals consumed. The formula used in this study is as follows:

$$FCS = a1 \times f \text{ (cereal and or tubers)} + a2 \times f \text{ (pulse)} + a3 \times f \text{ (milk)} + a4 \times f \text{ (fruit)} + a5 \times f \text{ (meat and or fish)} + a6 \times f \text{ (sugar)} + a7 \times f \text{ (vegetables)} + a8 \times f \text{ (oil)} + a9 \times f \text{ (condiments)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Table 1. Description of the variables.

Variable	Obs.	Mean	Std.Dev.	Min	Max	Definition
			Dependent Variables			
FCS	200	27.4	14.1	13	91	1 for Less food Consumption; 2 for Borderline food Consumption; 3 for Acceptable food Consumption
HFIAS	200	17.85	8.38	0	27	1 for Severely food insecure; 2 for Mild to moderate food insecure; 3 for Food Secure
			Independent Variables			
CDI	200	0.25	0.43	0	1	1 for yes; 0 for otherwise
Cattle ownership	200	0.51	0.50	0	1	1 for yes; 0 for otherwise
Household member	200	5.39	1.89	2	12	Number of family members
Credit facility	200	0.36	0.48	0	1	1 For yes; 0 for otherwise
Education	200	0.56	0.49	0	1	1 for literate; 0 for otherwise
Age	200	50.2	13.5	24	90	I for up to 40, 2 for 40-60, 3 for up to 90
Grain storage	200	0.11	0.31	0	1	1 For yes; 0 for otherwise
Landholding	200	4.8	5.97	1	40	1 for <5; 2 for >10; 3 for >10

Table 2. Food Groups of Food consumption Score.

Sr. No	Food Consumption Group	Food Group	Weight (Definitive)
1	Rice, Sorghum, Maize, Wheat, Millet, Cereals, Pasta, and Bread	Main Staple	2
2	Bean, Peas, Groundnuts and Cashew nuts	Pulses	3
3	Vegetables and Leaves	Vegetables	1
4	Fruits	Fruits	1
5	Egg, Fish, Beef, Goat, and Poultry	Meat and Fish	4
6	Dairy, Milk and Yogurt	Milk	4
7	Sugar and Sugar products	Sugar	0.5
8	Butter, Oil, and Fat	Oil	0.5
9	Salt, Spices, Tea, Small Amount of milk for tea, Coffee	Condiments	0

Explanation of factors
FCS = Food Consumption Score
f = frequency of food consumption (number of days for which each food group consumed during the past seven days)
a = weighted value representing the nutritional value of selected food groups

Food groups had been allocated specific weights that indicate the nutritional value of different food groups of the index. The FCS has three different categories of consumption behaviour: food consumption (0–21), borderline food consumption (21 < FCS ≤ 35), and acceptable food consumption (FCS > 35)(World Food Programme, 2009). The FCS was approved as it offers a precise measure of household nutrition. However, the FCS has some weaknesses because it no longer thinks about foods bump off outdoor. It does not provide any facts about meal distribution patterns among different members of a common household. To some extent, the seven-day recall makes it quite difficult to recall the number of meals eaten. Even though it has some flaws, FCS is nevertheless viewed as the most prudent method of household meal security.

Household Food Insecurity Access Score (HFIAS)

The HFIAS is an index used to access food insecurity of households during the past 30 days. The HFIAS reveals three universal household food insecurity fields like depression and anxiety, low quality, and inadequate food provisions (Deitchler *et al.*, 2011). HFIAS presents the household's diet pattern regardless of their nutritional composition (Coates *et al.*, 2007; Mango *et al.*, 2014; Vaitla *et al.*, 2015) and presents the household's behavioral and psychosomatic response and perception to food insecurity. While investigating, the household heads were asked nine unique questions related to food insecurity.

Respondents were requested to respond in yes or no (yes = 1 if the event occurred/ no = 0 if the case did not happen). Each question is followed by a frequency of happening items during the last four weeks. The minimum score of HFIAS will be zero when the response is 'no' to all questions. On the other hand, 27 is the maximum score of HFIAS and is obtained when a family responds yes to all inquiries. HFIAS (0–27) at a higher value confirms that a family is vulnerable to food insecurity, while a low total indicates that a resident is less food insecure. Following the guidelines given by Nyikahadzoi et al. (2012), the HFIAS is computed as follows:

HFIAS   (0–27)=Q1a*F1+Q2a*F2+Q3a*F3+Q4a*F4+ Q5a*F5+Q6a*F6+Q7a*F7+Q8a*F8+Q9a*F9   (2)

Crop Diversification (CD) Calculation

The crop diversification index was used to foresee the interest of farmers towards multiple cropping. The CDI has a straight association with diversification, such as zero value indicates specialization, and an amount greater than zero means crop diversification. With the CDI index's help, it is much easier to classify those farmers who cultivate multiple crops in a season and grow a single product every season. The Herfindahl index (HI) is subtracted from one (1-HI) to get the crop diversification index value. Precisely, the CDI is calculated as follows:

$$S_i = \frac{A_i}{\sum_{i=1}^{n}} \qquad (3)$$

Where,

S_i= proportion of ith crop in the gross cropped area

A_i = area under ith c

i = 1, 2, 3, 4… n (number of crops grown by farming households)

But Herfindahl index

$$HI = \sum_{i=1}^{n} S_i^2 \qquad (4)$$

Therefore, CDI becomes;

$$CDI = 1 - \sum_{i=1}^{n} S_i^2 \qquad (5)$$

$$CDI = 1 - H \qquad (6)$$

In this research, five significant crops cultivated commonly in Pakistan's small landholder farming system were used to calculate the index. The five crops included Wheat, Rice, Sugarcane, Cotton, and Maize. These crops contribute a significant portion of everyday food in every rural and urban household.

OLS Regression Empirical model

The ordinary least square regression model is the most reliable and significant regression technique used to analyze data (Rutherford, 2001). This regression scheme is quite robust to check assumptions, constant variance, and effects of different variables using graphical methods (Fox and Weisberg, 2019). Coding dummy variables extend this model to include grouped explanatory variables. Ordinary least square model as used are presented as;

$$Y = \alpha + \beta z \dots . (7)$$

Whereas;

Y= Dependent variable

Z= independent variable

α and β = interception of parameters

The OLS regression model is easily extended by including several descriptive variables. The model will be presented in the same way as a sole variable (Y), but Y will be estimated by the number of descriptive variables (Z1 to Zn).

$$Y = \alpha + \beta_1 z_1 + \beta_2 z_2 + \beta_3 z_3 + \beta_4 z_{4z} + \dots + \beta_n z_n \qquad (8)$$

The α and β (interpretation of the parameters) from equation (8) are the same as for the simple regression model given in equation (7). However, the relationship among multiple variables cannot be presented in a single scatter plot.

α = indicates the value of Y (dependent variable) when values of all the explanatory variables are zero.

β= parameter shows the average change in Y associated with a unit change in z while controlling other explanatory variables in the model.

An ordinary least square regression model was used to study the relationship between different socio-economic parameters and food security. FCS and HFIAS (household food security index) dependent variables

and all other independent variables like crop diversification index (CDI), household size, etc., were calculated before getting the precise results from the model. According to Isik-Dikmelik (2006), it is reliable to use OLS to ascertain the influence of a continuous variable on another continuous variable like in our case. The OLS model used in this study is specified as;

$$Y_i = \alpha_0 + \beta_1 Z_{i1} + \beta_2 Z_{i2} + \beta_3 Z_{i3} + \beta_4 Z_{i4} + \beta_5 Z_{i5} + \beta_6 Z_{i6}$$
$$+ \beta_7 Z_{i7} + \beta_8 Z_{i8} + e \qquad (9)$$

Where;

Yi = household food security outcome (either FCS or HFIAS),`

 Zi1 = crop diversification,

Zi2 = cattle ownership (1 = yes; 0 = no),

Zi3 = household size

Zi4 = access to credit (1 = yes; 0 = no),

Zi5 = education of household head (1 = at least primary education; 0 = otherwise),

Zi6 = age of household head

Zi7= Ownership of Agricultural Land

Zi8 = ownership of a grain storage facility,

α0 = intercept, α1 to α7 are coefficients,

e is the error term.

RESULTS AND DISCUSSION
Descriptive analysis

Table 3 shows that one-fourth (25.3%) of respondents were aged up to 90 years. Perhaps, these were the old-aged farmers among the participating farmers. More than half (56.6%) of respondents were aged between 40 and 60 years, followed by almost one-fifth (18.07%) respondents aged less than 40. These respondents were young farmers. Young farmers are witnessed to be more receptive to new technologies. The majority of the farmers (65.06%) had less than 5 acres of land, followed by one-fourth (25.9%) respondents having a land size of fewer than 10 acres. One in ten (9.03%) of the respondent had more than 10 acres of land. These farmers were large landholders and practicing agriculture on a commercial level. More than half (53.6%) of the respondents had formal education of the total respondents, whereas 46.39% of farmers did not attend formal schooling. This implies that the educational status of the farmers in the study area was not adequate. Half (50.6%) of respondents had cattle, 34.9% had access to credit, and 10.2% had a grain storage facility. Of the total respondents, 23.49% had experienced crop diversification. Crop diversification opted by less than one-fourth of respondents indicates that room for further adoption exists in the study area. If adopted by the farmers successfully, crop diversification can keep them abreast with production and their livelihoods.

Table 3. A percentage representation of the division of Dependent and Independent Variables.

Variables	Total observation	Percentage
Age	200	
• Up to 90		25.301
• 40 years to 60 years		56.63
• Up to 40		18.07
Landholding (acres)	200	
• Less than 5		65.06
• Up to 10		25.903
• More than 10		9.036
	Have (Percentage)	Have not (Percentage)
Education	53.61	46.39
Cattle ownership	50.6	49.3
Credit Facility	34.94	65.06
Grain Storage	10.24	89.76
Crop Diversification	23.49	76.51

Food Security indexes estimation
Food Consumption Score (FCS) and Household Food Insecurity Access Score (HFIAS)

Table 4 indicates that about the information received from the respondents and Food Consumption Score, 45.18% of respondents had less food consumption, and

42.17% of respondents were on the borderline food consumption. This infers that farmer had very regular food intake, and prevailing poverty and sluggish financial abilities could be cited as less food intake. Conversely, only 12.65% of the respondents had acceptable food consumption. These farmers were large farmers and had adopted crop diversification and were having better access and affordability of the required calories. The overall level of food consumption was poor in the study area. As for as Household Food Insecurity Access Score was concerned, 58.4% of respondents were

extremely food insecure. These respondents might have inadequate access to food and even the dwindling situation of affordability. Almost one-fourth (24.1%) of respondents were mild to moderate food insecure. Of the total respondents, 17.47% were food secure. They have good access to food and had the affordability to make the required food available. We can associate this affordability with the stability of income generation. They were able to cope with the different factors likely to make them needy and food insecure.

Table 4. Categories of food consumption behavior according to FCS and HFIAS.

Categories of food consumption behavior with score Range	FCS	
	Number	Percentage
Less food Intake (0-21)	91	45.5
Marginal food Intake (21<FCS≤35)	84	42
Acceptable food Consumption (FCS >35)	25	12 5
	HFIAS	
Severely food insecure (HFIAS>20)	116	58
Mild to moderate food insecure (11<HFIAS≤20)	48	24
Food Secure (0-10)	36	18

Factors affecting the level of household food security
The effect of different factors on food security was examined through the OLS regression model (Table 4). Overall, the model was statistically noteworthy (P<0.05). The beta values indicated that 54% variance would be explained in independent variables with the dependent

variable, such as Food Consumption Score (FCS). The variation of 72% would be explained in the relationship of independent variables with the dependent variable, HFIAS. The relationship between the independent and dependent variables is given in Table 5. The significance level was sed 1, 5 and 10%, respectively.

Table 5. OLS regression model analysis.

Variables	FCS		HFIAS	
	Co-efficient	P>|t|	Co-efficient	P>|t|
CDI	9.063	0.000***	-8.866204	0.000***
cattle ownership	2.173	0.153	-1.077659	0.138
family size	-1.673	0.001***	1.122658	0.000***
Credit Facility	2.847	0.062*	-1.373112	0.06*
Education	2.070	0.203	-0.8869575	0.253
Age of HH	0.128	0.066*	-0.0664399	0.046**
Grain Storage	-1.88	0.514	-0.9629403	0.485
Land holding	0.230	0.000***	-0.6176987	0.000***
_Cons	18.256	0.000	22.42142	0.000
N	200	200	200	
F	25.66		55.72	
R	0.5665		0.7395	
Adjusted R	0.5444		0.7263	
***Significant at 1%, ** Significant at 5%, *Significant at 10 %				

Crop Diversification

Crop diversification had a statistically significant relationship with Food Consumption Score (P<0.01). This indicates that with more implementation of crop diversification, the food consumption score of farmers will increase. Statistically, there is a likelihood of a 90% increase in food consumption score with the adoption of crop diversification.

Crop diversification had a statistically significant but negative association with the Household Food Insecurity Access Score (HFIAS) (P<0.01). The association was highly significant, and the negative association accentuates that food insecurity will decline with the rise of crop diversification. The statistical findings propose a change in food insecurity by 88% with the unit rise in the adoption of crop diversification (Holden and Lunduka, 2013). Under crop diversification, farmers go for diverse crops, earning them more income and access to healthy crops (Aslam, 2016). For instance, with the passage of time cultivation of highly nutritious crops such as Quinoa is rising. These high nutritious crops can earn farmers an additional income and facilitate meeting household dietary needs. Findings are endorsed with those of (Mango *et al.*, 2014) that farming households practicing crop diversification had more yield, income, and fewer risks.

Family size

Family size means the total number of family members living together. Family size was highly significant (P<0.01), negatively influencing food consumption scores. With the increase in family size, the dietary needs increase. The farmers who have an inadequate financial position can fall into the vivacious circle of poverty and fall into more profound food insecurity. HFIAS was highly significant at the 1% significance level (P<0.01), having a positive influence. As the number of family members reduces the level of food, insecurity even starts decreasing. It depicts that as the number of household members increases, more resources are required to fulfill their dietary needs (Bashir *et al.*, 2012). The requirement of dietary nutrition will be different for different age groups and according to their health conditions (Olayemi, 2012).

Credit facility

Access to credit had a statistically noteworthy and positive link with the FCS (P<0.05) and a statistically

significant but negative association with HFIAS (P<0.05). The association with the FCS indicates that with the increase in farmer's access to the credit facility, the food consumption chances will improve. Statistical coefficient indicates the increase of 28% in food consumption score with the unit increase in access to the credit facility. Findings are further evidence that there is a 13% decrease in food insecurity with the increase in credit access (Owusu *et al.*, 2011; Rehman *et al.*, 2015). It can be deducted here that increased access to credit facilities can enable farmers to operate farm operations properly and manage all the necessary inputs inevitable to get potential crop production. Managing all the inputs timely and adopting effective techniques to grow multiple crops guarantees increased income, ultimately uplifting the livelihood and food security level. Farming households with excellent access to credit had more capital to spend on off-farm and on-farm activities to generate additional income for their families (Akaakohol and Aye, 2014).

Age of participating farmer

Table 4 further shows that age was a statistically significant and positive association with FCS (P<0.05) and a statistically significant and negative relationship with HFIAS (P<0.05). The positive association between respondents' age and FCS accentuates the increase in food consumption score with the increase in age. Perhaps, the increase in age brings maturity to the individual, which helps him make good decisions to generate income (Bashir *et al.*, 2012). For example, working on-farm and off-farm and adopting high-value crops can help him generate more income. Age negatively influenced HFIAS, which shows that increase in age can outsource food insecurity. The possible reason could be the overwhelmed experience and the decision-making of individuals.

Landholding

Landholding size was statistically significant and positively related to FCS (P<0.01) Statistically significant but negatively associated with the HFIAS (P<0.01). Findings incur that more agricultural land gives more opportunities to the farmers to experiment with new crops and grow more food, improving their food consumption (Khan *et al.*, 2013). The coefficient values confirm that with the unit rise in land size, the FCS will improve by 23%. More resources enhance food security. Large farmers are likely to receive more information and

make well-versed decisions than small farmers (Mango *et al.*, 2014). Households with broad land ownership are supposed to have good managing skills to confirm an all-year-round supply of diversified, nutritious, and ideal food. The unit rise in land size tended to bring food insecurity down by 61%. It does not necessarily mean that large landholding guarantees more production and profit. Even small farmers practicing farming on small landholdings can obtain potential production by adopting the latest techniques and site-specific technologies. Crop diversification could be the most feasible way to increase production and income, particularly for small farmers (Mango *et al.*, 2018).

CONCLUSION AND RECOMMENDATIONS
Pakistan is a culturally diverse and geographically rich country. Agriculture is one of the primary income sources of farmers, who are primarily small landholders. Thus, various factors, including traditional farming techniques, are food insecure and trapped into a vivacious circle of poverty. This study accentuated that the food consumption score of the farming communities in the study area was not up to mark, and half of the households had an insufficient level of food consumption and were food insecure indeed. Food insecurity and poverty were further strengthened due to deprived educational levels, small landholdings, limited access to credit, and ordinary shifting to crop diversification. This indicates that farmers urgently needed to go for alternative strategies to cope with poverty and food insecurity.
Agriculture was the key income source for the farmers, thus improving the agriculture sector to harvest more income seems the right choice. The OLS regression model findings confirm that age, education, land size, crop diversification, and access to credit facilities were key determinants to increase food consumption and reduce the traces of food insecurity. OLS showed a likelihood of a 90% increase in food consumption and an 88% decrease in food insecurity by adopting crop diversification. Thus, crop diversification could be the right choice for the farmers, small farmers or large farmers. To accelerate the adoption of crop diversification, there is a need to shed light on education, utilization of land resources, and credit access.
The institutions in Pakistan need to address these challenges of the farmers. Giving farmers excellent access to credit by the public and private banks with the

effective involvement of the Government of Punjab, the Agriculture department could augment farmers to go for crop diversification. The extension advisory service providers (i.e., Public Sector Agriculture Extension) should target the young aged and educated farmers to exploit their potential and adopt the crop diversification with the assistance from experts from the agriculture department. For the small farmers, to promote crop diversification, the agriculture department should launch some projects, and farmers should be provided with the basic plans for crop diversification. The technical and educational programs for the farmers, either offline or online, could be the right option to make farmers educate regarding producing multiple crops, interact with markets, conserving the cost, and improving their food consumption behavior.

CONFLICT OF INTEREST
All the authors declare no actual or potential conflict of interest, including financial, personal, or other relationships with other people or organizations.

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