

Research Article



Assessing Food Insecurity Trends and Determinants by using Mix Methods in Pakistan: Evidence from Household Pooled Data (2005-2014)

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Abstract | In this study, we try to indirectly quantify the welfare of people in Pakistan through measuring the food insecurity, malnutrition during last decade (2005-14). This study takes lead from earlier studies, in a sense; it covers two food price hike periods (2007 and 2011). So, it is important to understand, how food insecurity status and nutrition are affected by these shocks during this period. Thus, we use nationally representative data called as Household Income and Expenditure Survey (HIES) from 2005-2014. Pakistan Bureau of Statistics collects this data in five rounds; 2005-06, 2007-08, 2010-11, 2011-12, and 2013-14 comprised 81102 households. Results from the headcount ratios suggest that over the period food insecurity trends of the households raised from (58%) to (77%). we find urban households are more food insecure over the time as compared to rural households. Whereas, in qualitative terms of food insecurity, we use two food diversification measures; one is dietary diversity score and second one is share of staple food in total calories consumed by household, suggest that households dietary diversity score is good on average that is 9 out of 10 food groups and on the whole it is slightly improved from (8.8 %) to (9%) in previous 10 years. Interestingly, when we analyze the share of staple food in total calories, results suggest that major portion of a household's diet is consisting of staple food (wheat), (53%) and increased to (57%) from 2005 to 2014. We use the Heckman Approach to find out determinants of food insecurity. Results suggest that female headship plays a significant positive role in caloric intake, among the other variable head education, households' member with basic education and higher education, live stock ownership, consumption of livestock produced at home, farming, consumption of food crop produced at home and foreign and domestic remittances plays a significant positive role in caloric intake of food insecure households.

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Introduction

Food security is a multifaceted concept and it can be achieved at the individual, household, national, regional and global levels, when all people, at

all times, have physical and economic access to adequate, safe and nutritious food to fulfill their intake needs and food choices for an active and healthy life (FAO, 1996). In other words, Food insecurity, or the inability to access food of sufficient

quantity and quality to satisfy minimum dietary needs, is the most basic form of human deprivation (Park et al., 2012). While the food insecurity, malnutrition and poverty are the most serious global challenges of the 21st century (IFPRI, 2014). Approximately half of the world's population lives below the poverty line. Around 805 million people across the world are facing extreme hunger, regardless of the fact that the world food production has doubled during the past three decades (FAO, 2014). More than three billion people over the world live on less than \$2.50 a day. Whereas 1.3 billion people in the entire world face extreme poverty and survive on less than \$1.25 a day. One billion children are victims of poverty worldwide. According to UNICEF, 22,000 children die each day due to undernourishment. More than 750 million people are in shortage of access to fresh drinking water. More than 2 billion people are facing micronutrient deficiencies (FAO, 2014). International organizations are afraid that this may increase considerably due to global demographic stresses, for example, shrinking cultivatable land, increasing water insufficiency, environmental changes (IFPRI, 2016).

Despite of the efforts made, situation in less developed countries is unsatisfactory (IFPRI, 2016). They are suffering from a greater prevalence of poverty and food insecurity (IFPRI, 2016). Food insecurity is a great problem in South Asia and Sub-Saharan Africa. It is found that in both regions, energy intake deficiency incidence is very much closer to each other i.e. 51 percent in South Asia, 57 percent in Sub-Saharan Africa (Wiseman, 2007). In south Asia, studies have been conducted in different countries like India, Nepal and Bangladesh to analyze the situation of food insecurity (Afza et al., 2015; Krishnaraj, 2005; Joshi and Maharjan, 2010; MK et al., 2011; Wiranthi et al., 2014) suggests that limited physical assets, lack of welfare policies plays the significant role in food insecurity in India. Whereas head education, head age, annual income, number of small and large animals have positive impact on food security, women empowerment can play a significant role to reduce the intra household food insecurity.

In Africa there are various studies (Abdullahi and Ayanlere, 2015; Abubakari and Abubakari, 2015; Abu and Soom, 2016; Ahmed, 2015; Fawehinmi and Adeniyi, 2014; Gottlieb and Fruman, 2011; Habyarimana, 2015; Ibok et al., 2014; Jumi et al., 2014; Mutisya et al., 2015; Muhoyi et al., 2014; Ngongi and

Urassa, 2014; Otunaiya and Ibidunni, 2014; Zakari et al., 2014) have showed that food insecurity is a major problem in this region. Most of the studies are based on primary data sets in different regions of sub-sahrahn Africa. Food insecurity is chronic in nature in Pakistan. Current studies (SDPI, 2014; NNS, 2011; FAO, IFAD and WFP, 2008) showed alarming situation of food insecurity in Pakistan as well. According to these studies food insecurity increased from 58 percent in 2005-6 to 72.8 percent in 2013, which is troublesome.

Pakistan has achieved substantial improvement in raising the per capita availability of all main food goods, such as cereals, meat, milk, sugar, and eggs over time. Resultantly, the per capita calorie intake rose from 2078 in 1949-50 to 2450 in 2012-13. Likewise, trends have been recorded for proteins and fats. However, the distribution of these calories is uneven. Disaggregated analysis of the data demonstrates that approximately half of the population is presently incapable to acquire its minimum /subsistence caloric need for healthy and productive living (GOP, 2014; SDPI, 2014; NNS, 2011; FAO, IFAD and WFP, 2008; Malik, Nazli and Whitney, 2015).

Different study focused on the various aspect of food insecurity in Pakistan. Substantial studies showed that food insecurity is major problem in Pakistan (Aziz et al., 2016; Asghar, 2011; Aslam and Rasool, 2014; Iram and Butt, 2004; Khan et al., 2009; Bashir et al., 2010; Begum et al., 2010; Hakeem et al., 2003; Nazli and Hamid, 2007; Sultana and Kiani, 2011).

The study is significant effort to measure food insecurity and its determinants with the help of pooled data. Thus, it is hoped that the present study has in general made a substantial contribution to the existing state of knowledge on the issues of food insecurity in general and more specifically with respect to Pakistan.

On the other hand, this study has few limitations as do other empirical studies. Due to the limitation of the data the intra household analysis has not been done. Moreover, the perception index of hunger has not been used due to lack of information in household income expenditure survey. Mal-nutrition regular indicators such as height-for-age, weight-for-height, weight-for-age and stunting growth have not been incorporated due to the lack of information in the

data.

Data and methodology

The research work has been done in the study with reference to household survey data. This data is collected by Pakistan Bureau of Statistics under the head of Household Income and Expenditure Survey. The study is concerned with the rounds of Household Integrated Economic Survey. The data provides comprehensive information about socio-economics characteristics of household and consumption quantities of food goods as well.

Materials and Methods

Pooling of data

Pooling is the way to analyze the data from multiple sources, most probably coming from the set of different populations. Such data usually comes from repeated surveys. Thus it is called independently pooled cross section (IPCS) (Wooldridge, 2013).

The precondition to pool the independent cross section or estimates at micro level is that sources of data and population should be comparable (Verma et al., 2009).

Therefore, it is possible to pool the HIES surveys over the repeated time periods. Data is comparable with each other with reference to source, population and sampling frame. So that one can get useful results from this exercise. Thus, this study has used the pooled data sets comprised of five HIES surveys including 2005-06, 2007-08, 2010-11, 2011-12 and latest one 2013-14. Thus 81006 households included in this analysis.

Food insecurity analysis

The study has employed various indicators to estimate food insecurity incidence for household by following the Wiseman (2007) study on South Asian countries and African countries and Malik (2015). The term food insecurity represents here the both qualitative and quantitative aspects. Basically, we divided food insecurity into two major indicators and they further divided into sub categories.

Diet quantity

Diet quantity has been divided into following three categories.

1. Food energy (calories) consumption; Household intake of calories per adult equivalent has been measured under this category. The total food consumption by household over the reference

period converted into calories and then divided by household adjusted size and number of days in the given period.

2. Percentage of household below calories threshold; is a household consuming inadequate food in each time to meet the recommended caloric intake per adult equivalent.
3. Percentage of household severely food energy deficient; is household consuming inadequate food that is not enough to fulfill minimum energy intake in the form of calories.

Diet quality

1. Household diet diversification; Food consumption has divided into 10 groups, out of them from how many groups, household is consuming over the reference period. The groups are wheat, rice, cereals, pulses and legumes, vegetable, fruits, dairy products; meats, poultry and eggs, oils and fats and sugar and products. The diversity score assigned as 1 for each group to the household, if and only if household is at least consuming one product from each group over the reference period.
2. Percentage of households with low diet diversity; either the household does not attain at least one food from 7 of the above 10 groups in the reference period.
3. Percentage of calories intake from Cereal food; food energy derived from cereal food (e.g.), wheat, rice, cereals.

Estimation of the food insecurity line

Food insecurity can be measured by numerous approaches but mainly two techniques are used: (1) daily minimum caloric intake required per person, (2) minimum expenditures needed to buy a bundle of calories per person. But the caloric intake method analyses the consumption of food goods of a household in real terms. In this method consumption is measured through calories obtained from food consumed. The calories converted from the food items consumed by all household for all food items has been added up together to get the total calories consumed by the household in the given time period. Then obtained calories are compared with a specific caloric intake requirement to determine food insecurity/ security status.

There is a disagreement amongst the various researchers about the selection of minimal caloric need. Few studies (Amjad and Kemal, 1997; Malik,

1988) employed 2250 calories per person per day as minimum requisite however some studies (Jamal, 2013; Malik, 2014, 2015) incorporated 2350 calories per adult equivalent. Planning Commission of Pakistan (2003) has also suggested the 2350 calories intake per adult equivalent per day at national level in Pakistan.

Therefore, in this study 2350 per adult equivalent has been used as a benchmark. The adult equivalent calories intake has been calculated by total caloric intake of a family divide by adjusted household size with respect to age and sex.

Therefore, the binary variable of food insecurity has been calculated as:

$D_1 = 1$ If a household is food Insecure.

$D_2 = 0$ If a household is food secure.

Determinants of food insecurity

In this paper, the proxy used for food insecurity is daily dietary energy intake (caloric intake). In other words, on average how much a household is deficient/sufficient in daily calories intake when compared to official benchmark of minimum daily energy intake. The basic objective of the study is to analyze food insecure group and the important factor affecting their calories intake. So, it was possible to draw a sub sample of the target group with the help of information mentioned above. Furthermore, this sub-sample can be used to explore the association between socio-economic factors and undernourishment by taking caloric intake as a dependent variable. It is assumed that dependent variable in the study follows a linear model and is randomly drawn from a population:

$$Y_i = \beta_0 + \beta_1 x_i + u_i \text{ with normally distribution}$$

In such type of cases the mean of error term is zero and uncorrelated with the predictor variables and the ordinary least square (OLS) estimates are consistent (Wooldridge, 2013). But it is possible in the case when full sample is included in the analysis rather than the censored group. But in our case, we wish to include the y_i observed from censored group. A nonrandom sample is possibly generated when a sample has been censored below or above specific threshold of the dependent variable, having information about the omitted variable (i.e.), whether above or below a certain threshold (Wooldridge, 2013). While it's also possible that self-selection bias has also been probable to arise because it is expected that poor households

have also been selected in food insecure group. In such type of cases where y_i is observed from a censored group /selected below and above a threshold. In this case the sub-sample of food insecure households may not be randomly drawn so the OLS estimates are not consistent and unbiased and our approximation would yield void estimators.

Therefore, in this case, study has used the Heckman approach (Campelo et al., 2016; Kamau et al., 2011) to correct the sample selection bias. In our study, sample selection bias is treated as omitted variable bias. Heckman (1979) established a two-stage model which is called Heckman Two Stage Model. It has been widely used to correct sample biases caused by sample selection method. The Heckman two stage can give consistent and asymptotically efficient estimates for all the parameters (Amemiya, 1985; Heckman, 1979; Maddala, 1983). The basic assumption of this model is the target variable which is unobserved (not selected) Heckman first applies the maximum likelihood models for example Probit or binary logistic. This model is used for whole sample to approximate the probability of being food secure or insecure by using binary variable in form of 0 and 1. A correction term called inverse mill ratio /predicted probability/ λ_j being produced in the first step. This is included in the second stage OLS regression with other explanatory variables to correct the bias arising from restricted sample of households categorized as food insecure. Hence in this study at second stage calories intake of restricted groups are taken as dependent variable, on the right-hand side the socio-economic characteristics are taken as explanatory variables along with inverse mills ratio produced in the first stage.

Logistic regression is a valuable technique for a condition in which investigator is interested to estimate the presence or absence of an attribute or conclusion based on a value of the set of forecaster variables. It is analogous to linear regression model, but it is appropriate in the case where dependent variable is a dichotomous variable (Hashmi et al., 2008). Logistic regression coefficients are used to estimate odd ratios for all explanatory variables in the model. A Logit model is a uni-variate dichotomous model. Dependent variable Y_i may assume simply two values one and zero. A set of continuous explanatory variable X_i , that,

$$P_r = (y_i = 1) = F(x_i b) \dots (1)$$

In the Equation 1 b is the parameter which desired to be assessed and F is logit Cdf. The primary equation to manipulate Logistic model is:

$$P_i = F(\alpha + \beta x_i) = \frac{1}{1 + e^{-(\alpha + \beta x_i)}} \dots (2)$$

While;

x_i is the likelihood that i th households can be poor and Y_i is assumed, where α is a vector of independent variables, e is the base of natural logarithm. Equation 2 may assume the following form:

$$P_i [1 + e^{-(\alpha + \beta x_i)}] = 1 \dots (3)$$

Or

$$(\alpha + \beta x_i = \log(\frac{P_i}{1 - P_i})) \dots (4)$$

The ratio $(\frac{P_i}{1 - P_i})$ is called the log odd or Logit, which acts as the dependent variable. This fraction appears in the form of odd which described that a household is poor or not (Hashmi et al., 2008).

The second stage model has estimated by using log linear form of OLS, which can be written as:

$$\log c_i = \alpha + \beta_i z_i + \varepsilon_i, i = 1, 2, \dots, n1 \dots (5)$$

Where;

C represents the household's calories; i represents the household; $n1$ represents the sub-sample; z_i represents individual and household characteristics; β_i the coefficients to be estimated and ε_i is the error term.

National and international literature points out that head age, head education, family member's education, gender of head, livestock owned, farming, agriculture land owned, electrification, safe drinking water are important determinants of food insecurity (Iram and Butt, 2004; Khan et al., 2009; Begum et al., 2010, Hakeem et al., 2003; Nazli and Hamid, 2007; Sultana and Kiani, 2011; Asghar, 2011).

Heteroscedasticity test and remedial measure

According to available literature, there is no chance of serial correlation in the independently drawn samples at household level. But there can be issue of heteroscedasticity in cross sectional data (Wooldridge, 2013).

Therefore, two tests have been applied in this regard

one is Breusch Pagan test is for the detection of linear heteroscedasticity and the other one White test is for the detection of non-linear type of heteroscedasticity. For the sake of remedial measures robust standard error approach has been used throughout the sample to correct the issue of heteroscedasticity, if it is found significant through diagnostic tests. The list of variables used in the analysis given in Table 1.

Results and Discussion

Descriptive analysis of hies data

This section describes the descriptive analysis of the data done by authors. The analysis of the data has been started from the estimations of head count ratio for food insecurity. These estimations are essential not only to find out the trend of food insecurity over the last 10 years, but these can provide basis to initiate econometric models to find out empirical factors that determine the food insecurity status and calories demand by food insecure group.

Food insecurity estimates / incidence of food insecurity

The study uses national line for daily calories intake per adult equivalent (2350) as a threshold. The household falls below 2350 calories per adult equivalent considered as food insecure, while household acquiring equal to or more than 2350 calories per adult equivalent per day are included in to food secure (Tables 2 and 3, Figure 1 and 2).

The results (Table 2 and 3) represents the trends of food insecurity over previous 10 years from 2005-6 to 2013-14. Food insecurity status of household (headcount ratio) has been calculated for Pakistan, urban and rural region separately. Furthermore, as described in methodology quantity of food consumption measure divided in to sub categories, therefore results based on food insecurity has presented in two (2 and 3) separate Tables. Table 2 depicts the picture of food insecurity with respect to suggested food calories intake, which is 2350/AE/day. According to these results the food insecurity is continuously increasing over the last 10 years in Pakistan. In 2005-06, there were 58 percent households who were food insecure, which increased to 77.4 percent in 2013-14. Similarly, food insecurity increased significantly over the 10 years in urban and rural areas of Pakistan. But the ratio is higher in urban region than rural region. Results are comparable to different studies done for different years (National Nutritional Survey, 2011; SDPI, 2014; FAO and WFP, 2008).

Table 1: List of variables used throughout the analysis of HIES pooled data.

Household size	Number of persons in the household
Household Head's Age	Household's head's age in years
Household Head's Sex	Male or female
Household Head's education	Highest class passed by the head
Children	No of children under 10 years of age
Earners	Earners in households (% of household size)
Dependents	No of dependents in households
Basic Education	Household members with at least primary or middle school education (% of Household).
Secondary Education	Household members with at least metric or secondary level education (% of Household)
Higher Education	Household members with at least graduate, masters, PhD level education (% of Household)
Professional Education	Doctor, Engineer, Lawyer, Technical diploma holders and others
Safe Drinking Water	=1 if Household has piped water facility or motorized pumping, 0 otherwise
Electricity Facility	= 1 if Household has electricity connection, within the household or even have an extension, 0 otherwise
Value of Assets owned	Value of property owned by household in Rs
Agriculture Land owned	1 =yes, 0 otherwise
Livestock owned (small animals, Goat, sheep, poultry etc.)	1 =yes, 0 otherwise
Livestock owned1 (large animals, cow, horse, etc.)	1= yes, 0 otherwise
Livestock output	1= output produced and consumed at home, 0 otherwise
Agriculture output	1= food crop produced and consumed at home, 0 otherwise
Domestic Remittances:	1= yes, 0 otherwise
Overseas Remittances	1= yes, 0 otherwise
Poverty status	1= poor, 0 otherwise
Food Insecurity status	1= food insecure, 0 otherwise
Urban	1= household living in urban area, 0 otherwise
Rural	1= household living in rural area, 0 otherwise

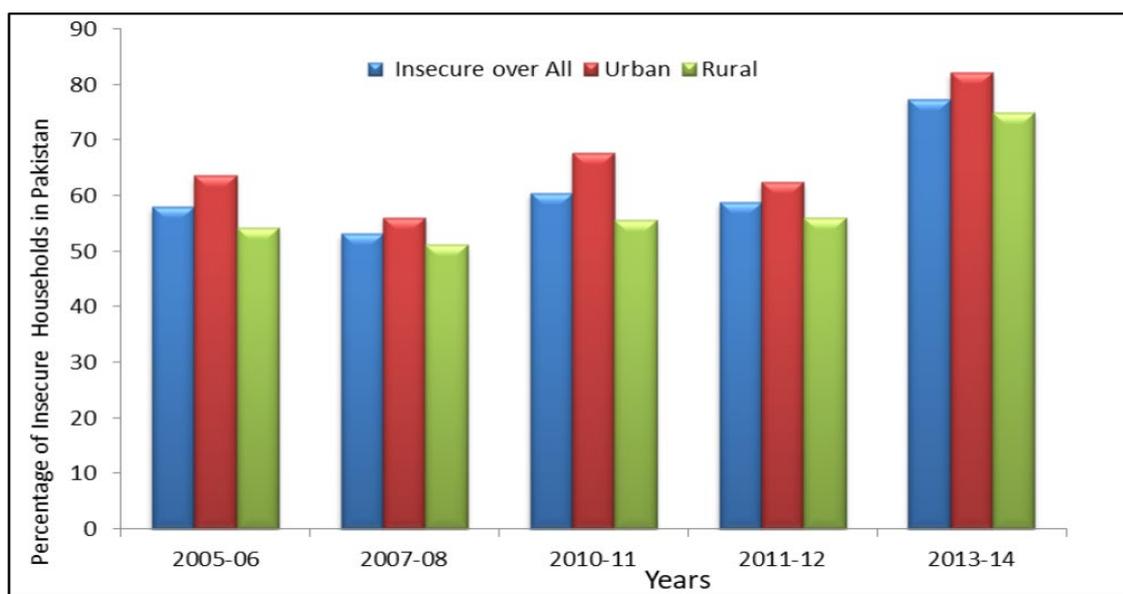


Figure 1: Food Insecurity estimates for Pakistan, urban and rural.

The results of household who are severely deficient in caloric intake have been reported in the Table 3 and Figure 2 and food insecurity average of 10 years is described in Figure 3. These results have

been estimated for Pakistan, rural, and urban areas separately. The results depict a good picture in this respect over the 10 years. The percentage of severely food insecure in calories intake (i.e.) less than 1700/AE/day decreased from 28.8 percent to 18.9 percent in 2005-06 to 2013-14. The situation in urban and rural areas has also improved over the decade. Results are in line with national and international studies (SDPI, 2014; FAO, IFAD and WFP, 2008).

A disaggregated analysis has been done by different sub groups to explore the matter in depth. For example, in the Table 4 food insecurity has been reported with respect to poverty status (based on authors's calculation) for Pakistan, urban and rural areas separately. This table represents four cases.

1. Not poor, not food insecure/food secure.
2. Not poor but food insecure.
3. Poor but not food insecure/food secure.
4. Poor and food insecure.

Each column represents two cases in itself, one that is reported for example, among the non-poor households in Pakistan, there was 55.5 percent food insecure, which has increased to 73.1 percent in 2013-14 and vice versa. Similar trends have been shown for poor groups for Pakistan, urban and rural respectively. But the rate is higher for urban areas with respect to poor and non-poor groups than rural areas. Situation is more alarming in urban areas, which needs an immediate action from authorities in Pakistan. It is important to note that food insecurity exists among

the non-poor group also in Pakistan, urban and rural regions (Figure 4). It is comparable with Malik (2015).

The quality analysis of diet has been described in Table 5 and Figure 5 and 6. The quality analysis of the diet consumed by household is very much necessary, just because the calories intake only cannot ensure the

Table 2: Food Insecurity Based on 2350 per Adult Calories Consumption per Day.

Years	Pakistan <2350	Urban<2350	Rural<2350
2005-06	58.0 %	63.6%	54.2%
2007-08	53.2%	56.1%	51.2%
2010-11	60.5%	67.8%	55.6%
2011-12	58.8%	62.4%	56.1%
2013-14	77.4%	82.2%	74.9%
Average 10 years	61.58%	66.42%	58.4%

Source: Author's own Calculation from HIES.

Table 3: Severe Food Insecurity Based on 1700 per Adult Calories Consumption per Day.

Years	Pakistan Se-vere <1700	Ur-ban<1700	Ru-ral<1700
2005-06	28.8%	33.7%	25.4%
2007-08	26.0%	28.6%	24.2%
2010-11	26.6%	31.0%	23.6%
2011-12	27.8%	29.4%	26.6%
2013-14	18.9%	19.7%	18.5%
Average10Years	25.6%	28.5%	23.7%

Source: Author's own Calculation from HIE.

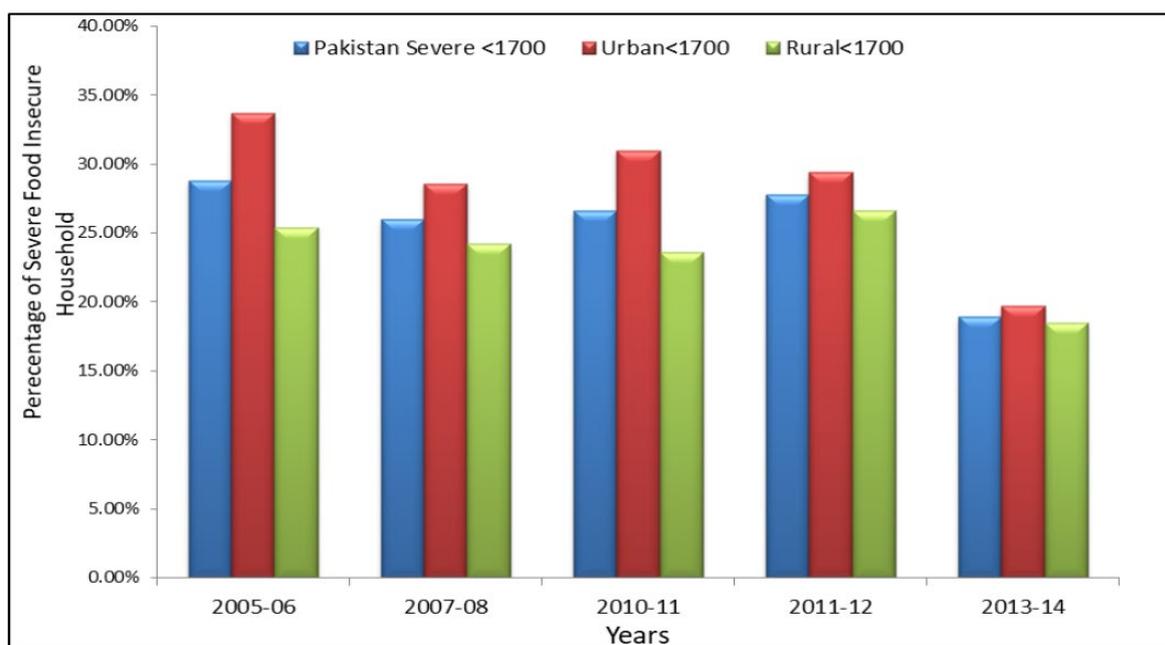


Figure 2: Severe food insecurity estimates for Pakistan, urban and rural.

nutritional quality of food utilized by the household. There are various measures of malnutrition which are widely used to quantify the undernourished persons and children. But due to the limitations of data, the measures for BMI and stunting and wasting cannot be applied to the data. So, it has been tried to analyze the mal-nutrition through the consumption pattern of households. The quality of diet can be measured through the food diversity and share of cereal food in diet consumed by household. For diet diversity 10 food groups has been developed by following available literature (Malik, 2014, Wiesman, 2007). Therefore, on the basis of consumption pattern of household it has assigned a score which was maximally 10 (if household consuming food from all 10 groups) and minimally 0 (if household not consuming from

any food group). The average dietary diversity score (DDS) for each year has shown overall a good trend.

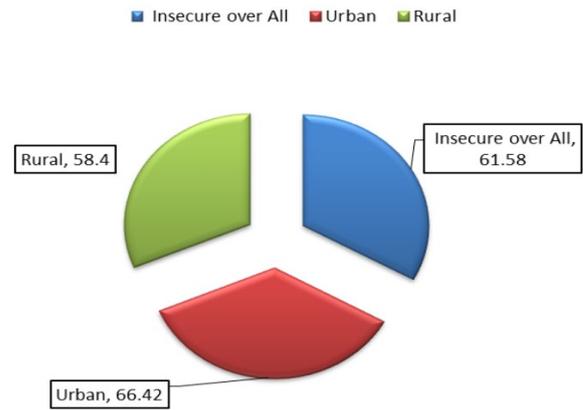


Figure 3: Food insecurity estimate's average of 10 years for pakistan, urban and rural.

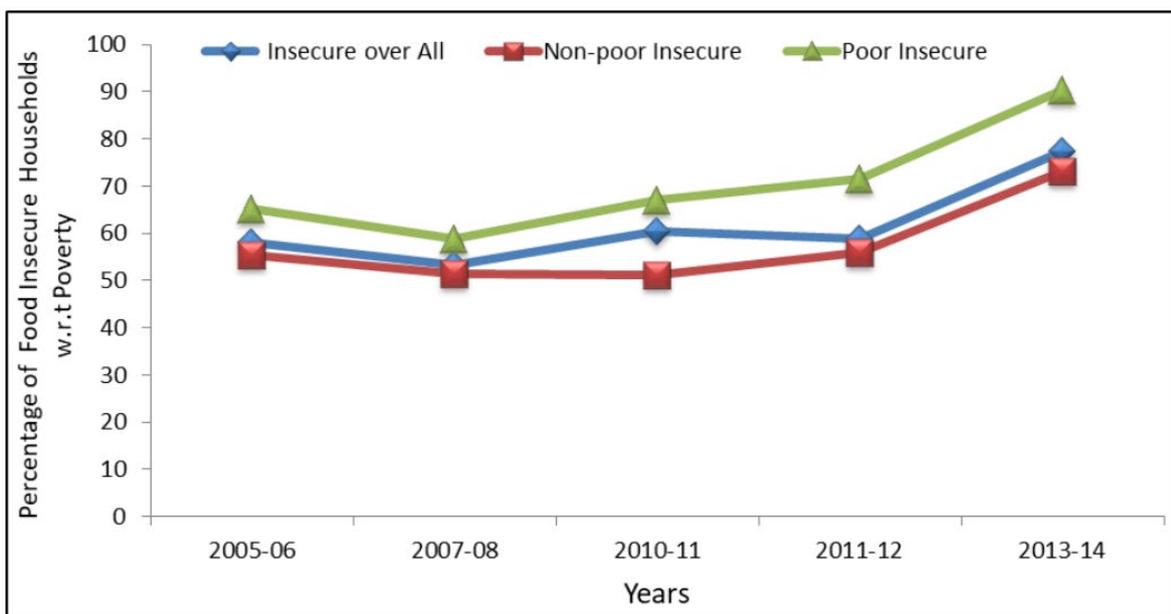


Figure 4: Food insecurity estimate's over the previous 10 years with respect to poverty.

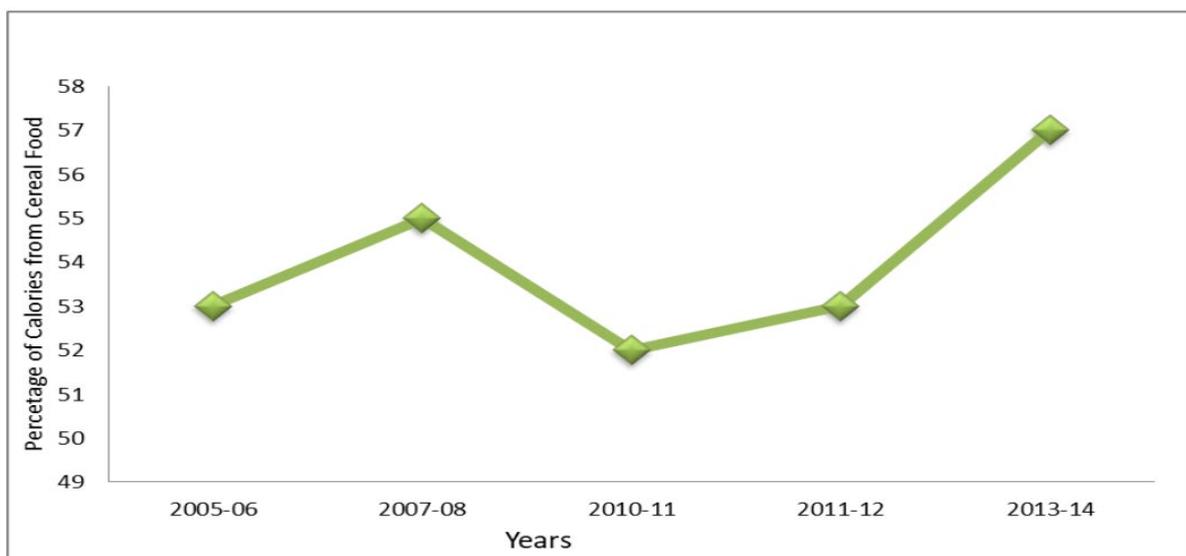


Figure 5: Percentage of calories from cereal food.

Table 4: Food insecurity with respect to poverty status.

Years	Non-poor	Poor	Urban non-poor	Urban poor	Rural non-poor	Rural poor
2005-06	55.5%	65.1%	62.6%	71.0%	48.9%	63.7%
2007-08	51.4%	58.9%	56.2%	55.7%	47.3%	59.8%
2010-11	51.2%	67.0%	66.2%	73.6%	51.2%	67.0%
2011-12	56.0%	71.6%	60.7%	85.5%	51.5%	68.8%
2013-14	73.1%	90.3%	81.0%	96.2%	67.0%	89.6%
Average 10 years	57.4%	70.5%	65.3%	76.4%	53.2%	69.8%

Table 5: Quality analysis of calories consumption.

Years	Calories cereal food	Cereal food (%)	D.D.S	% Low D.D.S
2005-06	1247	53	8.8	10.18
2007-08	1267	55	8.8	9.8
2010-11	1206	52	8.9	9.5
2011-12	1283	53	7.9	9.4
2013-14	1129	57	9.0	9.0
Average of 10 years	1226.4	54	8.7	9.7

Source: Author's own calculation from HIES.

People surveyed over the previous 10 years in Pakistan were consuming diverse food. It is meant people are consuming, cereal, pulses, meat and poultry, fruits, vegetables, fats and sugary products in Pakistan. But when we analyzed the share of cereal food in the diet of household over the 10 years, a contradiction is found in these two measures. The share of cereal food was significantly high in the last decade in Pakistan. More than 50 percent calories consumed by household have

been derived from cereal, wheat and rice. It was 53 percent in 2005-06 and rose to 57 percent in 2013-14. This result indicates that dietary diversity measure should be more narrowed down to explore the diet quality and nutritional value in detail. Hence it can be concluded that food consumed by people has low nutritional value and indirectly specifying the deficiency of micro and macro nutrients. Results are in line of available literature (Malik, 2014; Wiesman, 2007).

Overall it can be concluded from the estimates that situation of food insecurity and nutrition is not satisfactory in Pakistan. Food insecurity and malnutrition has increased over the time.

Determinants of food insecurity

The key model included in the research in hand is to determine the factors affecting the food insecurity of the deprived households in the previous 10 years.

As per requirement of Heckman Approach at first stage a likelihood model is estimated to produce the IMR that is a binary logistic model in this case. For second stage OLS model has been estimated with calories intake per adult equivalent by food insecure household. Two binary logistic models have been estimated to determine the food insecurity status one without time dummies, second with time dummies. The result showed the no major discrepancy in both models. But the higher r squared in time impact model represented it as a better fit than simple binary logistic. Thus, time logit has been used to produce

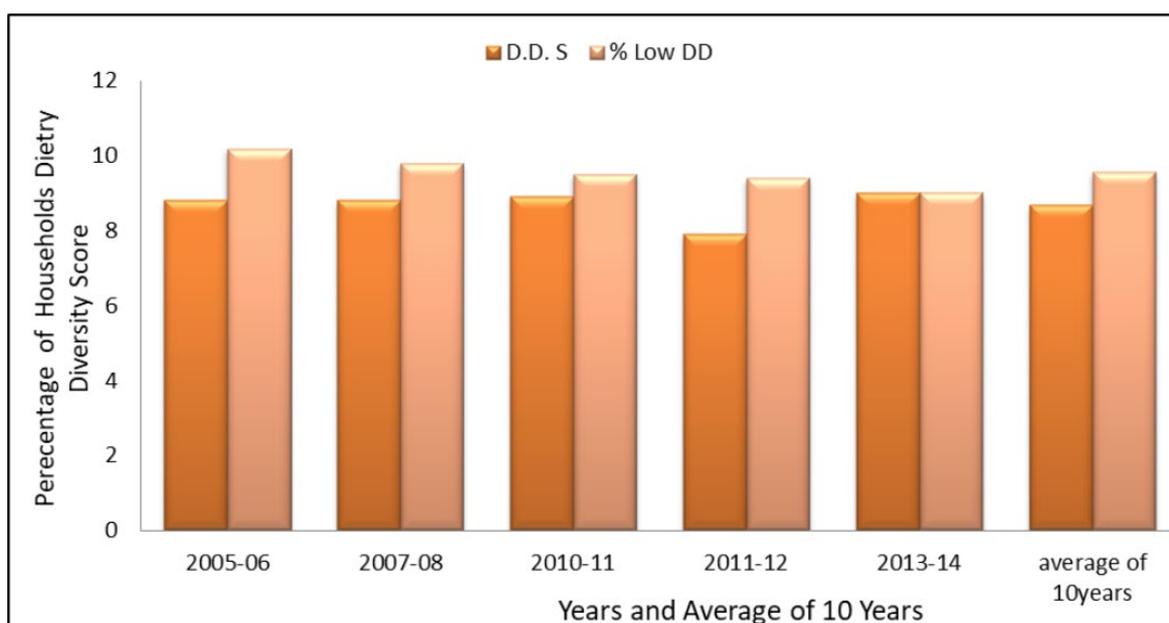


Figure 6: Dietary diversity scores.

IMR. The female headship, household size, ratio of household member with primary education, poverty status and urban area positively correlate with food insecurity status, while head age, head education, the percent of household members with different level of education, agriculture land ownership, livestock ownership, livestock products produced, food crop produced and asset value decrease the chance of being food insecure.

On the other hand, when we analyzed the time dummies, it was evident that year 2 (2007-8) had a negative relationship with being insecure as compare to reference year1 (2005-06) but the chance of getting in to food insecurity increased with year 3 (2010-11) year 4 (2011-12) and year 5 (2013-14). The column 3 and 4 of Table 5 has depicted the more technical aspects of binary logistic model (with time dummies) with the help of odd ratios and marginal effects. The odd ratios describe the chances of happening of an event e.g. being food insecure in the concerned model. It can be explained by the interpretation of some most important variables in terms of odd ratios. The odd of event being insecure is 1.02 times higher with a female head than a male head. The odd of head education showed that a one-unit increase in the head education decreased the chances of being insecure 0.99 times. One-unit increase in household

size increased the odd of event of being insecure by 1.21 times. Similarly, if a household had agriculture land the odd of event being food insecure decreased by 0.74 times. The odd of being poor described that the chances to fall below food insecurity line were 1.76 times more for poor than non-poor household. The odd of living in urban area demonstrated a 1.78 time more chances to be a food insecure than rural house hold. Among the time dummies the odd ratio of year 5 showed that chances of being insecure were 3.20 times more likely than the reference year1(2005-06). In the same way the odd ratios of other variables can be interpreted. There is no study available in Pakistan who estimated food insecurity status with the help of pooled data set. However, the results are in line with studies available on food security/insecurity status (Asghar, 2011; Aslam and Rasool, 2014; Aziz et al., 2016; Bashir et al., 2010; Sultana and Kiani, 2011). In our study the female headship increases the chance to be food insecure for a household but in contrast Aziz et al. (2016) reports the negative impact of femal headship on food insecurity status. Other variables shows almost the similar results to available literature.

Heckman 2nd stage equation; OLS with calories consumed per adult equivalent as dependent

The second stage equation for Heckman Approach has been estimated by taking the calories consumed by

Table 6: Determinants of food insecurity status; Heckman Two Stage with First Stage Binary Logistic and Second Stage Heckman OLS Regression.

	(1)	(2)			(3)
Models	Logit	Time Logit	Odd Ratios	Marginal Effect	Heckman2 nd stage OLS
VARIABLES	food_insecure	food_insecure	food_insecure	food_insecure	log_calories
Female Head	0.526*** (0.018)	0.024 (0.032)	1.025	0.006	0.0276*** (0.006)
Head age	-0.007*** (0.0006)	-0.006*** (0.0006)	0.994	-0.001	0.0003** (0.0001)
Head education	-0.026*** (0.002)	-0.023*** (0.002)	0.978	-0.005	0.0008** (0.0003)
HHS	0.185*** (0.003)	0.194*** (0.003)	1.214	0.044	-0.0031*** (0.0005)
Basic Educat	0.334*** (0.053)	0.349*** (0.054)	1.418	0.080	-0.067*** (0.010)
Secondary Educat	-0.334*** (0.056)	-0.321*** (0.057)	0.725	-0.073	-----
Higher Educat	-1.544***	-1.611***	0.200	-0.368	0.066***

	(0.092)	(0.093)			(0.019)
Proff Educat	-1.663***	-1.173***	0.309	-0.268	-----
	(0.155)	(0.156)			
Electricity	0.377***	0.0213	1.022	0.005	0.021***
	(0.020)	(0.025)			(0.004)
Owner	-0.297***	-0.291***	0.748	-0.066	-----
	(0.036)	(0.036)			
Farmer/Operator	-0.150***	-0.125***	0.882	-0.029	0.014
	(0.047)	(0.049)			(0.009)
Food produ cons	-0.217***	-0.323***	0.723	-0.076	0.0397***
	(0.036)	(0.037)			(0.005)
Livestock owner	-0.267***	-0.168***	0.846	-0.039	0.032***
	(0.044)	(0.046)			(0.008)
Livestock owner1	-0.266***	-0.334***	0.716	-0.079	0.0252***
	(0.042)	(0.043)			(0.009)
Livestock prod cons	-0.527***	-0.521***	0.594	-0.123	0.038***
	(0.043)	(0.045)			(0.008)
Domestic remit- tances	-0.861***	-0.793***	0.453	-0.192	0.058***
	(0.027)	(0.027)			(0.005)
Intern remittances	-1.050***	-0.967***	0.380	-0.236	0.097***
	(0.035)	(0.036)			(0.007)
Poor	0.600***	0.569***	1.767	0.124	-0.075***
	(0.021)	(0.021)			(0.003)
Assets value	-0.139***	-0.191***	0.826	-0.044	-----
	(0.007)	(0.008)			
Urban	0.440***	0.578***	1.783	0.129	-0.051***
	(0.020)	(0.021)			(0.004)
2.year	-----	-0.160***	0.852	-0.037	0.0267***
		(0.026)			(0.005)
3.year	-----	0.364***	1.438	0.080	0.053***
		(0.027)			(0.004)
4.year	-----	0.128***	1.136	0.029	-0.0492***
		(0.043)			(0.008)
5.year	-----	0.614***	3.204	0.029	-0.0481***
		(0.037)			(0.007)
IMR	-----	-----	-----	-----	-0.097***
					(0.012)
Constant	1.272***	1.954***	7.058***	7.058***	7.488***
	(0.090)	(0.094)	(0.659)	(0.659)	(0.008)
Observations	81,006	81,006	81,006	81,006	50,269
R-squared	0.121	0.144	0.144	0.144	0.055

Note: Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

household per adult equivalent as a dependent variable (continuous variable) to estimate the OLS model. The results have been presented in Table 6. The coefficient of inverse mills ratio was significant that depicts the selection model is necessary to correct the sampling bias. The other socio-economic variables show the results as they were expected. The female headship, head age, head education, percent of household members with higher education and electrification had significant positive relationship with calories intake. Among the other variables, farmer-operator, food crop producer, livestock owner (both categories), livestock product producer, remittances (both categories) demonstrated a strong positive and significant impact on calories intake except farmer-operator that was not significant.

Household size, Percent of household members with primary education, poverty status and urban area of living showed a significant negative relationship with calories intake of mal-nutrient household. The year dummies show a mixed relationship with food insecure household's calories intake. The year 2 (2007-8) and year 3 (2010-11) has a positive or more caloric intake with reference to base year (2005-06), while the year 4 (2011-12) and year 5 (2013-14) has a negative or lesser intake per adult equivalent than base year1 (2005-06).

Over all the results have few major implications in both models. The female headship shows a contrast relationship in both models. In full sample, the binary logistic results showed a positive relationship with the chance of being food insecure though it is not significant but in caloric intake OLS model the female headship demonstrates a positive and significant impact on caloric intake per adult equivalent. It is meant that female headship or empowerment of women can play an important role to overcome the malnutrition. Second the head education and higher education can play a vital role to improve the caloric intake among food insecure household. The year dummies describe that there is an increase in year 3 and year 4 for food insecure household while it decreases in year 4 and year 5 as compare to reference year 2005-06. Over all the situation of food insecurity is not good as shown by binary logistic results with time dummies. But it is also evident from caloric intake model for food insecure group that it is deteriorating in last 4 years for mal-nutrients household, because the first four years has shown a moderately high intake than base year1. Hence the situation is more alarming for

deprived people who are already taking fewer calories than a threshold level. Fewer studies available (Aslam and Rasool, 2014; Aziz et al., 2016; Irum and Butt, 2004; Khan and Gill, 2009) estimated OLS for caloric intake as a dependent variable. Generally, the results are comparable to these studies but particularly no study available in Pakistan who employed Heckman Approach. Few international studies (Campelo et al., 2016; Kamau et al., 2011) used the *Heckman Approach* to determine the factor effecting food insecurity of deficient group. Results of this paper are aligned with these studies.

Conclusions and Recommendations

The study is an effort to deeply analyze the situation of food insecurity and factor affecting the food insecurity of deprived group in Pakistan. It is evident that food insecurity is significantly increased in last few years. So, the results suggest a serious effort to be made by Government in form of welfare policies to improve the food insecurity situation. Moreover, agriculture sector plays a vital role in decreasing food insecurity and increasing caloric intake. Livestock ownership is also another significant element that can reduce food insecurity, so policies are needed to enhance the livestock business at small and medium level. On the other hand, women empowerment plays a good role to increase caloric intake. Education is the most important factor that has negative impact on food insecurity and positive relation with caloric intake. Thus, educational policies in general and particularly for females must be focused by government.

Author's Contribution

Amara Amjad Hashmi: Conceptualized the main idea, developed the methodology, did analysis and wrote the manuscript.

Maqbool Hussain Sial: Supervised the whole study.

Waqar Akram: Helped in conceptualization, modeling and estimations.

Maaida Hussain Hashmi: Provided assistance in handling the data and writing and editing the manuscript.

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