World Applied Sciences Journal 9 (4): 403-411, 2010
ISSN 1818-4952
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Rural and Peri-Urban Food Security: A Case of District Faisalabad of Pakistan

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Abstract: Pakistan is one of the leading producers of important agricultural commodities including buffalo milk and meat (ranked 2nd), wheat, sugarcane (ranked 6th) and rice (ranked 12th), but still has a higher proportion of undernourished population. This study aimed to assess the severity of food insecurity problem in the rural and peri-urban areas along with its socio-economic determinants. District Faisalabad of the Punjab, Pakistan was selected and primary data from 300 households were collected through proportionate sampling technique from four selected towns of the district. Study focused the problem in two phases firstly, the food security status was calculated using the calorie intake method and secondly, logistic regression technique was used to assess the socio-economic factors of food security. It was found that 18 percent of the households were food insecure. The situation in rural areas was slightly better than peri-urban areas. Further it was found that livestock assets, education level, number of earners, household head's income, tenancy status and income in the form of aids and gifts from relatives or any aid giving agency had a positive impact on household food security. On the other hand age of household head, family size and expenditures in the form of transfers had a negative relationship with household food security. It was suggested that the primary and secondary education enrolment must be increased along with technical education facilities, family planning programs be made effective. Moreover help can be sought from the welfare system of Islamic Economics to reduce the food insecurity.

JEL Classification: I30 · Q18 and R20

Key words: Food security · Rural households · Peri-urban households · Pakistan

INTRODUCTION

The current financial crisis is making the situation of food security more severe. Food security has been defined in various ways by different authors and institutions but the most comprehensive definition states, "Food that is available to everyone at all times, that they have means of access to it, that it is nutritionally adequate in terms of quantity, quality and variety and is acceptable within the given culture. Only when all these conditions are in place it can be said that a population is food secure" [1]. The most critical consequence of food insecurity is 'hunger' which may be seen as the most severe stage of food poverty and can be defined as an uneasy or painful sensation caused by lack of food. The number of chronically hungry people was 848 million in 2003-05 which rose to 923 million in 2007. Given the continued and drastic price rise in staple cereals and oil crops in 2008, the number of people suffering from chronic hunger has increased and is likely to increase further [2].

The intensity of food security differs from nation to nation. It is a complex phenomenon which includes a range of factors that vary in significance across regions, countries and social groups, as well as over time. These factors can be grouped in three core areas as; *Food availability* i.e. when sufficient quantities of food are constantly available to all individuals within a country through household production, other domestic output, commercial imports, or food assistance programs; *Food accessibility* i.e. when households and all individuals have adequate sources to obtain suitable foods for a healthy diet and depends on incomes of

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households, distribution of income within the household and the price of food; and *Food utilization* i.e. the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients, potable water and adequate sanitation which depends heavily on knowledge of food storage and processing techniques, basic principles of nutrition, proper child care and illness management [3].

Almost every country of the world is worried about to manage the problem of food insecurity whether it has a developed or a developing economy. About 11 percent households in USA are food insecure at least for some time during the year [4]. In Australia the evidence of food insecure population is likely to be over 5 percent and much higher among groups at risk [5]. Similarly 10 percent of Canadians are living in food-insecure situation [6]. The situation in developing countries is getting worse as in Africa about 200 million people are undernourished [7]. As compared to Africa situations in other developing regions such as East Asia, South Asia and Latin America are a little better but high food prices are having a deeper impact on low-income populations. In Indonesia, the doubling of prices within 12 months for soybeans which is a key staple food and mostly imported caused serious problems and resulted in street protests in early 2008. Similar was the situation in Egypt for hikes in prices where the cost of bread rose up to 26 percent and that of cooking oil up to 40 percent due to which people were forced to make protests in February 2008. Similarly protests broke out in Senegal over rice price hikes. China also faced similar situation where food prices increased by 20 percent in February 2008. Likewise in Vietnam food prices went up by 45 percent in June 2008. India also suffered from such situation where food accounts for 57 percent of the consumer price index [8].

Food self-sufficiency at national level is neither a necessary nor a sufficient condition for food security at household level. It is not a necessary condition because food imports can be used to fill the gap between domestic production and consumption. It is not a sufficient condition because even when a country is self sufficient, there may still be a significant number of people facing food insecurity [9]. Food security at one level does not imply food security at other level i.e. national / household and individual levels. A country which is food insecure will certainly contain groups of the population which are food secure and many countries which are food secure at national level will contain groups of population who suffer from severe food insecurity. Experiences from India and other countries have shown that even when the national level food security is achieved, individuals and groups in the country can still go hungry because they do not have the means to access food [10]. So, household food security is the most important tool for measuring food security.

Table 1: World Ranking of Agricultural Commodities (Production)

World Rank	Commodity
2	Buffalo Milk, Meat, Chick Peas, Roots & Tubers
3	Cottonseed, Pulses
4	Dry Onions, Cotton Lint, Goat Milk, Meat
5	Dates, Apricots, Dry Chillies & Peppers
6	Wheat, Sugarcane, Okra, Mangoes, Guavas
8	Castor Oil Seed, Unmanufactured Tobacco
9	Spinach, Cauliflowers, Broccoli
10	Pistachios
11	Sheep Meat, Lentils, Oranges
12	Rice, Paddy, Green, Dry Peas
13	Sunflower seed, eggs, Cow Milk, Wool

FAO, [13]

Pakistan with a population of about 161 million is the 6th most populous country in the world [11]. The population is expected to double in the year 2045 if it continues to grow at the present growth rate of 1.8 percent. Food and population growth (average annual rate of change) during 1995-97 and 2001-03 was 1.9 and 2.6 respectively [12]. Pakistan's agriculture sector is the largest sector of the economy contributing nearly 20 percent to GDP and employing 44 percent of the workforce. More than two-thirds of the population lives in rural areas and their livelihood continues to revolve around agriculture and allied activities [11]. There has been significant progress towards food sufficiency since the inception of Pakistan. It is one of the world's leading producers of many agricultural commodities (Table 1).

However, the proportion of undernourished population is too high i.e. 24 % [13, 14]. There are many urban and rural communities that have had to deal with uncertainty about their food security on daily basis, year after year, most often generation after generation [15]. The study in hand was designed to explore the food security situation and its key determinants at household level in the rural and peri-urban areas of district Faisalabad and to come up with possible solution to the problem.

Methodology: District Faisalabad was randomly selected for the current study. The District has eight towns as administrative divisions out of which four (Sadar, Jaranwala, Sumandri and Tandlianwala) were selected

randomly. To collect the data proportionate allocation method was used. The allocation is said to be proportional when the total sample size is distributed among the different strata in proportion to the size of strata [16].

$$n_i = n.\frac{Ni}{N} \text{ for i = A, B, C and D}$$

Where:
A, B, C and D are the selected towns respectively,
n_i is the i^{th} stratum sample size in research used,
Ni is the population size of the i^{th} stratum and
N is the total size of the population of four strata.

Calculation was carried out according to Population and Land Statistics, 2006. In this way, 90, 120, 48 and 42 households were interviewed from each town making the total sample size of 300. A comprehensive interview schedule was designed to record different parameters of household food security containing five parts; the *first* part contained general and demographic information about the household, the *second* part was specifically for the farmers about their crops and livestock, the *third* part of the schedule was to gather information to calculate the income of a household from crops, livestock, assets, labor etc., the *forth* part was related to consumption of food items on monthly, weekly and daily basis, the *fifth* part related to poverty which was calculated by "poverty score card". It was pretested and necessary amendments were made before the data collection.

Data Analysis: There have been different methods used to assess the food security status but none of them provide a full assessment of food security because they fail to take into account the vulnerability and sustainability elements of food security. Hence it is difficult to label any of these methods as a "gold standard" for the analysis of household food security [17]. Current study tried to focus the problem in two phases. First the food security status was calculated through the calorie intake method. For that a 7 days recall method of food consumption by the households was used. The quantities of food items consumed in last 7 days were converted to grams and the calorie content was estimated using the nutrient composition table of commonly eaten food in Pakistan. Per capita calorie intake was calculated by dividing estimated total household calorie intake by the family size after adjusting for adult equivalent units (AEUs) using the consumption factors for age-sex categories (Table 2). To get the household's daily per capita calorie intake the household's per capita calorie intake was divided by seven. Food security line was defined as the recommended daily per capita calorie intake for Pakistan that is 2450 kcal [18]. A household was considered as food secure whose daily per capita calorie intake was up to 2450 kcal.

Table 2: Adult Equivalent Units by Current Study

Age groups (years)	Male	Female
< 1	0.43	0.43
1-9	0.71	0.71
10-19	1.01	0.82
Adult	0.87	0.61

Summarized[1] from [19]

In the second phase the logistic regression technique was used because the dependent variable (*household food security)* is dichotomous (binary) in which the event either "occurs i.e. *food insecure (1)*" or "does not occur i.e. *food secure (0)*". The logistic regression directly estimates the probability of an event occurring for more than one independent variable, that is, for k independent variables [20]. The model can be written as;

$$\Pi X) = \{EXP\ (\beta_0 + \Sigma\beta_I * X_I)\} / \{I + EXP\ (\beta_{0+} \Sigma\beta_I * X_I)\} \quad (1)$$

I= 1, 2, 3,…..,11

Derivation of the logit model can be performed as follows.

Let p= P (X) and Z= (β_0 + $\Sigma\beta_I$* X_I)

Substituting for (1) Would Result

$$P = exp(z)/\{I + exp(z)\} \quad (2)$$

$$I - p = I/\{1 + exp(z)\} \quad (3)$$

$$P/1 - p = exp(z) = odds \quad (4)$$

Taking the natural logarithm of the above would result:

$$In\{p/1-p\} = In\{P(X)/(I-p(X)\} = LOGIT\{P(X)\} = \beta 0 + \Sigma\beta I * XI \quad (5)$$

$$P = e^{B0} * e^{B1X1} * e^{B2X2} * \ldots\ldots\ldots e^{B10X11}$$

1-p or Equivalently,

$$\frac{Pi}{1-Pi} = \beta_0 + \frac{Pi}{1-Pi}\beta_1 X_1 + \beta_2 X_2 + \beta X_3 \ldots\ldots\ldots \beta_{11} X_{11}$$

Where:

P = chance of a household being food insecure (i.e. probability of the event occurring)

1-P = chance of a household for not being food insecure (i.e. probability of an event not occurring)

Ln Pi = Is the probability or risk of the event occurring which is the odds 1- Pi of household food insecurity.

X_i = X_1, X_2, X_3,……, X_{11} are the independent variables[1] used in the model

β_i = β_0, β_1, β_2, β_3, β_4, β_5 are the regression coefficients indicating the magnitude of change (increased or decreased risk) in the independent variable.

X_1 = Structure of family; X_2 = age of household head;

X_3 = Education of household head;

X_4 = Total family members;

X_5 = Earners in the household;

X_6 = Tenancy status;

X_7 = Milking animals;

X_8 = Location (rural or Peri-urban);

X_9 = Net income;

X_{10} = Income in and

X_{11} = Income out.

The parameters of the model were estimated using the maximum likelihood method. That is, the coefficients that make the observed result "likely" were selected. The estimates of relative risk were computed on the bases of the odds ratios.

RESULTS AND DISCUSSION

Household Food Security Status: Table 3 reveals the food security status situation of the study area which shows that the situation is not that bad as there were only 53 households who were food insecure i.e. about 18 percent of the respondents. While a good majority of them (247 households) i.e. about 82 percent were food secure.

Table 3: Food Security Status of Households

Category	Frequency	Percentage
Food insecure	53	17.7
Food secure	247	82.3
Total	300	100.0

Table 4 shows the comparative situation of the peri-urban and rural areas according to which the situation in peri-urban areas was a bit worse as about 20 percent of the respondents from peri-urban areas were food insecure as compared to 15 percent of rural households that were food insecure.

Results of Logistic Regression: In logistic regression, the parameters of the model were estimated using the maximum likelihood method. That is, the coefficients that make our observed result "likely" were selected. In the logistic regression model, estimates of relative risk were computed either based on the odd ratios[2] or log of odd ratios[3]. For the current study the odd ratios were used for interpreting the relative risk of each independent variable. Table 5 shows the results of logistic regression which exhibits that family structure has the significant relationship with the response variable. It was noted that households with joint family system were 5.287 times more likely to be food secure than the reference category (nuclear family system) because joint families had positive relationship with the number of earning hands in the current study.

The age of the headship has also a significant relationship with the response variable. It was noted that household heads aged 36-45 years were 83 percent less likely to become food secure as compared to the reference category. Similar results were found by [21]. It was highest when household heads in the range of 61-70 years and least within that of 21-30 years. These results are in line with [22, 23].

Primary, middle and graduate household heads had the significant relationship with the food security as can be seen from the table that household heads with primary

[1] Variables were decided keeping in view the existing literature and regional characteristics of the study area.

[2] is defined as the ratio of the probability that the event will occur to the probability that it will not; $P/1\text{-}P = e^b * e^{b_1 X_1} * e^{b_n X_n}$ In the odd ratios, e^i is the factor by which the odds change when the i^{th} independent variable increases by one unit. If b_i is positive, this factor will be greater than one, which means that the odds are increased (increased risk of household food insecurity), If b is negative, the factor will be less than one ($e^{bi} < 1$), which means that the odds are decreased (decreased risk of outcome); when b is zero, the factor equals one ($e^{bi} = 1$) which leaves the odds unchanged.

[3] is defined as the logarithm or logit of the ratio of the probability that the event will occur to the probability that it will not occur; $\log (P) = \hat{a}_o + \hat{a}_1 X_1 + \hat{a}_2 X_2 \ldots. \hat{a}_n X_n$

Table 4: Peri-urban Vs Rural Household Food Security Status

		Food Security				
Variables		Food Insecure	%	Food Secure	%	Total
Location	Peri-urban	33	19.76	134	80.24	167
	Rural	20	15.03	113	85.00	133
Total		53	17.67	247	82.33	300

Table 5: Results of Logistic Regression

Variables	*B*	*SE*	Exp (β)
Family structure (X_1)			
Nuclear [RC]			
Joint	1.665	0.873	5.287 *
Age of Headship (years)(X_2)			
Up to 35[RC]			
36-45	-1.808	0.944	0.164 *
46-55	-4.217	1.161	0.015 **
56+	-4.113	1.304	0.016 **
Education of Headship (X_3)			
Illiterate[RC]			
Primary	1.900	0.872	6.687 *
Middle	1.857	0.879	6.402 *
Metric	1.024	0.780	2.785
Intermediate	1.212	0.967	3.361
Graduation	3.037	1.114	20.833 **
Total Family Members (X_4)			
Up to 3[RC]			
4-6	-4.056	1.370	0.017**
7-9	-3.805	1.375	0.022**
10+	-8.833	7.866	0.000**
Total Family Earners (X_5)			
1[RC]			
2	2.321	0.748	10.183**
3	2.994	1.353	19.956*
4+	1.991	0.951	7.323*
Tenancy Status (X_6)			
Landless [RC]			
Owner	2.192	0.823	8.951**
Owner-cum-tenant	-0.358	1.057	0.699
Tenant	4.461	1.524	103.603 **
Milking Animals (X_7)			
Zero [RC]			
1	-0.464	0.806	0.629
2	3.612	1.129	37.027 **
3+	1.482	0.936	4.403
Location (X_8)			
Rural [RC]			
Peri-urban	-0.385	0.553	0.681*
Net Income (X_9)			
Less than zero [RC]			
Zero	2.130	0.958	8.416 *
Up to 5000	2.693	0.883	14.775 **
5001-10,000	2.712	1.247	15.056 *
10001-20,000	0.809	1.115	2.245
20,001+	2.397	1.083	10.988 *
Income-In (in the form of) (X_{10})			
No [RC]			
Cash	2.037	0.877	7.664 *
Food	0.668	0.970	1.951
Other way	0.540	1.206	1.716

Note: ** is statistically significant at P< 0.01; * is statistically significant at P< 0.05

N= 300; -2 log likely hood ratio = 137.22; Cox & Snell R^2 = 0.378; Nagelkerke R^2 = 0.624; Overall classification = 91.7; Â = Regression Coefficient; SE = Standard Error; RC = Reference Category

education were 6.687 times more likely to be food secure as compared to the reference category at $p < .05$ which is not significantly different from eight years (middle) of education of headship. Graduate headship in the household has 20.833 times more likely to be food secure. Similar were the results found by [24, 25, 26, 23].

Households with family members of 4-6 and 7-9 were 97 percent less likely to be food secure and 10+ were 100 percent less likely to be food secure as compared to the reference category results are in line with [25, 20, 26].

Number of earners in a household had a positive impact on household food security situation. Households with two earners in the family were 10.183 times more likely to be food secure as compared to the reference category of one family earner. Households with three earners were 19.956 times more likely to be food secure and the households with four plus earners were 7.323 times more likely to be food secure. Odd ratios were less for four plus earners because they were unskilled. They were just included in the labor force, mostly in joint family system.

Ownership and tenancy status had a significant relationship with food security in the study area. Owners and tenants were 9 and more than 100 times more likely to be food secure as compared to the reference category of landless.

Households having two milking animals were 37.027 times more likely to be food secure than the reference category of having no milking animal. This confirms the earlier findings [23].

Location of the household was incorporated in the logistic regression to know whether the food security situation was better in rural or peri-urban areas. The analysis showed that peri-urban households were 32 percent less likely to be food secure as compared to rural households.

Households having zero net income were 8.146 times more likely to be food secure as compared to the reference category having negative net income. Households belonging to rupees 0-5000, 5001-10,000 and 20,000 plus income groups were 14.775, 15.056 and 10.988 times more likely to be food secure. The decrease in odd ratios was due to the reason that net income 20,000 plus group tend to save more even at the cost of food, in line with previous work [24 27, 28, 29, 21].

Household food security was improved when households received cash in form of gifts of from the relatives abroad as they were 7.664 times more likely to be food secure to the reference category not supported by the outside income.

Cox and Snell's R^2 was an attempt to imitate the interpretation of multiple R^2 based on the likelihood, but its maximum could be (and usually is) less than 1.0, making it difficult to interpret. Nagelkerke's R^2 was a further modification of the Cox and Snell coefficient to assure that it can vary from 0 to 1. That was, Nagelkerke's R^2 divided Cox and Snell's R^2 by its maximum in order to achieve a measure that ranges from 0 to 1. Therefore Nagelkerke's R^2 would normally be higher than the Cox and Snell measure (Nagelkerke, 1991). Nagelkerke R^2 value (0.624) means that the model has a strong predictive power.

CONCLUSIONS

It may be concluded from the above results that the proportion of food insecure households is high. Situation in rural areas was a little better than the peri-urban areas, perhaps due to the edge of self production. Further it is concluded that livestock assets, education level, number of earners in the household, household head's income, tenancy status, income in the form of aids and gifts from relatives had a positive impact on household food security and age of household head, family size and expenditure in the form of transfers had negative relationship with household food security. Keeping in view the importance of these determinants following suggestions are made for the policy makers to consider while designing and implementing the policy options;

- Special emphasis must be given to primary and secondary education through increasing the enrolments and improving the infrastructure. Technical education programs must be restructured and reforms must be planned for this aspect of education policy.
- Family planning programs should be made effective as to control the rapidly growing population through a comprehensive campaign through print and electronic media.
- Along with the long term plans it is the need of time to launch short and medium term projects for rural development through rural industries and allied disciplines.
- Guidance may also be sought from the Islamic Economics Welfare concepts.

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Annex-1

Food Composition Table for Pakistan (Revised 2001) Amount in 100g of edible portion

Sr. No	Name of Food	Kcal	Sr No	Name of Food	Kcal
A)	Cereal and Cereal Products		F)	Fruits	
1	Corn Whole grain flour	276	35	Apple	57
2	Rice Polished Fried	268	36	Banana Ripe	96
3	Vermicelli	345	37	Dates Dried	293
4	Wheat Whole grain flour	357	38	Dates Fresh	131
5	Wheat flour Granular	370	39	Guava Whole	73
6	Wheat Bread	369	40	Lemon	30
7	Wheat Bread	259	41	Lichi	62
8	Wheat Bread	364	42	Mango Ripe	64
9	Wheat Bread	293	43	Melon Water	23
10	Wheat Bread	263	44	Mandarin	44
11	Wheat Flour	440	45	Orange Sweet	43
B)	Legumes		46	Peach	47
12	Broad Bean Cooked	175	47	Pomegranate	66
13	Chickpea Cooked	187	48	Zizyphus	79
14	Lentil Cooked	178	G)	Dairy Products	
15	Mung Bean Cooked	120	49	Butter Milk	31
16	Mash Cooked	158	50	Curd	52
C)	Vegetables		51	Cream	361
17	Bath Sponge	18	52	Milk Buffalo Fluid Whole	105
18	Bottle Gourd	15	53	Milk Cow Fluid Whole	66
19	Bringal	26	54	Milk Goat Fluid Whole	70
20	Cauliflower	27	55	Yogurt	71
21	Cocumber	16	56	Ice-cream	148
22	Lady Finger	35	H)	Meat & Products	
23	Spinach	27	57	Beef	244
24	Tinda	23	58	Buffalo Meat	123

Annex-1: Continued

D)	Roots & Tubers		59	Chicken Meat	187
25	Carrots	37	60	Goat Meat	164
26	Onion	44	61	Sheep Meat	175
27	Potato	83	I)	Eggs	
28	Reddish	23	62	Chiken Egg White	400
29	Turnip	26	63	Duck Egg White (Raw)	895
E)	Spices & Condiments		J)	Fats & Oils	
30	Cumin Seed	336	64	Butter	721
31	Liquorice Root	212	65	Ghee	874
32	Clove	304	66	Ghee (Buffalo)	900
33	Turmeric	365	67	Lard (Raw)	899
34	Pepper Black	268	68	Dalda (Hydrogenated Oil)	892
69	Corn Oil	900	75	Jaleebe	395
70	Soybean	887	76	Koa (Whole Buffalo Milk)	401
K)	Sugar, Sweets & Beverages		77	Halwa Sohen	481
71	Sugar	380	78	Carbonated Beverages Pepsi, Coke, etc.	39
72	Gur	310	79	Lemon Juice	43
73	Honey	310	80	Mango Juice	74
74	Barfi	384			

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