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Food Security Challenges in Rural Pakistan: Analyzing the Socio-Economic and Farming Dynamics

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ABSTRACT: Despite being an agrarian economy, food insecurity is a major challenge in Pakistan. This highlights the need for deeper insight for ensuring food availability and affordability for all. The study aimed to explore the root causes of household food insecurity in Punjab province. Primary data on structured questionnaire was collected from 237 farming households based on multi-stage cluster sampling technique. The analysis of the data revealed that fewer than two-thirds of households had reliable access to food in Punjab. The logistic binary regression provided insights about determinants of food security at household level. The larger families, typically those with four or more members, were found to be relatively more food secure. The older household heads and those with limited education were observed to be vulnerable to food insecurity. The availability of agricultural resources, such as tractor ownership and land title, indicated better chances of being food secure. However, the livestock and irrigated land was found to have poor odds of food security. This could be due to challenges associated with effective management of these assets. It was concluded that education, particularly up to primary level, may be imparted to the rural households for increasing food security in the short-run, targeted support for larger families was required to maximise their labor potential, and small-scale farmers needed to be provided better access to farm machinery and land title or land tenure security.

KEYWORDS: Food Accessibility, Odds of Being Food Secure, Joint Family System, Education Level, Agricultural Mechanization, Land Ownership, Logistic Binary Regression

Introduction

Food insecurity is a harsh reality and a serious issue round the globe. The developing countries are especially grappling with food insecurity which can affect overall wellbeing of the people and push them into vicious cycle of poverty and underdevelopment. The concept of food security is very comprehensive, and it goes much beyond mere production of enough food in certain country. Rather, it means all the people should be able to consume food of their choice, in adequate quantity, with necessary nutrients and all the time (FAO, 1996).

Various risks associated with food insecurity include e.g. crop production failures, unstable employment, or unpredictable income fluctuations. Food insecurity can be a short-term challenge or an ongoing struggle that affects people for months or even years. Temporary food insecurity might be triggered by factors like

volatile food prices, poor crop yields or job insecurity. It makes it tough for households to plan ahead. On the other hand, chronic food insecurity is often deeply engrained in poverty. Chronic food insecurity is a big challenge that many households face day after day. Repeated episodes of temporary food insecurity can gradually push households into chronic food insecurity and this situation creates a vicious cycle that is hard to break (Re'tlinger & van llolst Pellekaan, 1986).

Measuring food security is not simple because it takes a multidimensional approach that looks at beyond people have enough to eat. Various indicators are incorporated to get an accurate picture of food insecurity. At the national level, key factors like food production, food demand, and its imports are carefully considered. However, the assessment of food security at the household level uses a common benchmark of daily calories intake per person. This calculation helps determine whether a household is meeting its nutritional needs or not. To gain a deeper look at food insecurity at an individual level, physical measurements such as body size and composition are assessed that provide valuable insights into past nutrition and overall health conditions. A comprehensive approach to measure food security involves four critical factors i.e. ensuring the availability of food, facilitating access to it, promoting proper utilization, and maintaining stability. Together, these elements provide a complete picture of food security. It enables targeted interventions and sustainable solutions.

Pakistan is home to large population of 241.5 million people. With an annual growth rate of 2.55%, Pakistan is the 5th most populous country globally (GoP, 2023). If this rapid growth continued unabated, the population is projected to double by 2050, posing significant challenges for the country's resources and infrastructure. Food security in Pakistan remains a pressing concern that affects both the nation and individual households despite the agriculture sector plays a vital role in the economy, contributes 24.0% to GDP and employs a substantial 37.4% of the workforce (GoP, 2024). Food grain production has increased a lot since 1947, but fast population growth has reduced the benefits of this increase. This shows an urgent need for new and effective ways to solve the problems of food security. Everyone should have fair access to healthy food. Finding long-term solutions is important for the well-being of Pakistan's growing population.

The 2018 National Nutritional Survey of Pakistan revealed a concerning reality: 36.9% of households faced food insecurity. This broke down into 18.3% experiencing mild food insecurity, 7.6% dealing with moderate insecurity, and 11.1% grappling with severe food insecurity. Children under five in Pakistan also faced significant nutritional challenges: 17.7% suffered from wasting due to acute malnutrition, signaling a nutrition emergency. Furthermore, 28.9% of young children were underweight, highlighting the prevalence of chronic undernutrition issues in Pakistan (GoP, 2018). Pakistan's ranking on the Global Hunger Index 2024 is 109th out of 127 countries, with a score of 27.9, indicating a "serious" level of hunger. This ranking suggests that Pakistan still faces significant challenges in addressing hunger and malnutrition (Miriam Wiemers & Holger Mann, 2024). Targeted interventions are crucial to tackle Pakistan's complex food security challenges. These efforts can help alleviate hunger, malnutrition, and related issues of vulnerable population in Pakistan.

This study seeks to conduct an in-depth analysis of food security at household level in Pakistan. It pinpoints the key factors that influence food security and offers actionable solutions along with policy recommendations. The article is organized into four main sections: an introduction that frames the topic; a literature review offering insights from relevant studies; a methodology and data analysis section detailing the

research approach; and results and discussion that present key findings and their implications. It concludes with a summary and policy recommendations aimed at improving household food security in Pakistan.

Literature Review

Many farming households in Punjab face food insecurity due to low incomes, unequal resource distribution, limited market access, and persistent poverty. These economic, social, and structural challenges hinder their ability to meet their own food needs. Targeted interventions can help improve incomes, market access, and social support, particularly for vulnerable smallholder and marginalized households. By addressing these issues, Punjab's farming communities can better achieve food security. Many farming households in Punjab were food insecure. Various studies reported food insecurity rate between 23% and nearly 50% in Punjab, Pakistan. The rates varied depending on the region and measurement method of food insecurity.

Saini et al. (2022) studied the Indian Punjab and concluded that marginal and small farm households faced food insecurity, low economic surplus, and high-income inequality. It recommended sustainable development through promoting high-value crops, livestock improvements, non-farm employment, and better access to education. Ahmed et al., (2017) found similar results for rural Punjab in Pakistan. Food insecurity was especially acute among marginal and small farm households. These households often could not cover their basic needs from agricultural income. Many households were not only food insecure but also vulnerable to chronic insecurity. They faced risks like price shocks, crop diseases, and health expenses. In a similar study of rural areas in Punjab, Azeem et al. (2016) also highlighted similar risks for population vulnerable to food insecurity.

Naz et al. (2020) explored dynamics of food insecurity on Pakistan and found that low and unevenly distributed income was a central cause of food insecurity. High dependency on agriculture and expenditure exceeding earnings also contributed to the issue. Many families were trapped in poverty and could not afford adequate food. Distance from market, limited market infrastructure, and high transportation cost reduced food security. Munawar et al. (2021) found that family related factors also increased costs and limited access to diverse foods. These factors included larger family size, lower education levels, and fewer family assets.

Ahmed et al. (2024) noted that women played a crucial role in food production and allocation. However, their empowerment, education, and economic autonomy were often limited in Pakistan. Nawaz et al., (2022) described that the broader issues, like water scarcity, inflation, and weak social safety nets, made food insecurity worse for the vulnerable population. The education of the household head, especially the mother, was closely linked to better food security. Families with household heads who were illiterate or had low education levels had more food insecurity (Akbar et al., 2023).

Hameed et al. (2024) in a comparative study of food and nutrition in Pakistan concluded that larger family sizes and higher dependency ratios increased the risk of food insecurity. Extended families and households with more dependents were especially vulnerable for food insecurity. They also suggested that female-headed households and those with lower maternal employment were more prone to food insecurity.

Pervaiz et al. (2017) found that ownership of agricultural land and livestock was strongly linked to lower food insecurity. Households without these assets faced much higher rates of food insecurity. Similarly, they found that larger farms, access to irrigation, and owning farm equipment (like tractors) helped improve food

security. Being close to markets, having good roads, and lower transport costs also made a big difference in the incidence of food insecurity.

Asghar and Muhammad (2013) by analyzing data from PSLM Survey for Pakistan showed that farming and agricultural activities helped reduce food insecurity in Pakistan. Meanwhile, rising food prices and inflation worsened food insecurity, especially for low-income households in rural areas. Babar (2020) conducted an empirical study to find out the incidence, depth and determinants of food insecurity in Pakistan. He concluded that households with older, educated heads and multiple earners tended to have better food security. It was also suggested in this study that the social welfare programs and religious charity in Pakistan helped mitigate severe food insecurity.

Mengistu and Kassie (2022) found the similar findings regarding socio-economic characteristics of food insecure households in Ethiopia. They acknowledge the importance of educated household heads and multiple earners within a household. On the other hand, Seligman et al. (2010) explored the medical related causes and future implications of food insecurity in developed country like USA. They found that food insecurity among poor adults aged 18–65 was associated with higher levels of blood pression and cholesterol. Thereby, food insecurity contributed to cardiovascular risk factors. They highlighted the need for policies that improved access to healthy and affordable food.

Households with larger farms, irrigation, secure land, and livestock tended to have better food security due to increased crop yields, stable income, and diverse food sources, making them more resilient to food shortages. The relevant literature indicated that larger farm sizes were consistently linked with lower food insecurity because they allowed for higher yields and more stable household food supplies. Households with more land were less likely to experience food shortages, especially when family size was also considered. Larger families with small landholdings were at higher risk, while larger families with more land were relatively more secure (Amare & Simane, 2017; Feyisa et al., 2023; Herrera et al., 2021).

Mudzielwana et al (2022) looked into the relationship of land ownership and food security in South Africa. They described that the secure land tenure whether through ownership or rental helped improve food security by allowing households to invest in farming and reap the benefits of their agricultural production. Hlatshwayo et al. (2023) showed that access to irrigation systems significantly improved crop productivity and food security in Africa because it reduced dependence on rainfall and increased the reliability of harvests. Farmers who owned tractors tended to be more productive and it helped alleviate food insecurity by making farming more efficient.

Getaneh et al. (2022) conducted comprehensive research and recommended that the livestock ownership, especially of diverse and larger herds, was positively associated with household food security. Livestock provided direct food sources (milk, meat, eggs) and could be sold for income. It improved the dietary diversity and resilience against food shortages. Danso-Abbeam et al. (2024) described that the type and number of livestock mattered. Households with mixed herds (poultry, small and large animals) experienced greater food security benefits.

In Pakistan, larger family size and high dependency ratios are key drivers of food insecurity, especially when resources are limited. To address this, strategies could focus on education, economic opportunities, and social support, particularly for vulnerable households. Shair et al. (2024) researched and found that

households with more members faced a significantly higher risk of food insecurity. For example, families with 16–21 members had food insecurity rates as high as 84.91%, compared to much lower rates in families with only 2–5 members. Larger family sizes increased the strain on household resources, making it harder to meet the nutritional needs of all members, especially when income and assets were limited. Tan et al. (2023) analyzed post Covid-19 scenario in Malaysia. They concluded that a high dependency ratio further worsened food insecurity. Households with more children or elderly members were less able to generate sufficient income which increased their vulnerability to food insecurity. The negative impact of large family size and high dependency ratios was observed across all provinces and was especially severe in regions with fewer economic opportunities.

Khan and Sadozai (2024) and Akbar et al. (2020) established that food insecurity was directly associated with low education levels, unemployment, lack of asset ownership (like land or livestock), and single-income households. Bashir (2012) did econometric analysis of food security data in Pakistan and found that joint family systems experienced higher food security due to pooled resources, shared responsibilities, and collective asset management.

Research Methodology

Data collection

A structured questionnaire was developed having separate modules on household economics, agricultural productivity, farm machinery, livestock, land use, and food security. After pre-testing and refining the questionnaire, data was collected from 237 households using a multi-stage cluster sampling technique. Punjab province was selected due to its significant population, cultivated area, and cropped area. The sample size was proportionately divided into four agro-ecological zones: irrigated, arid, Thal, and marginal lands. 13 districts and 22 sub-districts were selected within these zones, and villages were chosen using simple random sampling during September to October 2024. The data analysis consisted of two stages. First, households were categorized into food secure and food insecure groups. Then, binary logistic regression analysis was used to identify key determinants of food security.

Model Specification

The instant study focused on access to food and used the food insecurity experience measurement technique to categorize households (Bickel, 2000). The technique of Binary Logistic Regression was suitable for dichotomous dependent variables, such as food security status. It estimated the probability of a household being food insecure (1) or food secure (0) based on independent variables. The logistic regression model can be written as:

$$P_i = E(Y = 1 \mid X_i) = \frac{1}{1 + e^{-(\beta_o + \sum \beta_i X_i)}} \qquad (1)$$

The likelihood of a household experiencing food insecurity (P_i) can be modeled using Y = 1, indicating food insecurity is a function of various explanatory variables (Xi) with corresponding regression coefficients (βi) and a base of natural logarithm (e). After incorporating the error term μ_i, the logit model (Li) will be as following:

$$L_i = \beta_o + \sum_{i=1}^{n} \beta_i X_i + \mu_i \qquad (2)$$

Description of Variables

The analysis of household food insecurity in Punjab province was drawn on existing research, expert insights, and local context to identify key factors influencing food security. Logistic regression was employed to examine the impact of various variables on household food security. Literature review revealed that the age (X_1) of the household head affected food security at the household level. Their experience and physical ability influenced farming operations. The Education (X_2) enhanced farming skills, earning potential, and food security.

The family size (X_3) emerged as a crucial factor because larger households needed more food resources which in turn were dependent upon their availability and access. More family earners (X_4) meant more labor and higher productivity. Household budget management (X_5) affected food availability. For rural farmers, owning farm assets like land was crucial for food security. The materials used to build a home (X_6) reflected people's access to resources and food security. Farm size (X_7), land ownership (X_8), irrigation (X_9), and rental income (X_{10}) all impacted agricultural productivity and household income. Livestock (X_{11}) provided food, income, and financial security and increased household food security. Tractor ownership (X_{12}) also helped by increasing agricultural production and income and made farming more efficient and profitable.

Results and Discussions

Results and discussion have been presented as household food security status and binary logistic regression.

Household Food Security Status

Table 1 lays out the empirical findings on the bifurcation of households into food insecure and food secure categories as per guidelines provided by Bickel et al. (2000). It gave a concerning picture of food security in the province. The numbers revealed that less than two-thirds of the total households surveyed were managing to get by with secure food access. Specifically, out of a sample of 237 households across select districts in Punjab province, 167 households (70.5%) were classified as food secure while a significant 70 households (29.5%) fall into the food insecure bracket.

Table 1

Household Food Security Status in Punjab, Pakistan

Household Category	Frequency	Percentage
Food Secure	167	70.5
Food Insecure	70	29.5
Total	237	100.0

Binary Logistic Regression

Binary logistic regression analysis was used to pinpoint the key drivers of household food security in Punjab, Pakistan. This statistical approach allowed to model the relationships between various factors (X1 to X12) and the likelihood of a household experiencing food insecurity. The results showed that the model was statistically significant, with a chi-square value of 33.017 and a p-value of less than 0.003. Notably, the model explained approximately 54.102% of the variation in household food insecurity, as indicated by the Nagelkerke R2 value. In terms of predictive power, the model accurately classified 76.4% of the sample households. Breaking it

down further, it was found that the model correctly predicted 48.3% of food insecure households (sensitivity) and 81.1% of food secure households (specificity).

Table 2

Output of Binary Logistic Regression

Variables	Estimated Coefficients	Standard Error	Odds ratio	Comparison to Ref. Category (RC)
Age of HH (Years)				
Up to 35[RC]				
36 to 45	-0.297	0.618	0.743*	26% less likely
46 to 55	-0.187	0.455	0.829*	17% less likely
56 and above	-0.262	0.390	0.769**	23% less likely
Education of HH				
Illiterate [RC]				
Primary	-1.041	0.726	0.353*	65% less likely
Middle	-0.315	0.611	0.730*	27% less likely
Matric or above	0.174	0.649	1.190	No significant change
Family size				
Up to 4 [RC]				
4 to 6	1.525	1.102	4.593*	4.6 times more likely
7 to 8	0.794	0.920	2.213**	2.2 times more likely
9 or more	0.807	0.964	2.242*	2.2 times more likely
Family earners				
1 [RC]				
2	-0.189	0.458	0.828*	17% less likely
3 or more	-0.426	0.366	0.653**	35% less likely
HH monthly expenditure (Rs)				
Up to 30,000 [RC]				
30,001 to 50,000	0.472	1.245	1.603	No significant change
50,001 to 70,000	0.219	1.066	1.245	No significant change
70,001 or above	-0.395	1.095	0.674**	32% less likely
Land rent (Rs.)				
Up to 40,000 [RC]				
40,001 to 50,000	-1.435	0.701	4.200	No significant change
50,001 to 60,000	-1.308	0.655	3.637**	3.6 times more likely (but
60,001 to 70,000	-0.862	0.561	2.368	No significant change
70,001 or above	-0.419	0.540	1.520	No significant change
House building material	0.502	0.340	1.652*	1.65 times more likely
Agri. Farm area	-0.158	0.044	0.854**	15% less likely per acre
Agri. land title	0.728	0.320	2.071*	2 times more likely
Irrigated land	-0.091	0.547	0.913*	9% less likely
Livestock heads	-0.113	0.046	0.893*	11% less likely per
Tractor ownership	1.157	0.355	3.181**	3.2 times more likely

Note: ** is statistically significant at P<0.01; * is statistically significant at P<0.05; Sample size = 237; Pearson Chi-square = 33.017; Nagelkerke R^2 = 0.54102; Sensitivity = 0.483; Specificity = 0.811%; RC = Reference Category

The binary logistic regression analysis aimed to identify factors that influenced food security in households across Punjab. The findings revealed that age had a significant impact on food security. Compared to households where the head was aged 35 or younger, those with heads between 36 and 45 years were 26% less likely to be food secure. Similarly, heads aged 46–55 years had a 17% lower chance of food security. It indicated that older household heads were less food secure as compared with younger ones. In terms of education, the results indicated that households led by household heads with primary education or middle education were significantly less likely to be food secure than those led by illiterate household heads. Specifically, primary education was associated with being 65% less likely to be food secure. However, having a matric or higher education did not show a statistically significant effect, suggesting that the education level beyond middle school did not substantially alter food security. It was concluded that only higher education (Matric or above) showed slight improvement in food security but not strongly.

Family size was found to have a positive influence on food security. Households with 4 to 6 members were 4.6 times more likely to be food secure while those with 7 to 8 members and 9 or more members were both 2.2 times more likely to be food secure. Larger families might benefit from a greater labor force or diversified income sources which improved their overall food security. On the other hand, the number of family earners negatively impacted food security. Having two earners made a household 17% less likely to be food secure whereas with three or more earners, households were 35% less likely to be food secure. This suggested that having more earners may not necessarily correlate with better economic outcomes, possibly due to underemployment or the nature of their jobs.

The effect of monthly household expenditure revealed mixed results. Although households spending between Rs. 30,001 and 70,000 did not show a significant difference, those with expenditures over Rs 70,000 were found to be 32% less likely to be food secure. This indicated that high expenditures might reflect financial strain, debts, or high cost of living, rather than an indicator of wealth. Regarding land rent, households paying between Rs. 50,001 and 60,000 in rent were found to have 3.6 times higher odds of being food secure. This result was somewhat inconsistent due to the negative sign; however, it indicated that further analysis might be required. Similarly, the quality of house building materials had a positive effect. The households with those living in houses made from better materials being 1.65 times more likely to be food secure. This suggested a strong link between housing quality and food security.

The presence of agricultural land title significantly increased food security. The household having self-owned agricultural land with clear title were 2 times more likely to be food secure. Conversely, agricultural farm area appeared to negatively impact food security with each additional acre decreasing the likelihood of food security by 15%. This could be due to factors like land under poor cultivation practices, lack of resources, or managerial skills to cultivate larger farms effectively. Among agricultural assets, tractor ownership was a standout factor, with households owning a tractor being 3.2 times more likely to be food secure. It highlighted the importance of mechanization in improving agricultural productivity. On the other hand, irrigated land and the number of livestock heads were both negatively associated with food security. Specifically, households with irrigated land were 9% less likely to be food secure and each additional livestock head decreased food security by 11%. This could be overly fragmented land parcels in Punjab and lack of commercial dairy forming in the province.

Conclusions

It was concluded that fewer than two-thirds of households had reliable access to food. The logistic regression analysis provided valuable insights into the household-level determinants of food security. Family size emerged as an influential factor in reducing food insecurity. The households with larger families (especially those with 4–6 members, 7–8 members, or 9 or more members) were more likely to be food secure because of larger labor force and diversified income sources. The younger household head and educational levels (particularly only primary or middle education) were also positively associated with food security. However, the households with a higher monthly expenditure (especially above Rs 70,000) were less likely to be food secure. It could be due to financial burden of the families, and it highlighted the complexities of economic well-being beyond simple income levels.

Agricultural assets and practices played a pivotal role in food security outcomes. Tractor ownership was found to significantly contribute to achieving food security. It reflected the role of tractor or mechanization in enhancing agricultural productivity and access to food. Land title or ownership rights in contrast with rental property was another key positive factor suggesting the importance of legal land rights in fostering food security. The number of livestock heads and irrigated land were negatively related to food security. It could possibly be due to challenges in managing these assets effectively. Furthermore, house building material had a positive association with food security which pointed to the broader socio-economic conditions of households.

Recommendations

1. Education, particularly up to primary level may be imparted to the rural households. The vocational and adult education programs also strengthen the efforts towards achieving food insecurity.
2. Targeted support for larger families is required to maximize labor potential, reduce possibility of disguised unemployment and improve income generation.
3. Small-scale farmers may be provided access to agricultural machinery along with better land tenure security.

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