The Determinants of Rural Household Food Security for Landless Households of the Punjab, Pakistan

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Abstract:

This paper examines the situation of food security for the landless rural households of the Punjab province in Pakistan. Primary data from 576 landless households were collected from 12 districts of the province. About 27% of the sample households were measured to be food insecure. Household's monthly income and household head's education levels of middle and intermediate were positively impacting household food security. On the other hand, household heads' age and family size were negatively associated with household food security. Rural household food security can be improved by focussing on education, creation of income generating opportunities and family planning programs.

Keywords: landless households, determinants, food security, rural areas, Punjab, Pakistan

JEL Classification: I30, Q18 and R20.

1 Introduction

Food insecurity is increasing in the world where 925 million people are undernourished. Out of them, about 900 million people are living in developing countries (FAO, 2010). More than 70% of these people live in rural areas and depend, directly or indirectly, on agriculture for their living. Usually, there are limited number of markets and less diversity and availability of food items in rural areas that affect food security of rural households (Morris *et al.,* 1992). The majority of the developing countries under-invest in the agricultural sector due to which these households are more vulnerable to price instability. A sharp decline was observed in the overall rate of growth in agricultural research and development investment in developing countries, since the late 1980s. The main focus of agricultural investment remained on exportable crops to generate foreign exchange that forced countries to rely on continued low international food prices to meet national food demand. This approach failed to fulfil the desired results (IAASTD, 2008).

In contrast, Pakistan achieved food self sufficiency in the 1980s, (Gera, 2004) and maintains its status of food self sufficient country (Bashir *et al.*, 2007; and 2012). The economy of Pakistan, being a transitory economy, depends mainly on its agricultural sector. It adds about 22% towards the total GDP and employs about 45% of the workforce. Moreover, the rural areas of the country are providing shelter to more than 65% of the population (GOP, 2011). Despite the fact that Pakistan is one of the largest producers of many agricultural commodities of the world (FAO, 2011) and having the status of food self sufficiency, 26% of the population is undernourished (FAO, 2010).

Punjab is the largest province, population wise, of the country. It is the home to more than 73 million people i.e. 55% of Pakistan's population (GOP, 1998). The agricultural sector of the province has the largest share in the country's agricultural GDP i.e. 57%. More than 70% of the households are landless in the province. To earn their livelihood, they are mostly engaged in informal activities (Anwar *et al.*, 2004). Such households are the most vulnerable ones to suffer from food insecurity (Yasin, 2000). This study aims to examine food security of the landless rural households of the Punjab province. Key research questions are;

1. What levels of food security are experienced by the landless households of the province?
2. Which socio-economic factors correlate with and best explain the levels of food security of these households?

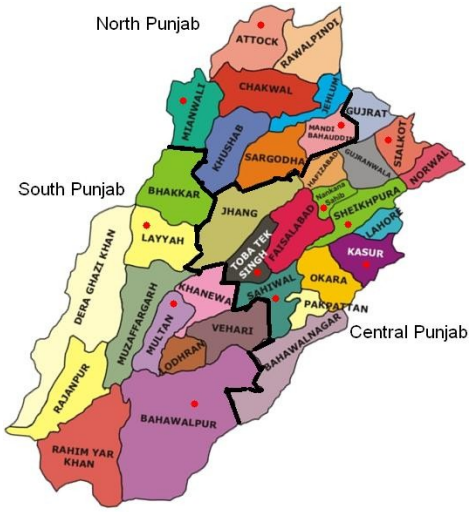
Results of this study are expected to provide useful information both for policy makers and researchers in their efforts to improve rural household food security. Rest of the paper is organized as follows: methodology is presented in section 2; results are presented and discussed in section 3and section 4 concludes the paper.

2 Methodology

Data Collection

The province was sub-divided into three regions on the basis of homogeneities in geographical characteristics. The province has 36 districts. The districts situated in the south of the Province and have desert and mixed characteristics of desert and plains were kept together to formulate South Punjab region. The districts having characteristics of plains only were jointly termed as Central Punjab region and those districts that are situated 350-900 meters above the sea level formulated North Punjab region. The regions were asymmetric in terms of district numbers i.e. 11, 17 and 8 in South, Central and North Punjab, respectively. It was decided to collect data from one third of the total districts (i.e. 12) to make it a representative sample of the districts. A proportionate sampling procedure was adopted to finalize the number of districts from each region that came out with 3, 6 and 3 districts from each region, respectively. The districts were selected on basis of homogeneity in district population, villages (numbers) and availability of irrigation water.

Figure 1: Sub-regions and district selection



One percent of the total villages were randomly selected from each district. This came out to be 72 villages (i.e. 6*12). From each village, 8 landless households were selected, randomly. The total sample size, thus, numbered 576 households (i.e. 72*8).

The required information was collected using a well designed interview schedule. Detailed information on various aspects relating to food security including household size, household type, household income, expenditures, ownership of livestock asset and food intake were obtained from the household heads.

Data analysis

Data were analysed in two stages: stage one calculates the household food security status; and stage two finds out the determinants of food security.

Food security status of the landless households was measured by calculating their per capita calorie intakes[1] using a 7 days recall method. The calculated calories were converted into per capita intakes after adjusting to adult equivalent units to cancel out the impacts of age and gender differences (see Annex-II). The calculated per capita calorie intake was, then, compared to a threshold level defined by the Government of Pakistan for its rural areas i.e. 2450 Kcal/capita/day (GOP, 2003). The households whose per capita calorie intake were equal to or above this threshold level were considered as food secure households. Mathematically defined as:

$$Y_i = \sum^{i=n} C_i^{ad} \geq 2450 \qquad (1)$$

Where;

Y_i is the food security status of ith landless household (1 for food secure and 0 for food insecure),

C_i^{ad} are the adjusted calorie intakes of ith landless household, and

n is the sample size i.e. 576

Despite the criticism on the dietary intake method, the selection is justified because the selected households belong to the lowest income group who often have to deal with uncertainty their food provisioning on a daily basis (Yasin, 2000). For them, filling their stomachs is more important than to choose from a tastier food. To avoid ambiguities due to lack of consensus on thresholds and to ensure maximum precision, the threshold level defined by the Government of Pakistan for rural households is used.

Determinants of rural household food security for the selected household category were identified using a binary logistic regression model. The binary form of the dependent variable i.e. '0' for food insecure and '1' for food secure, guided us to use this model (see for example Feleke *et al.*, 2005; Babatunde *et al*., 2007 and Bashir *et al.*, 2010). The probability of the occurrence of an event for more than one explanatory variable is directly estimated using this model (Hailu, and Nigatu, 2007). Assuming a linear relationship between food security status and various explanatory variables, the function Y_i can be written as:

$$Y_i = \sum^{i=n} \beta_i X_i + e_i \qquad (2)$$

Where, β_i represents the coefficients of the model, X_i represents the vector of socio-economic factors, and e_i is the error term.

As the dependent variable is in a binary form, the model can be re-written in terms of the probability of a household becoming food secure as:

$$\wp_i = \wp(Y_i = 1 \mid X_i = x_i) + e_i \qquad (3)$$

Where, $\wp_i$ is the probability of ith household becoming food secure, x_i is the vector of socio-economic factors, and e_i is the error term.

The general form of logit can be written for equation 3 as:

[1] Calories were calculated from Annex-I

$$\log it(\wp_i) = \beta_o + \beta_i x_i \qquad (4)$$

Equation (4) can be re-written for the explanatory variables as:

$$\wp_i(Y_i) = \beta_o + \beta_1 HHMI_i + \beta_2 AHHH_i + \beta_3 HHS_i + \beta_4 TEHH_i + \beta_5 HHT_i + \beta_6 OL_{Li} + \beta_7 OL_{Si} + \beta_8 Edu_{Pi} + \beta_9 Edu_{Mi} + \beta_{10} Edu_{Ii} + \beta_{11} Edu_{Gi} \qquad (5)$$

Where:

$\wp_i(Y_i)$ = Probability of the ith household to become food secure (dummy 0/1)

β_0 = Constant term

β_{1-11} = Coefficients of the explanatory variables

$HHMI_i$ = Monthly income of the ith household (Pak Rs)

$AHHH_i$ = Age of the ith household head (years)

$TEHH_i$ = Total number of earners in the ith household (numbers)

HHT_i = Household type (dummy '0' = nuclear and '1' = joint)

OL_{Li} = Ownership large livestock (cows and buffalos) animals by the ith household (numbers)

OL_{Si} = Ownership small livestock (goats and sheep) animals by the ith household (numbers)

Edu_{Pi} = Educational level of the ith household's head, (dummy, '0' = otherwise and '1' = primary i.e. completed five schooling years = grade 5)

Edu_{Mi} = Educational level of the ith household's head (dummy, '0' = otherwise and '1' = middle i.e. completed eight schooling years = grade 8)

Edu_{Ii} = Educational level of the ith household's head (dummy, '0' = otherwise and '1' = up to intermediate i.e. completed ten or twelve schooling years = grade 10 and/or 12

Edu_{Gi} = Educational level of the ith household's head (dummy, '0' = otherwise and '1' = graduation or above

3 Results and Discussion

Table 1 shows the results for food security situation of the selected landless households of the Punjab province. According to the results, more than 27% of the sample households are measured to be food insecure. This is alarmingly high compared to an earlier study for Faisalabad district of the same province. About 20% the sample semi-rural households (i.e. landless households living in semi-rural (peri-urban) areas) were measured to be food insecure (Bashir *et al.*, 2010). This implies that the situation has worsened for the landless household during one year's time period. The incidence of food insecurity is higher than the average undernourishment in the country i.e.26% (FAO, 2010).

Table 1. Food security status

	Frequency	Percent
Food insecure	156	27.1

Food secure	420	72.9
Total	576	100.0

Data source: Field survey, 2010-11

Descriptive statistics

The results of descriptive statistics are presented in Table 2. It is evident from these results that the lowest calorie intake of these households was as low as 590 Kcal/capita/day which is very low. On the other hand, the highest calories intake was about 5000 Kcal/capita/day suggesting a great diversity in food intake. The average calorie intake was about 3000 Kcal/capita/day which is above the threshold level. The minimum household monthly income was Rs 3000 which is far less than government's announced minimum wage rate of Rs 7000. The average monthly income was slightly above Rs 13000 with the highest income of Rs 49000. The age of household head ranged from 23 to 75 years with an average of 45 years. Average household size of selected households was 6 persons per household with minimum of 2 and maximum of 18 members. Numbers of earners in a household, ownership of both livestock assets (large and small animals) ranged from 1 to 5, 0 to 15 and 0 to 10, respectively.

Table 2: Descriptive Statistics

	Min	Max	Mean
Per capita calorie intake	590.1	4980.2	3005.9 (879.1)
Income	3000.0	48791.7	13210.1 (6424.1)
Age	23.0	75.0	45.1 (10.4)
family size	2.0	18.0	6.4 (2.3)
Earners	1.0	5.0	1.3 (0.6)
Livestock (large animals)	0.0	15.0	0.7 (2.3)
Livestock (small animals)	0.0	10.0	0.5 (1.6)

Data source: Field survey, 2010-11

Determinants of household food security for landless households

The results of the binary logistic regression are presented in Table 3. According to the results 5 variables are statistically significant. In terms of predictive efficiency, the model predicted with about 80% accuracy (see Table 3 above). The result of Hosmer and Lemeshow (H-L) test is non-significant at $p>0.05$, suggesting the acceptance of the null hypothesis that the model fits to the data well. On the other hand, the values of Cox & Snell and Nagelkerke R^2 explain that the model explains 27 and 39% variations in the data, respectively. These measures are also known as pseudo R^2 and their results cannot be tested in an inferential framework (Menard, 2000) hence are not a good measure of goodness of fit (Hosmer and Lemeshow, 2000).

The estimates of the probabilities, in binary regression, are explained in terms of the odds-ratios (ORs)[2]. The results of significant variables are explained below:

Household's monthly income is the total monthly income of the household from all sources. The coefficient of this variable is positively significant implying a positive relationship between food security and monthly income. The magnitude of coefficient is small suggesting that the impact of monthly income must be explained for an increase of Rs 1000 instead of a one rupee increase. This can be done by converting the value of the coefficient into OR for an increase of Rs 1000 as; $\exp^{0.0001*1000} = 1.105$. An increase of Rs 1000 in monthly income of a

[2] This is *the ratio of the odds of an event occurring in one group to the odds of it occurring in another group* (Grimes and Schulz, 2008).

household increases the chances of food security by 1.105 times or by 10.5%[3]. Earlier, Bashir *et al.*, (2012) found that an increase of Rs. 1000 increases the chances of rural households to become food secure by 5%. Similarly, using categorical variables, Bashir *et al.* (2010) also found a positive impact of income on food security. They found that the households belonging to the income group of Rs 5001–10000, had 15 times more chances of achieving food security compared to the households who belonged to the income group of Rs 0-5000 ($0 – 55). For India, Sindhu *et al.* (2008) using the same analytical technique for India, found that the chances of food security increases by 30% with an increase of 1000 Indian Rupees in monthly incomes. In a different context, Onianwa and Wheelock (2006) found that chances of a household to become food secure increases by 5% with an increase of households' annual income by $1000 for a family without children in the USA. These income effects on food security are relatively high compared to our finding perhaps due to the socio-economic differences of the study areas.

The age of the household head has a negative sign showing an inverse relationship between the age of household head and food security. It indicates that an increase of age year in the age of household head decreases the chances food security by 4.5%. The younger people are stronger than the elders and can perform tougher jobs in field. Moreover, households with older heads are the multigenerational households having more retired and/ or older persons to feed. This may explain the negative effect of this variable on household food security. In a related study, Bashir et al. (2012) found that an increase of one year in the age of household head decreases the chances of a household to become food secure by 3%. Similar relationship was observed by Titus and Adetokunbo (2007) for Nigeria using a different statistically technique. On the contrary, for USA, it was found that one year increase in the age of household head decreases the chances of a household to become food insecure by 2% (Onianwa and Wheelock, 2006).

Household size also has a negative sign explaining the negative impact on food security. An increase of an additional member decreases the chances of food security by 0.582 times i.e. 41.8%. A finding similar what Bashir *et al.* (2012) found in an earlier study. They found that an increase of an additional family member decreases the chances of a household to become food secure by 31%. Earlier in 2010, for an adjacent district to our study area Bashir *et al.*, found that households with large families of up to 9 members in the household were about half food insecure compared to the household with smaller family size of 4 to 6 members. In India, Sindhu *et al.* (2008) found that an increase in one family member increases the chances of a household becoming food insecure by 49%.

It was found that household heads having education levels of middle (8 years of schooling i.e. grade 8) and up to intermediate (10-12 years of schooling i.e. grade 10 or 12) has positive impacts on household food security. Having these education levels the chances of a household increases by 99.9 and 177.1%, respectively. This implies that at least intermediate level of education is a necessary condition to assure food security to the selected household category. Similar effect of education level of up to intermediate was found by Bashir *et al.* (2012). They found that having this particular education level increases the chances of a household by 99%. Similarly, Bashir *et al.*, (2010) found using categorical variables that graduation level of education increases the odds of a household to become food secure by 21 times compared to having no education. Other studies have also pointed out the positive effect of higher education on decreasing chances of household food insecurity (i.e. improving chances of food security) by 0.408 times (59%) in Nigeria (Amaza *et al.*, 2006) and 0.712 times (29%) in the USA (Kaiser *et al.*, 2003). The difference of the magnitudes in earlier

[3] Percentage = (OR-1)*100 ➔ (1.105-1)*100 = 10.5%

studies and the current study may be due to the socio-geographical situations of the study areas.

Table 3. Results of Binary Regression

Variables	β	SE	OR
Household Monthly income ($HHMI_i$)	0.0001***	0.000	1.0001
Age of Household Head ($AHHH_i$)	-0.046***	0.012	0.955
Household Size (HHS_i)	-0.541***	0.070	0.582
Total Earning Household Members ($TEHH_i$)	0.087	0.180	1.091
Household Type (HHT_i)	-0415	0.308	0.660
Ownership of Livestock (large animals) (OL_{Li})	0.097	0.166	1.102
Ownership of Livestock (large animals) (OL_{Si})	0.006	0.211	1.006
Education Level of Household Head (primary) (Edu_P)	0.270	0.264	1.309
Education Level of Household Head (middle) (Edu_M)	0.693*	0.419	1.999
Education Level of Household Head (up to intermediate) (Edu_I)	1.019**	0.423	2.771
Education Level of Household Head (Graduation +) (Edu_G)	0.134	0.489	1.143
Constant	5.217***	0.769	N/A
Model Prediction success	79.9%		
Log-likelihood ratio test statistics	494.142		
H-L model significance test results (df = 8)	7.627 (p-value = 0.471)		
Cox & Snell R^2	0.267		
Nagelkerke R^2	0.387		

*** significant at < 1 %; ** significant at < 5 %; * significant at <10% | Data source: Field survey, 2010-11

Relative importance of the factors to food security of landless households

The relative importance of the factors identified above with food security of landless households can be explained in terms of the comparison of the magnitudes of their coefficients (Omotesho *et al.*, 2007; Mengistu *et al.*, 2009; and Bashir *et al.*, 2012). This compared these factors in terms of the effects they have created on the food security of landless household. We can rank them for their relative importance with food security as:

1. Education level (up to intermediate) increases the chances for a household to become food secure by 177%.
2. Education level (middle) increases the chances for a household to become food secure by 99.9%.
3. Increase of Rs 1000 in monthly income increases the chances of a household to become food secure by 10.5%.

For negative impacts the important factors can be grouped together as:

4. Increasing household size decreases the chances of a household to become food secure by 42%.
5. Increasing age of household heads decreases the chances of a household to become food secure by 4.5%.

Earlier, education topped the ranks (for positive rankings)in the ranking by Bashir *et al.*, (2012) for rural households of the Punjab followed in order by livestock assets and monthly income. On the contrary, for Nigeria, Omotesho *et al.*, (2007) found household size to be the most important factor to effect household food security. According to them, expenditures on

food and access to health facilities were the 2nd and 3rd most important factors, respectively. The relative importance of factors, however, is expected to vary for varying socio-geographical conditions.

4 Conclusion

From the above discussion it may be concluded that food insecurity is on the rise in rural areas of the Punjab province of Pakistan i.e. 27% food insecure households compared to an earlier measurement of 20%. Households' monthly income and household heads' education levels of middle and intermediate were significantly improving food security. On the other hand, household heads' age and household size were deteriorating food security.

The study is one of the initial studies to rank the factors for their relative importance with food security. Education level of intermediate (10 to 12 years of schooling) was at the top of the list followed in order by education level of middle (8 years of schooling) and monthly income. Similarly, a negative impact ranks were also created and household size was at the top of this list followed by the age of household head. The ranking of the factors for their relative importance to food security provides an important 'to do list' to the government and policy makers in order to improve household food security. The ranks are expected to vary with regions and household categories. The ranking of the factors for their relative importance to food security is relatively a new idea in food security subject area and needs further refinement.

To improve household food security of the selected household category, following suggestions can be made from the above results:

1. Reforms must be introduced in education system to make it productive in terms of food security. Special emphasis must be given to education for every member of the household.
2. Improvements in income earning opportunities should also be made; for this purpose the idea of cottage industries may serve as a base point.
3. Family planning programs should be made effective as to slow down the pace of population growth

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Annex-I

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

No	Name of Food	kcal	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
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			

Source: AIOU, 2001

Annex-II

Adult Equivalent Units

Age groups (years)	Male	Female
< 1	0.43	0.43
1-3	0.54	0.54
4-6	0.72	0.72
7-9	0.87	0.87
10-12	1.03	0.93
13-15	0.97	0.80
16-19	1.02	0.75
20-39	1.00	0.71
40-49	0.95	0.68
50-59	0.90	0.64
60-69	0.80	0.51
70+	0.70	0.50

Source: NSSO, 1995