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FOOD SECURITY STATUS AND ITS DETERMINANTS: A CASE OF FARMER AND NON-FARMER RURAL HOUSEHOLDS OF THE PUNJAB, PAKISTAN

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This study aims to examine the food security status of farmer and non-farmer rural households of the Punjab, Pakistan. Three measurement methods i.e. DIA (Dietary Intake Assessment), HFIAS (Household Food Insecurity Access Scale) and HDDS (Household Dietary Diversity Score) were used to measure food security status of the households. Primary data from 576 (50% farmer and 50% non-farmer) rural households located in six districts of the Punjab is used. Results of all three measuring methods showed that farmer households were more food secure than non-farmer households. According to DIA, 38.9% farmer and 45.5% non-farmer households were food insecure, according to HFIAS, 45.1% farmer and 51.7% non-farmer households were food insecure and according to HDDS, 57.3% farmer and 65.3% non-farmer households were food insecure. Prevalence of food insecurity varied for each measuring method but pattern was same. A strong correlation between three measuring methods was found. Determinants of food security also varied for farmer and non-famer households but monthly income, family size and family structure were important determinants for both type of households.
Keywords: Multiple methods, calorie intake, access to food, dietary diversity, logistic regression.

INTRODUCTION

Food security has emerged as a concern in academic scholarship over the past few decades. Food security is not just about having enough food in town or on store shelves, it has different dimensions. Lacy and Busch (1986) argued that there are three dimensions of food security; availability, adequacy and accessibility. They further articulated that availability is about having sufficient food to sustain human life, even in the face of production shortages. Adequacy refers to a balanced diet and variety of foods in both short and long term. Finally, accessibility is about transportation, marketing and livelihood strategies by which food is acquired.

The concept of food security has gone through transition period since its emergence as an issue in 1970s. More than thirty definitions of food security are found in literature as different organizations/researchers have defined food security differently, e.g. FAO (1983) defined food security as "ensuring that all people at all times have both physical and economic access to the basic food they need". UN World Food Council (1988) defined food security as "adequate food available to all people on regular basis". Later, World Food Summit (1996) defined food security as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". This definition emphasized on consumption, the demand side and the issues of access by vulnerable people to food, which is most closely identified with the seminal study by Amartya Sen. Eschewing the use of the concept of food security, he focuses on the entitlements of individuals and households. Also, this is the definition of food security used by every organization and researcher now.

Food security is a concern in both developed and developing regions of the world but situation is severe in developing regions (Bashir *et al*., 2013a). Despite the recent decrease in the number of food insecure population around the world, still, 794.6 million (as illustrated in Fig. 1) people are underfed. Out of these 794.6 million, 780 million are from developing regions of the world. Situation is even worse in Asia and Africa where 511.7 million and 232.5 million food insecure people live, respectively (FAO *et al*., 2015).

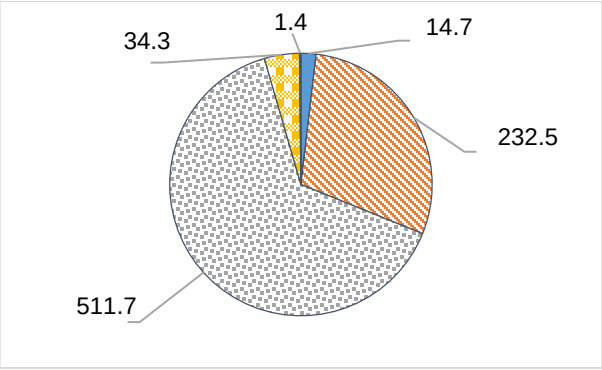

Figure 1. Food insecurity around the world (millions).
Source: FAO *et al*. (2015)

South Asia consists of 23% of the whole world's population and home to 35.4% of the world's undernourished population (FAO *et al*., 2015). It is a low-income region with only 2% share of the global economy. Although numerous initiatives have been set to address poverty and hunger worldwide, Pakistan persists in its food insecurity (at household level) and poverty status. For example, in 2000, United Nations set eight Millennium Development Goals, first goal among them was to reduce poverty and hunger to half by 2015. Only three countries (figure 2) from South Asia (Bangladesh, Maldives and Nepal) achieved that goal. Pakistan, despite the fact that it produces surplus of many agricultural commodities (FAO, 2016a) and is food self-sufficient at national level (Bashir *et al*., 2012), has missed the goal by a great margin. The prevalence and depth of food insecurity varies across different groups and regions in Pakistan. Rural household (both farmer and non-farmer) are among the most vulnerable groups when it comes to food security because they command very few resources and have to worry about food for a good part of the year (Yasin, 2000; NNS, 2011).

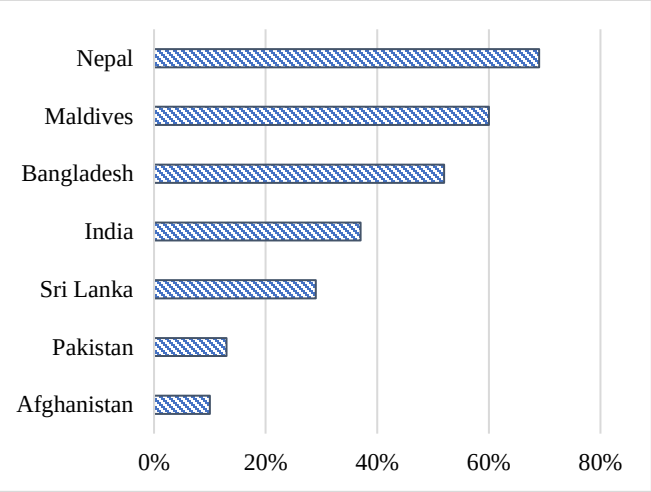

Figure 2. Reduction in undernourishment population in South Asia 2000-2015.

*red line in figure 2 denotes the Millennium Development Goal set by United Nations. Source: FAO (2016b)

Food security has been defined differently by different researchers according to their research agendas. The literature on food security cites more than 190 studies focusing only on its concept and meaning (Maxwell and Frankenberger, 1992; Clay, 2002). The majority of definitions try to answer five common questions: who should get, when, how, how much, and what kind of food? The measurement of food security remains a debatable issue due to the selection and sequence of these questions (McKeown, 2006).

These questions then become the base line for food security measurement and variations in measurement methods. Other important questions that create diversity in measurement methods are related to prevalence/incidence of food insecurity, variations in the prevalence/incidence, factors affecting food security, underlying relationship between these factors and food security, potential effects of food insecurity on human health and behavior. To answer such questions different methods have been used to measure food security (Alinovi *et al*., 2009). Consequently, the incidence/ prevalence of food security is reported to be varying to a great extent (Dutta *et al*., 2007).

Dietary intake assessment (DIA) method has been mostly applied to measure the food security situation of households/individuals in Pakistan. DIA measures food consumption only, it does not take into account other factors like feelings of anxiety, uncertainty regarding access to food and dietary diversity. No study in Pakistan has considered these factors simultaneously. This study has used three methods of measurement i.e. Dietary Intake Assessment (DIA), Household Food Insecurity Access Scale (HFIAS) and Household Dietary Diversity Score (HDDS) to measure food security status of farmer and non-farmer rural households (most vulnerable groups) from different angles simultaneously. This study also aimed at examining that whether determinants of food security vary for farmer and non-farmer households which can help policy makers to develop a more informed and targeted policy for the area under study.

MATERIALS AND METHODS

***Data collection and analysis*:** This study was conducted in the Punjab, Pakistan. Province of Punjab has 36 districts which are divided into three regions based on geographical variability. Districts with deserts or mixed typologies of desert and plains formed South Punjab region. Districts with mostly plains situated at less than 350 meters above sea level formed Central Punjab and districts situated between 350 and 900 meters formed North Punjab region. Primary data were collected using multi-stage random sampling technique. At first stage, a total of 6 districts (2 from each region) were selected randomly. At second stage, one tehsil from each district was chosen randomly. At third stage, four villages from each tehsil were selected randomly. At fourth stage, 24 households (12 farmer and 12 non-farmer) were selected from each village to make an overall sample of 576 households. On average, every village in Pakistan has about 200 households in which majority (>80%) are either small farmer or non-farmer households (GOP, 2010). Survey data for this study were gathered from 12% (i.e. 6% farmer and 6% non-farmer) of these households.

Interview schedule was used to gather data on different aspects of food security. Data were gathered in four categories. In first category, general and demographic data of household was gathered; second category was about intake of different food items (for DIA); third category was about

access to food, anxiety and uncertainty in food security (HFIAS) and fourth category was about dietary diversity of household (HDDS).

***Empirical analysis*:** Empirical analysis for this study was conducted in two steps. At first step, households' food security status was measured using aforementioned three instruments.

DIA: In this method, dietary intake record of a household is obtained through 7 days recall method to calculate calories. These calories were then adjusted for household members on the basis of age and gender using 'Adult Equivalent Units' given by National Sample Survey Organization (NSSO, 2007). DIA measures actual food consumption, it deals with dietary quality and quantity and can also identify at risk households and individuals. (Pérez-Escamilla and Segall-Corrêa, 2008). Food security threshold (2450Kcal/person/day) established by Government of Pakistan (GOP, 2003) is used in this study. Mathematically, it can be written as

$$FS_{ij} = \sum_{j=2}^{i=n} FS - T \geq 0 \qquad (1)$$

Where, FS_{ij} is food security status of i^{th} household (i = 576) of j^{th} category (j = farmer, non-farmer) and T is food security threshold for rural areas.

HFIAS: It was created by Food and Nutrition Technical Assistance (FANTA) and it is concerned with how households perceive food insecurity. It contains nine questions to assess the households' perception of food insecurity (Coates *et al*., 2007). It measures food security on the basis of problems experienced by households in terms of access to food and it uses the domains of food insecurity which are culturally universal (Radimer *et al*., 1990; Frongillo *et al*., 2003; Coates *et al*., 2006; Webb *et al*., 2006). HFIAS is the only measuring instrument which directly measures households' experience of food insecurity rather than using proxy measures such as food availability or anthropometry and it is easy both to administer and interpret. The HFIAS score is created by summing up the number of occurrences for each of the nine food insecurity related situations. Households with higher score experienced more food insecurity (access) and vice versa. The lowest score that could be achieved is 0 and the highest is 27.

HDDS: This was computed using dietary history of 20 food items (12 groups) for a given amount of time. This score can also be applied as proxy for access to food (Hoddinott and Yohannes, 2002). A 24-hour reference period has been used by FAO which does not indicate an individual's routine diet but it does provide good assessment at population level (Savy *et al*., 2005). We used *food groups* rather than *food* because it is more meaningful to know that a household has consumed from 4 different food groups (that ensures diversity in both micro and macronutrients) than knowing that a household has consumed 4 different foods, as all of them might be cereals (Swindale and Bilinsky, 2006). HDDS is computed for each household using a set of 12 food groups as suggested by (Swindale and Bilinsky, 2006). The food groups in the 24-hour dietary diversity were scored with 1 if the household has consumed the food group in the past 24 hours and 0 otherwise. Scores of HDDS were then classified using cut-off points suggested by FAO (2006).

At second step, binary logistic regression was applied on DIA scores to identify the determinants of food security Logistic regression gives the probability of occurrence of an event for a number of independent variables (Hailu and Regassa, 2007). Assuming food security and socio-economic characteristics have linear relationship, food security can be written as:

$$FS_{ij} = \sum_{j=2}^{i=n} \beta_i S_{ij} + \varepsilon_i \qquad (2)$$

We can rewrite the model as probability of a given household being food secure or insecure using the logistic distribution function narrated by Gujarati (2009) as;

$$P_{ij} = E(FS_{ij} = 1 | S_{ij}) = \beta_o + \beta_i S_{ij} \qquad (3)$$

Where, P_{ij} is the probability of i^{th} household of j^{th} category to be food secure and S_{ij} is the vector of socio-economic characteristics of i^{th} household of j^{th} category. FS_{ij} = 1 means the household is food secure and now the equation 3 can be rewritten as;

$$P_{ij} = E(FS_{ij} = 1 | S_{ij}) = \frac{1}{1+e^{-(\beta_o+\beta_1 S_{ij})}} \qquad (4)$$

For convenience, the equation 4 can as be written as;

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^Z}{1+e^Z} \qquad (5)$$

Where

$$Z_i = ß_0 + ß_1FSt + ß_2DRd + ß_3FmS + ß_4HHA + ß_5MI + ß_6LS + ß_7HHEdu + ß_8LO + ß_9HHT + ß_{10}DPur + ß_{11}DCons + ß_{12}EM + \varepsilon_I \qquad (6)$$

Where, $P(FS_{ij})$ = the probability of i^{th} household from j^{th} category to become food secure (1 for food secure, 0 otherwise), ß0 = constant term, $ß_{1-12}$ = coefficients of socio-economic variables, FSt = family structure of the household (Nuclear or Joint), DRd = distance between household and road, FmS = family size, HHA = household head's age, MI = total monthly income of household from all sources in Pakistani Rupees, LS = ownership of livestock by household HHEdu = household head's education level (years of schooling), LO = land owned (acres), HHT = household type i.e. male headed or female headed, DPur = decision making regarding purchase of food, DCon = decision making regarding consumption of food, EM = total earning members in the household

RESULTS

***Socio-economic characteristics of the respondents*:** Table 1 shows that 68% farmer and about 76% non-farmer household heads had age up to 55 years representing the active age group. While, about 32% farmer and about 24% non-farmer

household heads were aged over 55 years. About 44% famer and about half of the non-farmer households had up to 6 members, 25% farmer and about 20% non-farmer households had 7 to 8 members. While, remaining, about 32 and 30% farmer and non-farmer households, respectively, had more than 8 members. About 41% farmer and 51% non-farmer households had only 1 earning member. About 32% farmer and 23% non-farmer households had 2 earning members. While, about 28% farmer and 26% non-farmer households had more than 2 earning members. More than half (about 51% farmer and 58% non-farmer) households had joint family structure. More than one third (about 37%) farmer and a little less than half (about 47%) non-farmer households were illiterate.

Table 1. Socio-economic characteristics of the respondents.

Variables	Farmer	Non-farmer	Total
	f (%)	f (%)	f (%)
Age			
Up to 35	42 (14.5)	64 (22.2)	106 (18.4)
36-55	154 (53.5)	156 (54.1)	310 (53.8)
>55	92 (31.9)	68 (23.7)	160 (27.7)
Family size			
Up to 4	41 (14.2)	45 (15.6)	86 (14.9)
5-6	85 (29.5)	100 (34.7)	185 (32.1)
7-8	69 (25.0)	58 (20.1)	127 (22.0)
9-10	45 (15.6)	49 (17.0)	94 (16.3)
>10	48 (16.70	36 (12.5)	84 (14.4)
Earning members			
1	117 (40.6)	146 (50.7)	263 (45.7)
2	91 (31.6)	66 (22.9)	157 (27.3)
3	48 (16.7)	45 (15.6)	93 (16.1)
>3	32 (11.1)	31 (10.8)	63 (10.9)
Family structure			
Nuclear	142 (49.3)	121 (42.0)	263 (45.7)
Joint	146 (50.7)	167 (58.0)	313 (54.3)
Education of HH			
Illiterate	105 (36.5)	134 (46.5)	239 (41.5)
Primary	33 (11.5)	53 (18.4)	86 (14.9)
Middle	45 (15.6)	32 (11.1)	77 (13.4)
Matric	69 (24.0)	36 (12.5)	105 (18.2)
Intermediate +	36(12.5)	33 (11.5)	69 (12.0)

Table 2 shows the comparison of the results of different measuring methods. It is clear from the table that according to DIA, mean of calorie intake for farmer and non-farmer households was 2655±746 and 2058±657 respectively. About 39% farmer and about 46% non-farmer households were food insecure (i.e. calorie intake was less than 2450 Kcal/person/day). For HFIAS, mean scores for farmers and non-farmers were 5.4±6.7 and 6.3±7.1, respectively. According to the recommended cut-offs suggested by Coates *et al*. (2007), prevalence of food insecurity for farmer households was 45.1% out of which 8% of the households were mildly, 9.7% were moderately and 27.4% were severely food insecure. While, prevalence of food insecurity for non-farmer households was 51.7% out of which 6.3% of the households were mildly, 14.9% were moderately and 30.6% were severely food insecure.

Table 2. Comparison of food security status of households.

Food security status	Farmer	Non-farmer	Total
	f (%)	f (%)	f (%)
DIA			
Secure	176 (61.1)	157 (54.5)	333 (57.8)
Insecure	112 (38.9)	131 (45.5)	243 (42.2)
Minimum*	986	563	563
Maximum*	5161	4997	5161
Mean±SD*	2655±746	2058±657	2356 ±763
HFIAS			
Secure	158 (54.9)	139 (48.3)	297 (51.6)
Mildly food insecure	23 (8)	18 (6.3)	41 (7.1)
Moderately food insecure	28 (9.7)	43 (14.9)	71 (12.3)
Severely food insecure	79 (27.4)	88 (30.6)	167 (29.0)
Minimum**	0	0	0
Maximum**	19	18	19
Mean±S.D**	5.4±6.7	6.3±7.1	5.9±6.9
HDDS			
High dietary diversity	14 (4.9)	10 (3.5)	24 (4.2)
Medium dietary diversity	109 (37.8)	90 (31.3)	199 (34.5)
Low dietary diversity	165 (57.3)	188 (65.3)	353 (61.2)
Minimum***	1	1	1
Maximum***	7	7	7
Mean±SD***	4.1±1.5	4±1.4	4.1±1.4

*calorie intake; **Household food insecurity access score; ***Household dietary score

For HDDS, of the 12 food groups assessed using the 24-hour household dietary diversity questions; 4.9% farmer and 3.5% non-farmer households had high dietary diversity, 9.7% farmer and 14.9% non-farmer households had medium dietary diversity and 57.3% farmer and 65.3% non-farmer households had low dietary diversity. As HDDS can also be used as proxy for access to food so it can be said that lower the dietary diversity of a household, higher the food insecurity. So, we can say that according to HDDS 57.3% farmer and 65.3% non-farmer households were food insecure. Spearman's r correlations among all the three measures were quite strong and all the measures were significantly associated in the expected direction at $p<0.01$ (Table 3). DIA and HFIAS were much more strongly correlated. Overall strong correlation among these measures was expected as they have shown strong correlation in previous studies, e.g. Maxwell *et al*. (2013) reported a strong Spearman's r correlation among all the measures of food insecurity.

Table 3. Spearman's rho correlations between food security measures.

	DIA	HFIAS	HDDS
DIA	1.000	0.833**	0.774**
HFIAS	-0.833**	1.000	-0.727**
HDDS	0.774**	0.727**	1.000

** significant at p<0.01

***Determinants of rural household food security*:** Binary logistic regression was used to find out the determinants of food security for both farmer and non-farmer households. The estimations of relative risk in binary logistic models were calculated by odds-ratios (OR). The findings of logistic regression model (Table 4) indicate that out of twelve, five variables were statistically significant for farmer (family structure, family size, monthly income, household head's education and earning members) and non-farmer rural households (family structure, family size, household head's age, monthly income and ownership of livestock). Only significant results are explained below. Odds-ratios were converted into percentages (% = (OR-1) * 100) for better understanding.

***Family structure (FSt)*:** This refers to the combination of relatives that comprise a family. In Pakistan two family structures are common i.e. joint and nuclear family. It was found that farmer and non-farmer households with nuclear family structure were 95.2 and 90.7% more food secure than those with joint family structure, respectively.

***Family size (FmS)*:** This was statistically significant with a negative sign. This indicates that family size and food security were inversely related. An increase of one family member deteriorated household food security by 14.4 and 24.5% for farmer and non-farmer households, respectively.

***Monthly income (MI)*:** MI had positive effect on food security for both farmer and non-farmer households. Results show that if income increased by Rs. 1000 per month, the probability of a farmer and non-farmer household of being food secure increased by 6.1 and 9.4%, respectively.

***Household head's age (HHA)*:** HHA was statistically significant (for non-farmer households only) with a positive sign which implies that increase in household head's age increased the chances of a household being food secure. Results revealed that an extra year of household head's age increased the chances of food security for a non-farmer household by 4.1%.

***Livestock (LS)*:** LS also had a direct and significant effect on non-farmer households' food security status. Addition of one livestock animal increased the probability of food security by 23.5%.

***Household heads' education (HHEdu)*:** HHEdu was also positively and significantly associated with farmer households' food security status. For farmer household heads, an extra year of schooling was responsible for 10% increase in the chances of being food secure.

***Earning members (EM)*:** Numbers of earning members was also positively and significantly associated with farmer

Table 4. Results of binary logistic regression.

Variables	Farmer		Non-farmer	
	B	OR	B	OR
FSt	-3.042 (0.370)***	0.048	-2.375 (0.403)***	0.093
FmS	-0.156 (0.048)**	0.856	-0.281 (0.095)**	0.755
HHA	0.019 (0.013)	1.019	0.040 (0.014)**	1.041
MI	0.00006 (0.000)**	1.00006	0.00009 (0.000)**	1.00009
LS	0.073 (0.387)	0.929	0.961(0.410)**	0.765
HHEdu	0.097 (0.038)**	1.102	0.070 (0.041)	1.073
EM	0.398 (0.154)**	1.489	0.052 (0.179)	0.950
LO	0.042 (0.023)	1.043	N/A	N/A
HHT	0.469 (1.027)	1.599	-1.158 (1.344)	0.314
Dpur	-0.197 (0.394)	0.821	0.325 (0.363)	1.384
Dcon	-0.316 (0.414)	0.729	-0.216 (0.365)	0.806
DRd	-0.058 (0.048)	0.944	-0.136 (0.043)	1.145
Constant	4.301 (1.793)	N/A	3.418 (1.688)	N/A
MPS	78.5%		84.0%	
Log likelihood	248.321		211.442	
H-L model (df = 8) significance test results	10.6 (p value = 0.227)		5.3 (p value = 0.720)	
Cox & Snell R^2	0.378		0.343	
Nagelkerke R^2	0.512		0.501	

*** Significant at P < 0.01; ** Significant at P < 0.05; MPS = Model Prediction Success
Figures in parenthesis are standard errors.

Table 5. Comparison of the ranks of significant factors.

Ranks	Farmer		Non-farmer	
	Factors	Impact (%)	Factors	Impact (%)
Positive impacts				
1	Earning members	49.0	Livestock	23.5
2	Education	10.0	Income	9.4
3	Income	6.1	Age	4.1
Negative impacts				
1	Family structure	95.2	Family structure	90.7
2	Family size	14.4	Family size	24.5

households' food security. More earning members mean higher income and higher household income ensures food security. An increase of one earning member in the family, increased the chances of being food secure by 49%.

Table 5 presents the relative importance of determinants according to their impact on food security for farmer and non-farmer rural households. For farmer households, earning members had the most significant positive impact followed by education and then income. For non-farmers, livestock had the most significant impact on food security followed by income and then age of household head. Family structure (dummy) and family size showed negative impact on food security for both farmer and non-farmer rural households. This ranking of determinants of food security can be used to formulate a policy to overcome food insecurity.

DISCUSSION

Three measures of food security were used in this study and all of them reported high levels of food insecurity. Same pattern was reported by all the measures but intensity varied. According to these measures farmer households were more food secure than non-farmers. Bashir *et al*. (2013b) in another study conducted in Punjab, also reported that farmer households were more food secure than non-farmer households. This situation can be explained by the fact that wheat is staple food of Pakistan and farmer households can grow wheat and vegetables and other food crops for them, even small and subsistence farmers can grow food which will last them a good portion of the year, while non-farmer households either have to purchase all the food including wheat or they have to procure wheat grain by offering their labor during harvesting season which is paid in kind (wheat grain) rather than cash (Gazdar and Mallah, 2013). As the same sample showed different percentages of food secure and insecure households, it is established that measurement of food security is sensitive to measuring technique.

The results of household dietary diversity score revealed that cereals and vegetable food groups were most consumed and seafood; meat/poultry; any type of fruits; oils/fats had the lowest consumption for both farmer and non-farmer households. Clausen *et al*. (2005) and Ansari (2010) in their studies in Bangladesh and Pakistan, respectively, found that cereals (wheat, rice and rice) and vegetables consumption was higher than fruits and proteins from animal origin.

The results of logistic regression model showed that determinants of food security also vary for farmer and non-farmer households. Family structure was found to be a significant determinant for both farmer and non-farmer households. It is normally perceived that joint families are more food secure than nuclear ones because they can bring their resources together under a common household head. Contrary to this perception, in this study nuclear families were found more food secure than joint ones. This finding can be explained by the fact that joint families in Pakistan have a higher rate of dependency ratios, 65% according to World Bank (2016), which makes a household vulnerable to food insecurity. Sultana and Kiani (2011) and Bashir *et al*. (2013b) also found that households with nuclear family structure were more food secure than joint ones and this relationship was found to be significant at $p<0.01$.

We found family size negatively affected (as expected) food security status of both farmer and non-farmer households. It would take more resources to feed a larger family which is difficult especially when dependency ratio within a family is high. Bashir *et al*. (2012) also reported negative relationship between family size and food security status. They stated that addition of one family member decreased the probability of the household of being food secure by 31%. Sidhu *et al*. (2008) also found similar results in India. According to them, addition of one family member in a household deteriorated the chances of food security by 49%.

Having enough food in town does not mean anything unless people have enough money to buy it. Income of the households was also found significant determinant (as expected) for both farmer and non-farmer households. Bashir *et al*. (2012) also found that addition of PKR 1000 in monthly income of rural households increased their probability of being food secure by 5%. Bogale and Shimelis (2009) in Ethiopia, also found that income was positively and statistically significant for food security. Households with better income generating activities were more food secure than those with no or little access to income opportunities.

With one-unit increase in income, odds of becoming food secure increased by a factor of 0.995 (0.5%).

Household heads' age was found significant determinant of food security for non-farmer households. Older household heads have more experience that can be used for both increase in income and efficient spending of income and both of these can lead to food security. Oninawa and Wheelock (2006) also found in USA that increase in the age of household heads reduced food insecurity by 2%. Sekhampu (2013) also reported that, in South Africa, age of the household head and food security status of household were significantly associated with each other at $p<0.05$.

Ownership of livestock was found significant determinant for non-farmer households. Livestock in rural areas is raised by almost every farmer and non-farmer household. For non-farmer households, livestock is more important than for farmer households because it does not only serve the household's need of milk but surplus milk is sold for cash income. Livestock is also used for meat and it is also sold when a household is in need of money. So, the importance of livestock in the context of food security is manifold. Bogale and Shimelis (2009) in Ethiopia, reported that ownership of livestock and food security status of a household were significantly associated with each other at $p<0.05$. In South Africa, Nathalie (2012) also found that ownership of livestock was an important determinant of household food security. Bashir *et al*. (2013a) also reported similar importance of livestock for food security in Punjab, Pakistan, they stated that addition of one livestock animal increased the probability of food security by 26%. In Ethiopia, Muche *et al*. (2014) also found that addition of one large livestock animal increased the odds of food security by 43.1%.

We found education of household head an important determinant of food security for farmer households. With better education, household heads can claim better jobs and can also adopt new agricultural techniques to increase productivity which will ultimately result in improved food security status. Similarly, using binary logistic regression, Amaza *et al*. (2006); Bashir *et al*. (2013b) and Muche *et al*. (2014) reported that household head's education and food security status of that household were positively and significantly associated with each other. Otunaiya and Ibidunni (2014) also found that, in Nigeria, the coefficient of educational status of household head (1.386) was positive and significant at $p<0.01$, implying that increase in education would result in improved food security status.

More number of earning members means more man power for farmer households which can result in increased agricultural production and ultimately improved food security status. Bashir *et al*. (2013b) also found significant relationship between number of earning members and food security at $p<0.05$. Similarly, in Nigeria, Otunaiya and Ibidunni (2014) found that dependency ratio was negatively and significantly (-0.256) associated with food security at $p<0.01$.

***Conclusion*:** It is statistically proven that farmer and non-farmer households of Punjab experience different levels of food security no matter what measuring instrument we use. This study also established that food security is sensitive to measurement, the intensity of the food security varies for farmer and non-farmer households according to every measure but pattern remains same. Relative importance of determinants of food security also varies for farmer and non-farmer households but three determinants i.e. monthly income, family size and family structure are important for both farmer and non-farmer households. Results suggest that to tackle food insecurity in the study area, policy makers might be interested in improving efficiency of family planning programs to reduce family size, reforming education system to make people able for better jobs, increasing income generating activities to reduce dependency ratio within households and efficiency of livestock policy and encouraging rural household to raise livestock. Further research is needed to examine whether food security status and determinants of rural and urban households vary according to these measuring instruments.

REFERENCES

Alinovi, L., E. Mane and D. Romano. 2009. Measuring household resilience to food insecurity: application to Palestinian households. FAO Food Security Program Rome, Italy.

Amaza, P.S., J.C. Umeh, J. Helsen and A.O. Adejobi. 2006. Determinants and measurement of food insecurity in Nigeria: some empirical policy guide. Available online at http://ageconsearch.umn.edu/bitstream/25357/1/pp060591.pdf

Ansari, N.B. 2010. The role of household food insecurity access, socioeconomic status and dietary diversity as underlying determinants of undernutrition in Pakistani households. Ph.D. diss., Div. Epid., Univ. California, Davis, USA.

Bashir, M.K. and S. Schilizzi. 2012. Have policies in Pakistan been effective for improving food security? Wanted: disaggregated policy assessment. World Appl. Sci. J. 17:1182-1191.

Bashir, M.K., S. Schilizzi and R. Pandit. 2013a. Regional sensitivity of rural household food security: The case of Punjab, Pakistan. J. Anim. Plant Sci. 23:1200-1206.

Bashir, M.K., S. Schilizzi and R. Pandit. 2013b. Impact of socio-economic characteristics of rural households on food security: the case of the Punjab, Pakistan. J. Anim. Plant Sci. 23:611-618.

Bogale, A. and A. Shimelis. 2009. Household level determinants of food insecurity in rural areas of Dire Dawa, Eastern Ethiopia. Afr. J. Food Agric. Nutr. Dev. 9:1914-1926.

Clausen, T., K.E. Charlton, K.S.M. Gobotswang and G. Holmboe-Ottesen. 2005. Predictors of food variety and dietary diversity among older persons in Botswana. Nutr. 21:86-95.

Clay, E. 2002. Trade and Food Security: Conceptualizing the linkages. Available online at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.413.7930&rep=rep1&type=pdf

Coates, J., A. Swindale and P. Bilinsky. 2007. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: Indicator guide 3rd Ed. Acad. Edu. Dev., Washington, DC.

Coates, J., E.A Frongillo, B.L. Rogers, P. Webb, P.E. Wilde and R. Houser. 2006. Commonalities in the experience of household food insecurity across cultures: What are measures missing? J. Nutr. 136:1438-1448.

Dutta, I., C. Gundersen and P.K. Pattanaik. 2006. Measures of food insecurity at the household level, Research Paper, UNU-WIDER, United Nations University (UNU), No. 2006/95. pp. 42-61.

FAO, IFAD and WFP. 2015. The state of food insecurity in the world 2015. Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress. Rome, Italy.

FAO. 1983. World Food Security: A reappraisal of the concepts and approaches. Director General's report, Rome.

FAO. 2006. Baseline survey report protecting and improving household food security and nutrition in HIV/AIDS affected areas in Manica and Sofala Province, Maputo, Mozambique.

FAO. 2016a. Country Fact Sheet on Food and Agriculture Policy Trends, Pakistan. Available online at http://www.fao.org/3/a-i6054e.pdf

FAO. 2016b. Asia and the Pacific: Regional overview of food insecurity. Investing in a zero-hunger generation. Available online at http://www.fao.org/3/a-i6481e.pdf

Frongillo, E.A., N. Chowdhury, E.C. Ekstrom and R.T. Naved. 2003. Understanding the experience of household food insecurity in rural Bangladesh leads to a measure different from that used in other countries. J. Nutr. 133:4158-4162.

Gazdar, H. and H.B. Mallah. 2013. Inflation and food security in Pakistan: Impact and coping strategies. IDS Bull. 44:31-37.

GOP. 2003. Economic Survey of Pakistan, 2002-03. Ministry of food and agriculture. Finance Division, Economic Advisor's Wing, Islamabad, Pakistan.

GOP. 2010. Economic Survey of Pakistan, 2009-10. Ministry of Food and Agriculture. Finance Division, Economic Advisor's Wing, Islamabad, Pakistan.

Gujarati, D.N. 2009. Basic econometrics, 5th Ed. McGraw-Hill/Irwin., New York.

Hailu, A. and N. Regassa. 2007. Correlates of household food security in densely populated areas of Southern Ethiopia: does the household structure matter. Stud. Home Com. Sci. 1:85-91.

Hoddinott, J. and Y. Yohannes. 2002. Dietary diversity as a household food security indicator. Washington, DC, Food and Nutrition Technical Assistance Project, Academy for Educational Development.

Lacy, W.B. and L. Busch. 1986. Food security in the United States: Myth or reality. In new dimensions in Rural Policy: Building upon our heritage. Government Printing Office, Washington, DC.

Maxwell, S. and T. Frankenberger. 1992. Household food security: concepts, indicators, measurements. A technical review. UNICEF Program Publications, New York.

McKeown, D. 2006. Food Security: Implications for the Early Years. Background paper, Public Health, Toronto, Canada. Available online at http://www.toronto.ca/health/children/pdf/fsbp_final.pdf

Muche, M., B. Endalew and T. Koricho. 2014. Determinants of household food security among southwest Ethiopia rural households. Food Sci. Technol. 2:93-100.

Nathalie, D.C. 2012. A comparative overview of commonly used food security indicators, case study in the Limpopo Province, South Africa. M.Sc. Diss. Dept. Nutr. Rural Dev., Ghent Univ., Ghent, Belgium.

NNS. 2011. National Nutrition Survey of Pakistan. Nutrition Wing, Cabinet Division, Government of Pakistan.

NSSO. 2007. Nutritional Intake in India 2004-2005. National Sample Survey Organization (Report No. 513). Ministry of Statistics and Program Implementation. Available online at http://mospi.nic.in/rept%20_%20pubn/513_final.pdf

Onianwa, O. and G. Wheelock. 2006. Analysis of the determinants of food insecurity with severe hunger in selected Southern States. S. Rural Soci. 21:80-96.

Otunaiya, A.O. and O.S. Ibidunni. 2014. Determinants of food security among rural farming households in Ogun State, Nigerian J. Sust. Dev. Afr. 16:33-44.

Pérez-Escamilla, R. and A.M. Segall-Corrêa. 2008. Food insecurity measurement and indicators. Rev. Nutr. 21:15-26.

Radimer, K.L., C.M. Olson and C.C. Campbell. 1990. Development of indicators to assess hunger. J. Nutr. 120:1544-1548.

Savy, M., Y. Martin-Prével, P. Sawadogo, Y. Kameli and F. Delpeuch. 2005. Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. Eur. J. Clin. Nutr. 59:703-716.

Sekhampu, T. 2013. Determination of the factors affecting the food security status of households in Bophelong, South Africa. Int. J. Bus. Econ. Res. 12:543-556.

Sidhu, R., I. Kaur and V. Vatta. 2008. Food and nutritional insecurity and its determinants in food surplus areas: the

case study of Punjab state. Agri. Econ. Res. Rev. 21:91-98.

Sultana, A. and A. Kiani. 2011. Determinants of food security at household level in Pakistan. Afr. J. Bus. Manage. 5:12972-12979.

Swindale, A. and P. Bilinsky. 2006. Household dietary diversity score (HDDS) for measurement of household food access: Indicator guide, 2nd Ed. Acad. Edu. Dev., Washington, DC.

United Nations. 1988. Towards Sustainable Food Security: Critical Issues. Report by the Secretariat, World Food Council, Fourteenth Ministerial Session, Nicosia, Cyprus.

Webb, P., J. Coates, E.A. Frongillo, B.L. Rogers, A. Swindale and P. Bilinsky. 2006. Measuring household food insecurity: Why it's so important and yet so difficult to do? J. Nutr. 136:1404-1408.

World Bank. 2016. Age dependency ratio (percent of working-age population). Available online at https://data.worldbank.org/indicator/SP.POP.DPND

World Food Summit.1996. Rome Declaration on World Food Security, Rome.

Yasin, M.A. 2000. An investigation into food security situation in rain-fed areas of district Rawalpindi. M.Sc. (Hons.) Diss. Inst. Agric. and Res. Econ., Univ. Agric. Faisalabad, Pakistan.