



Regional distribution of food security and its determinants across regions of the Punjab, Pakistan



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INTRODUCTION

The term food security originated in international development literature in the 1960s and 1970s. Over time, a large number of different definitions of food security have been proposed.

FAO (2015) 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".

Despite the recent decrease in the number of undernourished people around the world, still, about 795 million people (as shown in figure 1) are food insecure. From these 795 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).

The extent of food insecurity can vary both spatially and temporally (Iftikhar and Mahmood, 2017). Food security is affected by multiple factors like age of household head, educational status of household head, family size, farm land size, dependency ratio, livestock asset, income. Importance of these factors may vary from society to society and over time. It means one policy to overcome food insecurity is not good enough. We need different policies at various levels to tackle food insecurity (Muche *et al.*, 2014). Having enough food is not sufficient for food security. Countries with sufficient food at national level might also have food insecure people due to unequal distribution of food within country. For example, Pakistan became self-sufficient in food at national level in 1980s and sustains this status (Bashir *et al.*, 2013), yet a considerable proportion population i.e. 22% is food insecure (FAO *et al.*, 2015). An even greater proportion (58%) was reported by National Nutrition Survey (NNS, 2011). The Punjab province of Pakistan has major share in country's agricultural production and yet has significant food insecure population i.e. 23% (Bashir *et al.*, 2013) and 59.5% (NNS, 2011). The difference between reported food insecure proportions can be explained by sensitivity of food security towards measuring instrument. Bashir *et al.* (2013) used dietary intake assessment only, while National Nutrition Survey (NNS, 2011) have taken into account caloric intake, anxiety and perceptions of people regarding quality and quantity of food. As noted earlier, food security may vary spatially. This study was designed to check the spatial distribution of food security in rural Punjab.

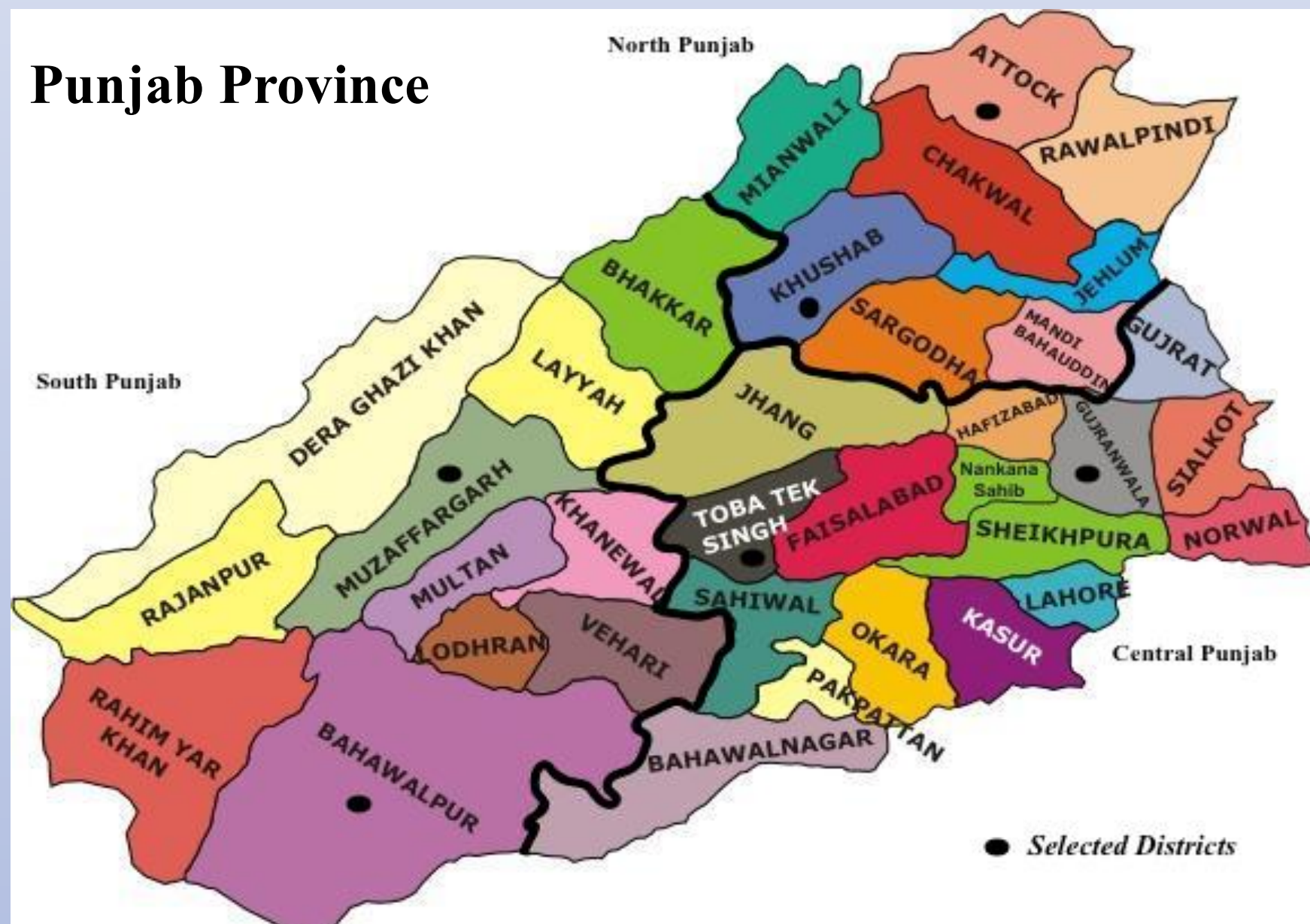
MATERIALS AND METHODS

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. A total of 6 districts (2 from each region) were selected randomly. Then from each randomly selected district, 4 villages were selected randomly. On average, every village contains almost 200 households and majority of the households (i.e. > 80%) are either small farmer or non-farmer households (GOP, 2010). Data were gathered from 12% (576) of these households. A structured interview schedule was developed to gather information on different facets of food security. Data were gathered in two sections. In first section, demographic and general data of household was gathered; second section was about intake of different food items. All participants provided informed consent before the survey was started.

Empirical Model:

Empirical analysis for this study was conducted in two steps. At first step, households' food security status was measured for each region by calculating per capita calorie intake through Dietary Intake Assessment (DIA) using seven days reference period. Calculated calories were then altered according to age and gender of the household members using caloric adjustment used by

Punjab Province



National Sample Survey Organization (NSSO, 2007). DIA method was used because it measures actual food consumption and it deals with dietary quality and quantity and can also identify at risk households and individuals. Also, target households in this study are from the less privileged group and they are very vulnerable to being food insecure (Yasin, 2000).

For such households, filling their bellies is a bigger concern than eating a tastier food. Different threshold levels of dietary intake were used by different researchers but for this study, threshold level given by Government of Pakistan (2450 Kcal/adult/day) for rural areas (GOP, 2003) was used.

Mathematically, it can be elaborated as

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

Where, FS_{ij} is food security status of i^{th} household ($i = 576$) of j^{th} category ($j =$ North, Central and South Punjab) and T is food security threshold for rural areas.

At second step, to identify food security determinants, binary logistic regression was used because food security (dependent variable) was binary variable. Probability of occurrence of an event can be obtained through logistic regression when a number of independent variables are at work (Hailu and Regassa, 2007).

Suppose food security and socio-economic factors have linear relationship, food security can be elaborated as

$$FS_{ij} = \sum_{i=1}^n \beta_i S_{ij} + \epsilon_i \quad (2)$$

Where: β_i denotes the coefficients; S_{ij} denotes the vector of socio-economic characteristics; and ϵ_i represents error term.

We can rewrite equation 2 as probability of a given household being food secure or insecure using the logistic distribution function narrated by Gujarati (2009) as;

$$P_{ij} = E(FS_{ij} = 1 | S_{ij}) = \beta_0 + \beta_1 S_{ij} \quad (3)$$

Where, P_{ij} is the probability of i^{th} household of j^{th} category to experience food security 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;

$$P_{ij} = E(FS_{ij} = 1 | S_{ij}) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 S_{ij})}} \quad (4)$$

RESULTS

For convenience, the equation 4 can be written as;

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

Where

$$Z_i = \beta_0 + \beta_1 FSt + \beta_2 DRd + \beta_3 FmS + \beta_4 HHA + \beta_5 MI + \beta_6 LS + \beta_7 HHEdu + \beta_8 LO + \beta_9 DMr + \beta_{12} EM + \epsilon_i \quad (6)$$

Where, β_0 = constant term, β_{1-12} = coefficients of socio-economic variables. **FSt** = family structure of the household (Nuclear or Joint), **DRd** = distance between household and road, **DMr** = distance between household and market, **FmS** = family size, **HHA** = household head's age, **MI** = monthly income (Pakistani Rupees) from all sources, **HHEdu** = household head's education level (years of schooling), **LO** = land owned (acres), **EM** = total earning members in the household.

Table 1: Demographic characteristics of the respondents

Variables	North	Central	South	Total
Age	f (%)	f (%)	f (%)	f (%)
Up to 35	38 (19.8)	26 (13.5)	42 (21.9)	106 (18.4)
36-55	93 (48.4)	111 (57.8)	106 (55.2)	310 (53.8)
>55	61 (31.8)	55 (28.6)	44 (22.9)	160 (27.8)
Family size				
Up to 4	37 (19.3)	28 (14.6)	21 (10.9)	86 (14.9)
5-8	103 (53.6)	102 (53.1)	107 (55.7)	312 (54.2)
>8	52 (27.1)	62 (32.3)	64 (33.4)	178 (30.9)
Earning members				
1	83 (43.2)	102 (53.1)	78 (40.6)	263 (45.7)
2-3	91 (47.4)	69 (36.0)	90 (46.9)	250 (43.4)
>3	18 (9.4)	21 (10.9)	24 (12.5)	63 (10.9)
Family structure				
Nuclear	97 (50.5)	92 (47.9)	74 (38.5)	263 (45.7)
Joint	95 (49.5)	100 (52.1)	118 (61.5)	313 (54.3)
Education of HH head				
Illiterate	75 (39.1)	76 (39.6)	88 (45.8)	239 (41.5)
Primary (5 years)	29 (15.1)	37 (19.3)	33 (17.2)	99 (17.2)
Middle (8 years)	30 (15.6)	37 (19.3)	28 (14.6)	95 (16.5)
Matric (10 years)	43 (22.4)	30 (15.6)	34 (17.7)	107 (18.6)
>10	15 (7.8)	12 (6.3)	9 (4.7)	36 (6.3)

Figure 1: Regional distribution of food security according to Household Dietary Diversity (DIA) score



Results

Table 2: Determinants of food security by regions

Variables	North		Central		South	
	B (SE)	OR	B (SE)	OR	B (SE)	OR
FSt	-3.07 (0.52)**	0.08	-5.35 (0.85)**	0.06	-2.00 (0.44)**	0.135
MI	0.00007 (0.00)**	1.00007	0.00006 (0.00)*	1.00006	0.00009 (0.00)**	1.00009
FmS	-0.04 (0.07)	0.97	-0.46 (0.13)**	0.631	-0.33 (0.08)**	0.720
LS	1.08 (0.46)*	0.34	1.17 (0.72)	1.621	0.90 (0.44)*	0.406
LO	0.11 (0.06)	1.11	0.16 (0.05)**	1.173	0.11 (0.03)**	1.111
HHEdu	0.41 (0.16)*	0.66	0.31 (0.22)	0.735	0.24 (0.11)*	1.271
HHA	0.03 (0.02)	1.03	0.02 (0.02)	0.976	0.03 (0.02)*	1.034
EM	0.09 (0.19)	1.09	0.81 (0.31)**	1.31	0.16 (0.16)	1.172
DRd	-0.07 (0.07)	0.94	-0.18 (0.07)	1.196	-0.22 (0.12)	0.801
DMr	-0.03 (0.03)	1.03	-0.01 (0.04)	1.008	-0.07 (0.04)	1.069
Constant	3.67 (1.45)*		7.49 (1.92)**		2.56 (1.29)*	
Log likelihood	162.000		100.227		168.333	
H-L model (df = 8) significance test results	18.741 (p value=0.016)		8.865 (p value = 0.354)		13.092 (p value = 0.109)	
Cox & Snell R ²	0.418		0.576		0.353	
Nagelkerke R ²	0.558		0.769		0.483	

Table 3: Comparison of the ranks of significant factors

Ranks	North Punjab		Central Punjab		South Punjab	
	Factors	Impact	Factors	Impact	Factors	Impact
Positive impacts						
1	Livestock	66%	Earning members	31%	Livestock	59.4%
2	Education	34%	Land ownership	17.3%	Education	27%
3	Monthly income	7.2%	Monthly income	6.1%	Land ownership	11%
4					Monthly income	9.4%
5					Age	3.4%
Negative impacts						
1	Family structure	92%	Family structure	94%	Family structure	86.5%
2			Family size	37%	Family size	28%

CONCLUSION

It is statistically proven that households from each region of the Punjab experience different level of food security. According to the findings of this study as we go from North to South, level of food insecurity increase. Determinants of food security also vary in each region when ranked according to their importance to food security. Family structure and monthly income were significant determinants for all regions. Results suggest that a single policy cannot be used to overcome the food insecurity issue in different regions of the Punjab. Different kind of policy focus, depending upon the determinants, is required to tackle food insecurity in each region of the Punjab.

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