





Article

Tackling Food and Nutrition Insecurity among Rural Inhabitants: Role of Household-Level Strategies with a Focus on Value Addition, Diversification and Female Participation

Shamsheer Ul Haq ¹, Pomi Shahbaz ², Azhar Abbas ², Zahira Batool ³, Bader Alhafi Alotaibi ^{4,*} and Abou Traore ⁵

- ¹ Department of Economics, Division of Management and Administrative Sciences, University of Education, Lahore 54700, Pakistan; drshamsheer@ue.edu.pk
- ² Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad 38040, Pakistan; Pomi1781@gmail.com (P.S.); Azhar.Abbas@uaf.edu.pk (A.A.)
- ³ Department of Sociology, Government College University, Faisalabad 38000, Pakistan; zahbatool@gcuf.edu.pk
- ⁴ Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh 11451, Saudi Arabia
- ⁵ Department of Community Sustainability, College of Agriculture and Natural Resources, Michigan State University, 328 Natural Resources Building, East Lansing, MI 48824, USA; traoreab@msu.edu
- * Correspondence: balhafi@ksu.edu.sa



Citation: Haq, S.U.; Shahbaz, P.; Abbas, A.; Batool, Z.; Alotaibi, B.A.; Traore, A. Tackling Food and Nutrition Insecurity among Rural Inhabitants: Role of Household-Level Strategies with a Focus on Value Addition, Diversification and Female Participation. *Land* **2022**, *11*, 254. <https://doi.org/10.3390/land11020254>

Academic Editor: Francisco Manuel Parejo Moruno

Received: 22 December 2021

Accepted: 5 February 2022

Published: 8 February 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Ensuring food and nutrition security (FNS) is a formidable challenge under increasing population pressure. Governments around the globe have been striving to achieve this goal, but a major impact is attainable once the masses opt for measures at the household level. We conducted this study to explore household-level practices aimed at ensuring FNS and their association with FNS in rural Pakistan. Using cluster analysis, we divided a sample of 200 randomly selected rural households into high and low FNS groups, the majority of which belonged to the low FNS group. Logistic regression was applied to explore the association between household-level measures with the FNS of rural households. The households in the high FNS group adopted a greater number of measures for ensuring FNS. Households headed jointly by a male and female showed to have a higher likelihood of FNS. Similarly, households adopting diversification strategies on their farms were more likely to have high FNS. Moreover, households with working women exhibited a greater probability of experiencing high FNS. Similarly, households' adoption of value addition in dairy products decreases the probability of food and nutrition insecurity. This study concludes with an emphasis on women's empowerment, off-farm income diversification, and on-farm enterprise diversification to address FNS challenges.

Keywords: food security; nutrition security; rural household; livelihood; accessibility

1. Introduction

Food and nutrition insecurity is one of the greatest problems faced by humanity due to limited resources and an increasing population, especially in developing and low-income countries. People residing in rural areas of developing countries will be more at risk of food and nutrition insecurity in the near future owing to climate change and uncertain economic conditions. More than 820 million people globally were not able to fulfill their energy requirements in 2015–2018 [1], and the majority of these people belonged to low-income, developing countries. To add to this complexity, the global population is expected to reach about 9.8 billion by 2050. Moreover, the COVID-19 pandemic will not only increase the number of poor people in the world, but will also make it more difficult for many people in developing countries to maintain food and nutritional security (FNS) [2]. Therefore, governments around the globe are facing tremendous challenges in ensuring the FNS of their populations [3].

FNS is a combination of both food security as well as nutrition security. The food security component individually uses the economic approach in which food as a commodity is the main focus, and the nutrition component individually targets the nutritional status of people by using a biological approach. Neither food security nor nutrition independently is sufficient to provide adequate nutrition status to people to ensure health and prevent diseases. Human needs can only be fulfilled by providing well-diversified nutritious foods with essential required micro-and macronutrients. Experts use the term FNS to include both components together. FNS is attained if sufficient food (quantity, quality, safety, socio-cultural acceptability) is available, accessible, and satisfactorily utilized by all individuals at all times to live a healthy and active life [4]. Despite FNS being a priority of many governments, two billion people lack access to safe, adequate, and healthy food worldwide. Food is readily available in Pakistan, but the overall situation of FNS is poor in the country. High levels of poverty give Pakistan some of the highest rates of hunger, undernourishment, and childhood stunting in the world. More than 20% (42 million) of the country's total population is undernourished [1]. Food systems and related natural resources are under extreme pressure due to the growing population.

Climate change also affects food production and rural incomes. This affects the entire food chain, including production, distribution, and consumption [1], making it more difficult to ensure FNS and forcing parents to take difficult measures such as working in non-agricultural activities or withdrawing their children from school to work and earn money for food. Thus, households not only take measures on agricultural farms to improve their production and income [5] but also adopt different off-farm strategies to maintain FNS. Climate-coping mechanisms such as diversifying practices, soil and water conservation, and the adoption of improved seed varieties can increase farm productivity and household incomes [6–8]. Low-income rural households may seek to maximize their utility by using cheaper foods with low nutrients [9]. Moreover, low-income people tend to seek quantity over quality to escape from severe hunger [10]. Food is cultural for many people, and both food and culture are interwoven [11]. Cultural and traditional practices to produce, prepare, and preserve food can also affect the FNS of households. These practices may vary among different societies based on social norms and cultural values. Small and medium entrepreneurship activities play a vital role in household poverty reduction [12–14]. Women undertake a large part of household entrepreneurship activities that enhance the FNS of the rural households.

Thus, climate change adaptation strategies at the farm level alone are not sufficient to ensure FNS in rural households. Other strategies such as entrepreneurial practices, participation in off-farm activities, preserving and storing facilities for food, and quality of drinking water are also equally important. Some studies [6,15–18] have explored the effect of climate change strategies adopted at the farm level to support food security. However, there is limited literature on the effect of on-farm and off-farm measures to safeguard FNS. Therefore, this study contributes to fill the gap in the literature. For this purpose, we used a holistic approach to examine the association between adopted strategies and FNS at the household level by considering on-farm and off-farm practices together.

This study proceeds as follows: first, we explore existing practices at the household level (on-farm and off-farm) to reduce food and nutrition insecurity in rural areas in Pakistan. Second, we analyze the association between on-farm and off-farm strategies and FNS of rural households.

We also examine policy implications for governmental institutions working to improve FNS in Pakistan by emphasizing household-level practices. The results provide insightful information about the practices useful to federal and provincial institutions and non-governmental organizations for their policy priorities to enhance FNS among rural households.

2. Materials and Methods

2.1. Study Area and Sample Size

Faisalabad is the third-largest city in Pakistan, and more than 50% of its population lives in rural areas. The district has fertile agricultural land, helping to improve the FNS not only in the Punjab province but also in the country [19]. Therefore, Faisalabad was selected as the study area for this research (Figure 1).

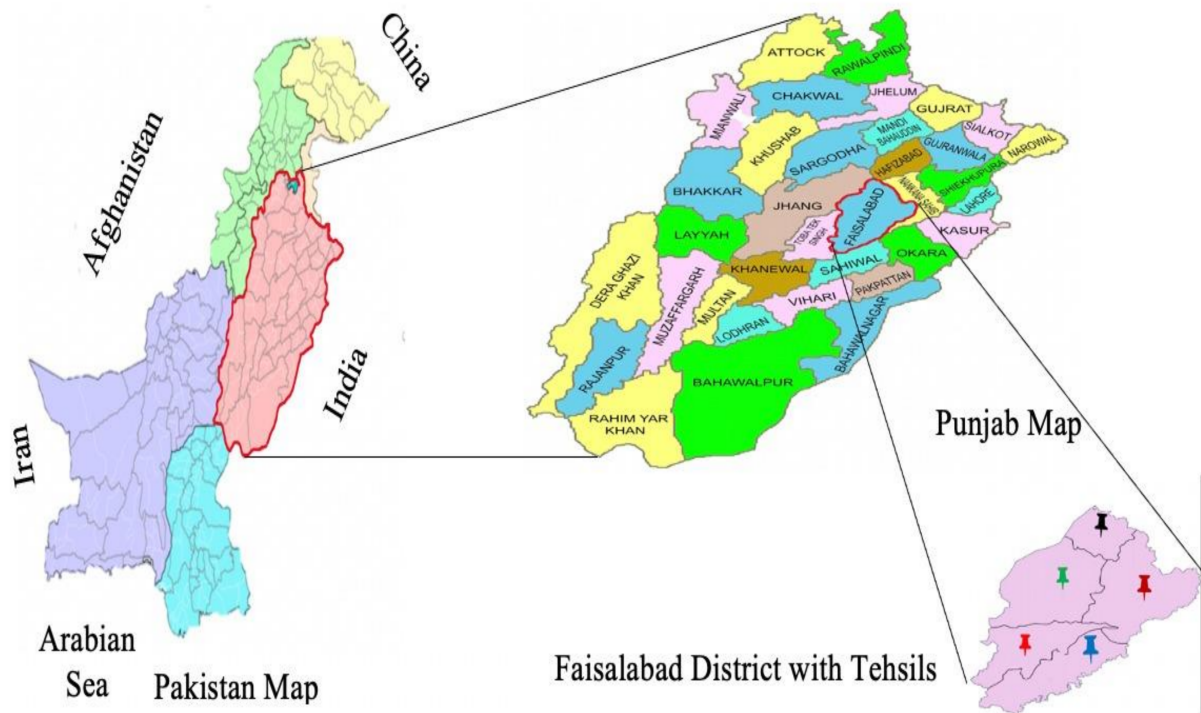


Figure 1. Study area.

After selecting the Faisalabad district of the Punjab province as the study area, the next challenge was to extract a representative sample size. For this purpose, Cochran's sample size determination formula [20] was used. The formula is as follows:

$$n_0 = Z^2 \times p \times q / e^2$$

where “n” is the sample size, “Z” describes the abscissa of the normal curve that cuts off an area α at the tails, “e” depicts the desired level of precision, “p” is the estimated proportion of an attribute, and “q” is equal to $1 - p$. The value of “p” is equal to 0.5 (maximum variability) at the desired confidence interval; the precision level is assumed as $\pm 7\%$. By putting these values in the above formula with $Z = 1.96$, a sample size of 196 rural households was estimated. The estimated sample size was distributed throughout the smallest residency units (villages) by applying the multistage random sampling technique.

In Pakistan, a district is further divided into smaller administrative units locally known as “tehsils”. Faisalabad consists of 5 tehsils. Similarly, a tehsil is composed of even smaller units called union councils. In the second step, 5 union councils with the largest numbers of rural households from each tehsil were selected. A union council consists of 4–8 villages and 4 villages from each union council were randomly chosen (total 20 villages) in this step.

Lastly, the selected sample size of 196 was proportionally divided into 20 villages and resulted in a number of 9.8 ($196/20$) households from each village for the survey. This number was rounded to 10, and data from 200 rural households were collected through face-to-face surveys by experienced male and female enumerators in January–February 2020 before the beginning of COVID-19 in the country. These 10 rural households were

randomly selected from each village's list of households, which was obtained from the village heads ("numberdar" in the local language). The adult family members of the households, both male and female, were interviewed directly to obtain data on FNS.

The questionnaire was validated (content validity) by a panel of 6 experts familiar with the FNS situation of Pakistani households. Per the experts' recommendation, the questionnaire, initially prepared in English, was translated into Urdu by a researcher. The English and Urdu versions of the questionnaire were sent to a translator to ensure that the content was understandable.

A pilot study was conducted to assess instrument content validity and reliability. The pilot survey assisted in the arrangement of the questionnaire for the final survey. For example, sociodemographic questions were asked first in the pilot survey questionnaire, and respondents were hesitant to answer them at the beginning of the survey. Therefore, the sociodemographic questions were placed at the end of the final survey questionnaire. Another important detail noticed during the pilot survey was that no female respondent was comfortable facing male enumerators due to cultural barriers.

The respondents were invited to participate in the study and informed about its purpose before starting the survey and only after obtaining their consent, respondents were asked survey questions. The majority of the respondents gave their consent to participate in the study, and 9% opted out. After providing consent, participants were informed that their participation was completely voluntary and that they did not need to answer any question they did not like.

2.2. Conceptual Framework

FNS for the current study was defined as when sufficient food was available to rural families, and they had physical, social, and economic access to nutritious food that met their dietary needs and food preferences, with a sanitary environment, adequate health services, and knowledge/care to ensure an active and healthy life. All physical dimensions of food security (FS) (availability, accessibility, utilization) and temporal dimensions (stability) were interlinked with one another. These food security dimensions, along with the dimensions of nutrition security (NS), including education and care, a sanitary environment, and health status, are commonly considered in the assessment of household food and nutrition security (FNS) [21,22]. The fourth dimension, food diversity, was added in the nutrition security assessment for this study because food diversity is directly related to nutrition.

The households with the consumption of diversified food items in daily life are more likely to have FNS than households with the consumption of homogenous food items in daily life [23]. Education and care indicate the education level and care of households related to food-borne diseases, cross-contamination, and the suitable temperature and arrangement of food items in a refrigerator. The sanitary environment represents 5 key elements of food safety: (1) keep food clean, (2) separate raw and cooked food, (3) cook food thoroughly, (4) keep food at safe temperatures, and (5) use safe water and raw materials. The health status dimension of nutrition security was aimed at measuring the health conditions of households, the availability of healthcare services, and the ability of rural households to benefit from those healthcare services, as health affects the nutrition status of the people. Food intake and health status of individuals are interlinked and determine the overall goal of food and nutritional security [24]. A household will be food and nutritionally insecure if that household has either poor food security (FS) or poor nutrition security (NS). On the other hand, a household will only be food and nutritionally secure if that household has suitable FS and NS. Off-farm and on-farm practices, along with sociodemographic characteristics, are taken as exogenous factors in this study (Figure 2).

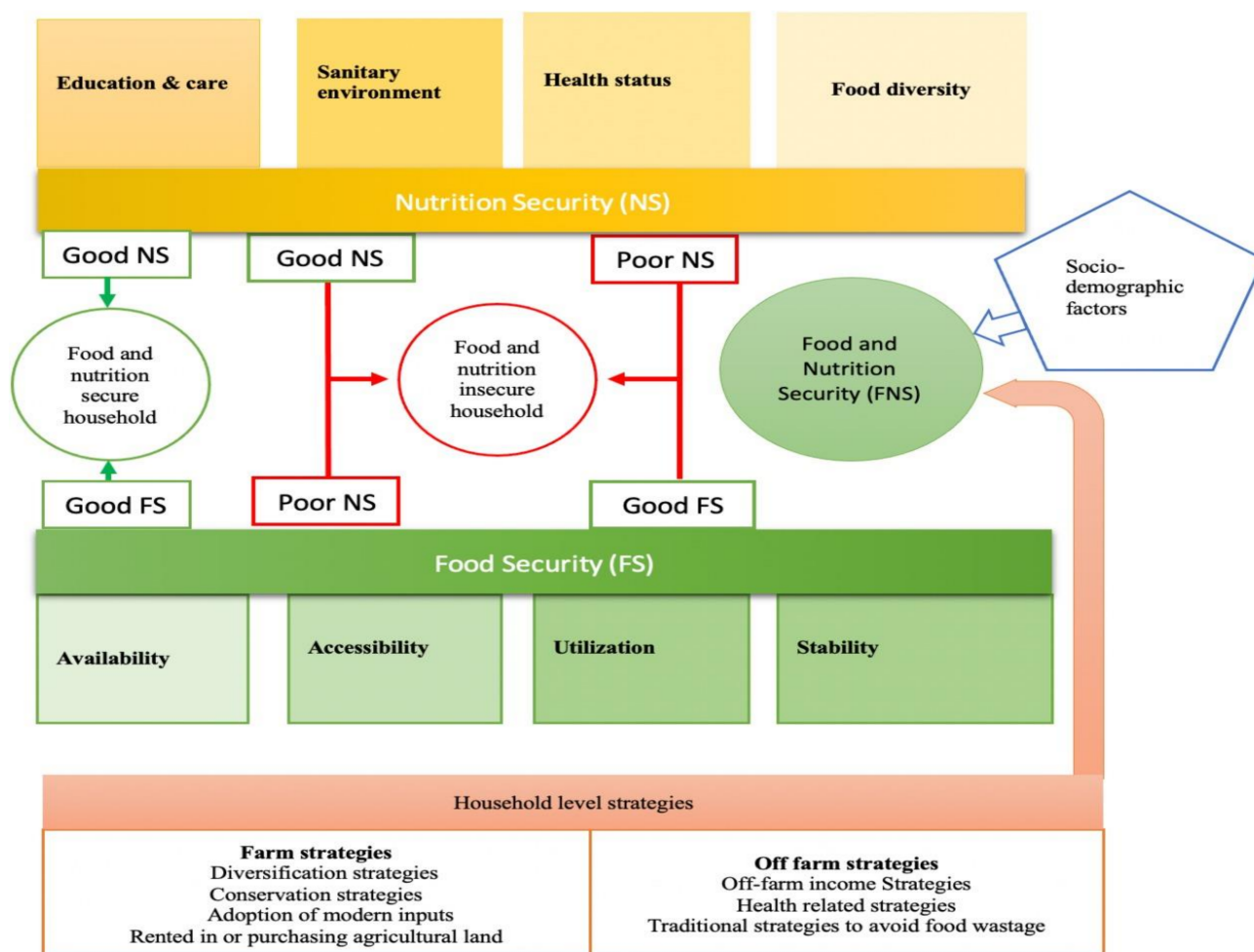


Figure 2. Conceptual framework for FNS of rural households.

2.3. Selection of Explanatory Variables

The explanatory variables used in this study were household-level strategies adopted by the rural households to maintain their FNS. These household-level strategies were selected with the assistance of experts familiar with FNS in Pakistan, the researchers' own observations, and by reviewing FNS-related literature. The household-level strategies were divided into off-farm and farm-level strategies. Off-farm strategies included strategies that assisted rural households in sustaining FNS through the provision of extra income, maintaining health, and decreasing food waste. Such strategies consisted of off-farm income strategies, health-related strategies, and traditional strategies to avoid food waste in the house. These income strategies assisted farmers in generating extra income from sources other than farming. Off-farm income strategies positively contribute to household food security [25]. Such strategies include women's participation in economic activities other than farming and housework. Women's participation in economic activities in addition to their housework is positively associated with the FNS of their household [26]. The other strategy included in off-income strategies is migrating abroad to earn extra non-farming income. Foreign remittance is an important source of income for maintaining food security in Pakistan [27]. Obi et al. [28] also stated that foreign remittances positively contribute to the food security of the receiving households. The third strategy considered in off-farm income strategies is the value addition of dairy products, such as the conversion of milk to yogurt, butter, and cheese. These value-added products not only improve the income of rural households but also add food diversity in the daily eating of rural households. Multidimensional benefits of value addition, such as the prevention of food losses, the

promotion of nutrition and health and entrepreneurship opportunities for families, can significantly contribute to FNS [29]. Direct marketing is the sale of agricultural goods and products from the farm straight to the consumer [30]. The direct marketing of dairy and agricultural products enables farmers to earn a greater profit by excluding middlemen. Poverty is common in rural areas of Pakistan, and 80% of its poor population lives in rural areas [31].

Although child labor is prohibited in Pakistan, child labor is still a common strategy to fulfill the daily food needs of households. Health and nutrition are linked to each other. Rural households adopt different strategies such as buying perishable food commodities on an as-needed basis, cooking at home, drinking clean water from canals, and maintaining a careful diet for elders to maintain health. The majority of the traditional strategies considered in this study is local and may vary by region and country. Traditional strategies decrease food waste and also assist in saving income for rural households. All off-farm strategies have the potential to directly or indirectly influence the FNS of rural households either through increasing income or avoiding food waste.

The farm-level strategies considered in this study are diversification strategies, conservation agriculture, the use of modern inputs, and the purchase of agricultural land. These strategies improve the farm productivity and income of rural households. Diversification strategies include crop diversification, intercropping, and farm diversification. Crop diversification is a cost-effective technique that reduces productivity uncertainties [32], minimizes the occurrence of weeds [33], and lowers the cost of production by lowering the use of weedicides [2]. Farm diversification helps farmers to overcome income shocks [27] and meet daily needs for dairy food items [23]. Conservation strategies such as water conservation strategies enable farmers to irrigate their crops efficiently [34].

Agroforestry lowers the land erosion risk that helps to maintain the soil quality. Moreover, it also provides a supplementary source of income to farmers [35]. The adoption of green manure, crop rotation, and dry farming also enables farmers to improve soil health, save inputs, and increase crop yield. The adoption of modern inputs enhances crop productivity [36]. Thus, the farm-level strategies considered in this study either improve agriculture productivity or save input costs, thus assisting rural households in improving their FNS. In addition to the off-farm and farm-level strategies, sociodemographic characteristics (gender of household head, family size, farming experience, and market distance) were also used as independent variables in the study because they are also associated with the FNS of households [23,37–39].

2.4. Measuring FNS of Rural Households

FNS of rural families was calculated from the responses to a series of questions. These questions were related to the behavior, conditions, and experiences that apply to the rural families when they are having difficulty in meeting basic needs to enjoy a healthy and active life. Therefore, there are a number of indicators required to capture various combinations of food conditions, experiences and behavior to measure the FNS of rural families [40]. For that, data were gathered regarding the food conditions, experiences, and behavior of rural households, which serve as indicators to assess the FNS of the rural families in this study. These statements are given in Appendix A. All these statements described whether the condition or behavior occurred at any time during the previous 12 months. Moreover, 44 statements assessed cleaning of the house and refrigerator, keeping cooked and raw food items separate, cooking food thoroughly, keeping food safe, and using safe water and raw materials to estimate the sanitary environment dimension of NS. The food diversity score was calculated by summing up the consumption frequency of vegetables, fruits, dairy items, bakery items, and drinks. For this, respondents described these food items and their consumption frequency whenever items were available. Voluntary fasting or dieting activities to lose weight are thereby not included in measuring the FNS of rural household families. Each response to the question was scored based on its contribution to the FNS of the rural households. For example, a “no” response to the question, “We worried whether

our food would run out before we got money to buy more,” was given score a score of 1. Similarly, a “yes” response to the question, “We can afford to eat balanced meals,” was assigned 1, otherwise 0.

The continuous variables such as education were scored based on the average education of the sampled respondents. Those with an education level greater than the average were assigned 1, otherwise 0. Food diversity was directly considered as more consumption of different food, leading to high FNS. The scores of all question statements were summed up to reach the dimension’s value of FNS. K-means cluster analysis was applied to these dimensions’ values to divide the rural households into high and low FNS groups, denoted as Cluster 2 and Cluster 1, respectively (Table 1).

Table 1. Results of the cluster analysis.

FNS Dimensions	Cluster 1	Cluster 2
	Low FNS	High FNS
HFANSS (Availability)	4.55	5.42
HFANSS (Accessibility)	7.31	9.02
HFANSS (Utilization)	6	6.27
HFANSS (Stability)	4.49	4.67
HFANSS (Sanitary environment)	25.7	28.09
HFANSS (Food diversity)	26.36	52.57
HFANSS (Education and care)	4.13	4.56
HFANSS (Health status)	4.26	4.53

2.5. Statistical Analysis

The prime objective of the study was to analyze the association of adopted household-level strategies with the FNS of rural households. For this, the households belonging to the high FNS group were assigned 1, and those belonging to the low FNS group were assigned 0. This categorical variable was used as a dependent variable in logistic regression. Four sociodemographic variables—gender of household head, family size, farming experience, and market distance from home—were used as independent variables in the analysis. Climate change-counteracting measures at the farm level were categorized into three groups (diversification, conservation, and modern input strategies), and an index was developed for these categories. Similarly, an index was created for health-related strategies and traditional strategies. These indices were used as independent variables in the model. The categorical variables used were working women, migration to other countries, child labor, value addition, direct marketing, and renting or purchasing land to examine these strategies’ association with the FNS of rural households. The general functional form of the logistic regression is given as [41]:

$$P_i = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1 + e^{-(\beta_0 + \beta_i X_i)}}$$

For the ease of exposition, the probability of high FNS households is given as:

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

The probability of low FNS households is $1 - P_i$, thus:

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

Thus, the ratio of the probability that a household has high FNS to the probability that a household has low FNS is:

$$L_i = \ln \left| \frac{P_i}{1 - P_i} \right| = Z_i$$

3. Results and Discussion

3.1. Descriptive Statistics of Sampled Rural Households

The majority (69%) of the rural households belonged to the low FNS group (Table 2). This may be due to the prevalence of high poverty and large family sizes in the rural areas of Pakistan, which limits the ability of rural households to attain sufficient FNS.

Table 2. Descriptive analysis for sampled rural households.

FNS Groups	Description	Frequency	Percent
Low	Low FNS rural households	138.00	69.00
High	High FNS rural households	62.00	31.00
Independent variables		Mean	Std. Dev.
Sociodemographic factors			
Gender of household head	Assigned 1 if headed jointly by male and female, 0 otherwise	0.45	0.50
Family size	Total number of members in a family	7.65	4.47
Farming experience	Farming experience of the household head in years	20.81	12.88
Market distance	Distance from home to market in kilometers	7.05	6.89
Household-level adopted strategies			
1. Off-farm strategies			
i. Off-farm income strategies			
Working women	Assigned 1 if a household had women working jobs other than looking after their own home/farm, 0 otherwise	0.58	0.49
Migrating abroad	Assigned 1 if a household member migrated abroad, 0 otherwise	0.25	0.43
Value addition	Assigned 1 if household added value to their dairy products, 0 otherwise	0.41	0.49
Direct marketing	Assigned 1 if household sold their products to consumers, 0 otherwise	0.37	0.48
Child labor	Assigned 1 if child labor existed in a household, 0 otherwise	0.37	0.48
ii. Health-related strategies		0.53	0.22
Preparing food items at home	Assigned 1 if household preferred to prepare own food, 0 otherwise	0.47	0.50
Buying fresh perishable commodities	Assigned 1 if household preferred to buy fresh, perishable commodities on a daily basis, 0 otherwise	0.50	0.50
Proper cleaning of home and refrigerator	Assigned 1 if household cleaned home and refrigerator properly on a regular basis, 0 otherwise	0.71	0.45
Use of drinking water from canal pumps	Assigned 1 if household drank canal water, 0 otherwise	0.45	0.50
Taking care of diet	Assigned 1 if households took care of diet of elders, 0 otherwise	0.48	0.50
iii. Traditional strategies to avoid food waste		0.87	0.32
Avoiding purchase of food items in bulk quantity	Assigned 1 if households avoided bulk purchasing of food items, 0 otherwise	0.90	0.31
Use of ice for milk storage	Assigned 1 if households used ice for milk storage, 0 otherwise	0.69	0.46
Cooking according to daily needs	Assigned 1 if households cooked for daily needs only, 0 otherwise	0.88	0.33
Putting rice in sunshine	Assigned 1 if households put rice in sunshine to save it from insects/pests, 0 otherwise	0.96	0.20
Freezing milk	Assigned 1 if households froze milk for future use, 0 otherwise	0.91	0.29

Table 2. Cont.

FNS Groups	Description	Frequency	Percent
2. Farm strategies			
i. Diversification strategies		0.67	0.30
Crop diversification	Assigned 1 if households practiced crop diversification, 0 otherwise	0.63	0.49
Intercropping	Assigned 1 if households practiced intercropping, 0 otherwise	0.67	0.47
Farm diversification	Assigned 1 if households were cultivating crops and animals together, 0 otherwise	0.71	0.46
ii. Conservation strategies		0.61	0.24
Water conservation	Assigned 1 if households practiced water conservation, 0 otherwise	0.73	0.45
Agroforestry	Assigned 1 if households practiced agroforestry, 0 otherwise	0.59	0.49
Green manure	Assigned 1 if households used green manure, 0 otherwise	0.46	0.50
Crop rotation	Assigned 1 if households practiced crop rotation, 0 otherwise	0.54	0.50
Dry farming	Assigned 1 if households practiced dry farming, 0 otherwise	0.76	0.43
iii. Adoption of modern inputs		0.77	0.25
New and high-yielding seed varieties	Assigned 1 if households used new and high-yielding seed varieties, 0 otherwise	0.91	0.29
Synthetic fertilizer	Assigned 1 if households used synthetic fertilizer, 0 otherwise	0.71	0.46
Pesticides	Assigned 1 if households used pesticides, 0 otherwise	0.71	0.45
Renting or purchasing land	Assigned 1 if households purchased or rented land, 0 otherwise	0.89	0.31

Rural households reported that they employed a number of strategies to maintain and improve the FNS of their families. These household-level measures were categorized into two main groups: farm-level strategies and off-farm strategies. Each type of strategy has a specific purpose that is associated with improving the FNS situation in rural areas. Health status and traditional off-farm measures have more inclination towards the nutrition aspect of FNS, while on-farm and off-farm income measures tilt more towards the food security aspect. However, the integration of all these strategies is associated with increasing or stabilizing all dimensions of the FNS of rural households.

Off-farm strategies help to improve the income level of rural households and thus provide more resources not only to buy extra food but also to purchase new food cooking/preserving items (refrigerator, microwave oven, pressure cooker, etc.). The first off-farm income strategy adopted by the respondents was women working. Even though women represent more than 49% of the total population, their labor force participation is low in Pakistan due to cultural barriers and the unavailability of workable environments. FNS issues, however, force women to work outside the home, and the majority (67%) of the women labor force is involved only in agricultural activities [42]. Similarly, 58% of the women in the sampled households are working to improve their family income as well as FNS. Most of these women work within the boundary of their village or hometown as domestic servants or in agricultural fields with their husbands as laborers. Poverty among rural households also forces parents to take their children out of school and involve them in paid work to fulfill family food and income requirements. Child labor is common in the Punjab province despite its legal prohibition [43]. Child laborers work in agriculture fields, the textile sector, the manufacturing sector, and at brick kilns. Child labor cannot be incentivized to improve FNS. Therefore, more stringent laws and effective implementation are needed to discourage this evil. Moreover, parental awareness and the support of different NGOs can also prevent the pushing of children into labor. Food and nutrition insecurity forced 37% of the total rural households to send their children to work, primarily in barber shops, mechanical shops, and even as domestic servants in other cities. Migration to earn income abroad was also practiced in the study area, with one in four people forced to leave

their hometown for extra earnings to fulfill their household needs. More than 40% of the rural households practice value addition to their dairy products. These value-addition activities include preparing yogurt and butter from milk at home and selling it at the local market. This not only adds extra income from the sale of the products that is used to buy other food items, but also supports food diversity in the daily consumption of the rural households involved in such activities. Furthermore, some rural households sell their farm outputs, such as vegetables and fruits, directly to consumers. Approximately 37% of the rural households in this study adopted this strategy to improve their FNS.

Health status strategies help keep rural households healthy and active by using cheaper, fresh, and preferred food. About half (47%) of the rural households prefer to use food items (marmalades, pickles, jams, etc.) prepared at home to control their food expenditures and to ensure the quality of their food items. Almost 50% of the total rural households purchase perishable commodities (vegetables, fruits) preferentially on a daily basis. Safe and clean water is an integral part of the FNS. However, the situation of safe water is precarious in the study area. Therefore, 45% of the total rural households fetch drinking water from hand pumps erected on the sides of canals in rural areas.

The scarce availability of electricity, and food preserving, heating, and cooking appliances (refrigerator, microwave oven, pressure cooker) force people residing in rural areas to adopt some cultural and traditional strategies to decrease food waste and food and nutrition insecurity. These strategies may vary among households and villages. Descriptive analysis revealed that 90% of the rural families did not purchase food items in bulk because of the unavailability of proper preserving facilities in order to avoid food waste. Another cultural strategy involves the use of ice in the summer season for milk when electricity is not available. This milk can be used not only for the day's tea purposes but also for value addition the next day. A majority of the rural households undertake this activity. Similarly, 88% of the rural families cook fresh food separately three times a day (breakfast, lunch, and dinner) to lower the chances of wasting food. Almost 91% of rural families freeze milk in the event of a sudden need during a shortage. More than 87% of the total rural households adopted these cultural and traditional strategies for their FNS.

Farming is the main source of income for a large rural population in Pakistan. Moreover, sustainable agricultural production is the key to ensuring food and nutritional security for an increasing population in the country, but climate change poses a great risk to the agriculture sector. Thus, rural households take measures to ensure efficient farm production as well as FNS. The low adaptive ability of rural households to climate change directly affects food security [44]. Climate change adaptation strategies are divided into three broad categories: diversification strategies, modern input strategies, and conservation strategies. The adopted strategies minimize the impact on farm production that ultimately affects the family income and enhance FNS for the rural population. Moreover, rural households also increase their operational area either by renting or purchasing more land to achieve economies of scale, which helps to save costs and increase production. This, in turn, helps improve their FNS.

Diversification strategies minimize risk by diversifying the income source of rural households. Another benefit of farm-level diversification strategies is that they provide diversified foods to rural households, which helps to improve FNS. About 71% of the rural households adopted farm diversification measures to improve their farm income. Overall, the adoption of diversification strategies was 67% in the study area. Most of the rural households in the locality preferred to diversify their farms in the form of rearing different animals and cultivating different crops.

Healthy soil with essential nutrients and irrigation water are vital to production, but both resources have limited availability. Therefore, the conservation of these scarce resources is key, and rural households are well aware of this fact. The households surveyed are taking measures to conserve these resources. In particular, 73% of the rural households adopted water conservation strategies to save water and to lower seepage losses to increase the irrigated area for better production of crops. Almost 46% of the rural households apply

green manure to maintain soil fertility for sustainable earning and yield. Overall, 61% of the total rural households adopted these conservation strategies on their farms to combat climate change and to improve FNS.

The use of modern agricultural inputs is crucial for increasing farm productivity. These modern input strategies include the use of new and high-yielding seed varieties, synthetic fertilizers, and pesticides. Almost 77% of the total rural households adopted these measures. The use of new and high-yielding seed varieties was the most common practice on farms in the study area, exercised by 91% of the total rural households.

Sociodemographic factors showed that the average family size in the area was large (eight members per family). The reason may be the joint family system of the country, wherein many families live together under one roof. The large family size was also reported by Haq et al. [45] in their findings on the same study area. Only in 45% of the total sampled rural households were male and female household heads making decisions jointly.

3.2. Strategies Adopted by High and Low FNS Groups

Figure 3 shows the off-farm income strategies, health status strategies, and traditional strategies to avoid food waste employed by low and high FNS rural household groups. The proportion of working women in the high FNS group was much higher (71%) than the proportion of working women (52%) in the low FNS group. Similarly, child labor participation of the high FNS group was higher than the low FNS group. A greater proportion of the rural households in the high FNS group add value to their dairy products and directly sell their products to the final consumer than the low FNS group. The direct selling of agricultural products to consumers offers better profits compared to selling through middlemen.

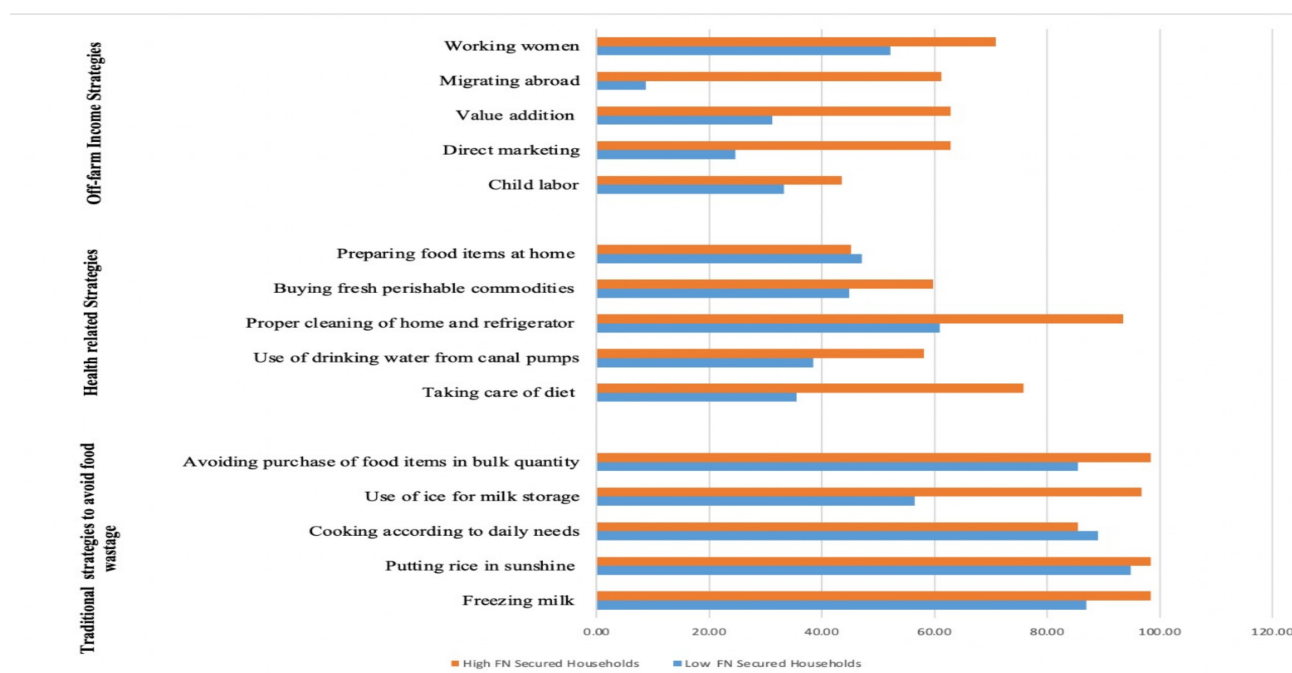


Figure 3. Prevalence of off-farm strategies among high and low FNS households.

A larger proportion of the rural households in both groups preferred to use food items (pickle, jams, and marmalades) from the market as compared to homemade food items. This may be because the ingredients that are used in preparing these products are also bought from markets. Therefore, many households prefer to buy these food items directly from markets. On the other side, rural households preferring homemade food items may be more satisfied with the food items. Around 60% of the rural households in the high FNS group preferred to buy perishable commodities on a daily basis as compared to 44%

of the low FNS group. Similarly, 93% of the total households in the high FNS group were cleaning their homes and food-preserving facilities on a regular basis, while this proportion was only 60% in the low FNS group. Traditional and cultural strategies to preserve and reduce food waste were commonly adopted by the majority of rural households in both high and low FNS groups.

Figure 4 depicts the farm-level strategies adopted by the low and high FNS groups. The figure shows that 98% of the rural households belonging to the high FNS group opted to grow their farm business by purchasing or renting more farmland compared with 84% of the rural households in the low FNS group. The proportion of rural households that adopted water conservation practices was almost the same in both FNS groups. Moreover, the use of synthetic fertilizers was higher among the high FNS group as compared to the low FNS group. Similarly, the adoption of crop diversification is more conspicuous among the high FNS group (around 75% respondents in this category) compared with 57% respondents in the low FNS group. As evident from Figure 4, the frequency of strategy adoption is generally higher for high FNS households than low FNS households.

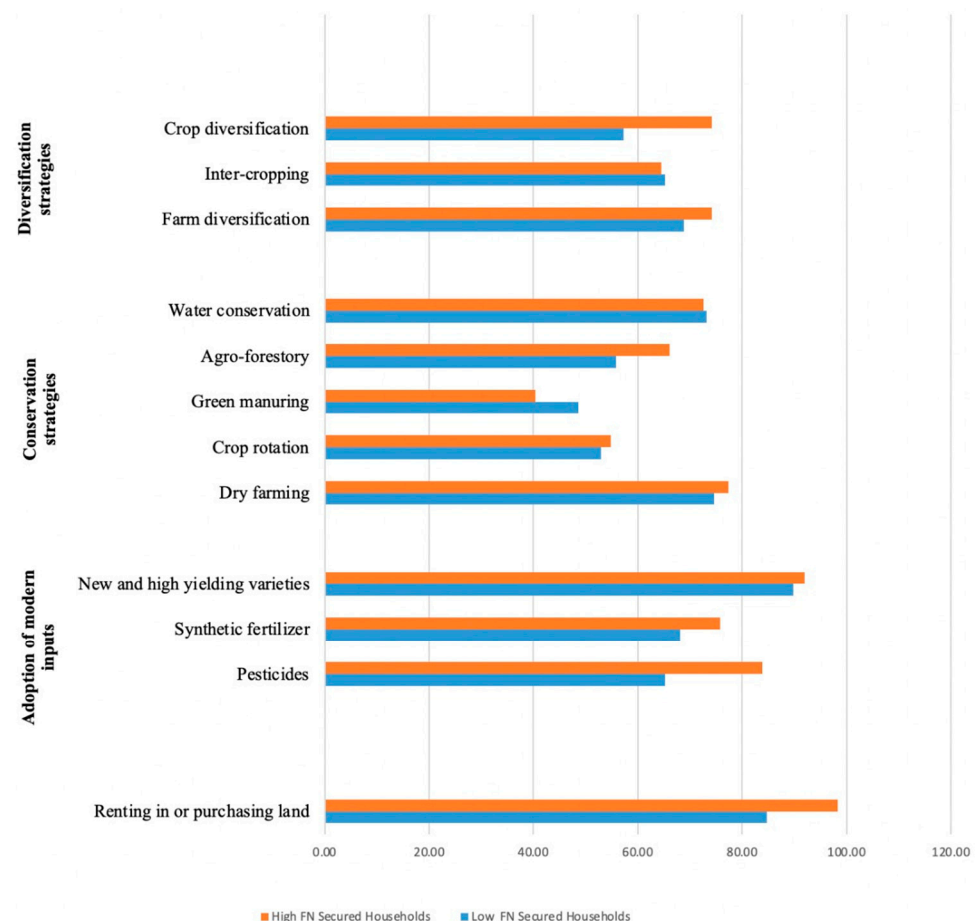


Figure 4. Prevalence of farm-level strategies among high and low FNS households.

3.3. Association of Household-Level Adopted Strategies with FNS of the Rural Families

Table 3 describes the results of logistic regression. The overall model was significant ($p < 0.01$). The role of the household head is important in the FNS of a family [46], as all decisions of a household are made by the head of the family, which ultimately affects the income as well as the FNS of the family. Our results indicate that rural households making all decisions jointly (male and female heads of household) are more likely to have high FNS as compared to households in which decision making involves either a male or female head only. This may be due to the fact that male household heads are mainly responsible for the earning of income, whereas female household heads are responsible for making

decisions on food preparation, processing, and preservation. In rural areas, decisions in relation to food purchase and preparation are generally undertaken by the females of the household [47]. Thus, appropriate decisions to improve FNS are only possible with the involvement of both male and female household heads.

Table 3. Association of household-level adopted strategies with the FNS of the rural families.

Variables	Coef.	Std. Err.	t-Values	p-Values
Constant	−8.531	1.978	−4.310	0.000
Sociodemographic factors				
Gender of household head	1.940 *	0.793	2.450	0.002
Family size	−0.133 **	0.063	−2.100	0.036
Farming experience of family head	0.009	0.012	0.770	0.440
Market distance	0.022	0.026	0.820	0.410
Off–farm strategies				
Off–farm income strategies				
Working women	1.589 *	0.367	4.320	0.000
Migrating abroad	0.242	0.298	0.810	0.416
Value addition	0.556 *	0.200	2.780	0.007
Direct marketing	0.726 **	0.335	2.170	0.030
Child labor	0.305	0.314	0.970	0.332
Health–related strategies	0.579 *	0.204	2.840	0.005
Traditional strategies to avoid food waste	0.665 **	0.222	3.000	0.003
Farm strategies				
Diversification strategies	1.435 **	0.581	2.470	0.013
Conservation strategies	0.326	0.730	0.450	0.656
Modern inputs	−0.535	0.690	−0.780	0.438
Renting in or purchasing land	0.530	0.313	1.690	0.090
No. of observations = 200; Log likelihood = −51.368032; LR chi2 (15) = 144.9; Prob > chi2 = 0; Pseudo R ² = 0.6851				

* and ** represent significance at 1% and 5%, respectively.

Family size in rural households is also an important factor in FNS. Family size was found to be negatively associated with the FNS of the rural households, which indicates that rural households with a large family size are more likely to have low FNS than rural households with a small family size. This result clearly highlights the importance of family planning in the study area as well as in the country because large family sizes are common in Pakistan, especially in rural areas. Therefore, more than 42 million people in the country do not have access to enough safe food and water due to family size [48]. This finding is consistent with the findings of Bogale [49], who reported that households having a large family size are more likely to have low food security.

The presence of working women in the family was positively associated with FNS, meaning that households with working women are more likely to have high FNS compared to those that do not. Only 26% of the total female labor force in the country is currently participating in the labor market, and more than 67% of this employed labor force is involved in agricultural activities. The majority of the rural households do not allow their women to work outside the house premises. However, our results indicate that rural households should allow women to work not only in agricultural fields but also in other sectors of the economy. Their inclusion in working activities can benefit their family by increasing the household income and sharing the economic burdens of the house, which can help to raise the living standard and FNS of the family. Mehra and Rojas [50] stated that women could facilitate the development of rural areas through their efforts to enhance agricultural production as well as their active involvement in other income-generating activities. This would also help achieve national food security and can contribute towards

national economic development. Agarwal [51] also described that women could enhance FNS by participating in procuring and production activities.

Value addition to dairy products was also found to have a positive association with the FNS of the households. This means that households that add value to dairy products are more likely to have high FNS as compared to those that do not. The value addition finding stated that this practice could significantly contribute to the FNS of the family. This practice involves selling yogurt and butter instead of only raw milk at the local market or village, which provides more income to the rural households. On-farm value addition to farm products, especially milk, is acknowledged and highly encouraged through value chain approaches for its benefits in terms of improving farm income [52].

Health-related strategies and cultural strategies were also significantly associated with the FNS of rural households. The adoption of health-related strategies increases the likelihood of rural households becoming high FNS households. Similarly, the cultural activities that were adopted by the rural households also contribute to the high FNS in the study area. The significant positive association of renting or purchasing farmland indicates that access to more land increases the probability of rural households maintaining FNS. The rented or purchased land directly increases the farm production, which increases the FNS of rural households. Rehmato [53] and Barraclough [54] described in their studies that the reduction in access to land in an agrarian society leads directly to a reduction in income and access to food.

Climate change-counteracting measures adopted on farms help to improve income by minimizing the impact of climate change on agriculture. Diversification strategies were found to have a positive association with the FNS of the rural households. The results indicate that farms with the adoption of diversification strategies are more likely to have high FNS as compared to those that do not. This may be because these strategies have direct contributions to income, dietary diversity, and food accessibility and availability. For example, crop diversification and farm diversification both lower a farm's business risk [55]. Diversification strategies are adopted by rural households on their farms for maintaining their farm income under the uncertainty of weather and market conditions. Moreover, crop diversification significantly increases farm income and also contributes to poverty reduction [56]. Diversification assists rural households in accumulating income, which they can use to enjoy a favorable FNS level. Diversified activities also support rural households to fulfill immediate household needs such as food, shelter, and healthcare [57]. Pellegrini and Tasciotti [58] explored the positive relationship between crop diversification and two other indicators, dietary diversity and farm incomes from crops. Similarly, farm diversification also generates more stable farm incomes [59].

4. Conclusions and Policy Recommendations

Improving the FNS situation in Pakistan is one of the foremost priorities of the government. For this purpose, the government has encouraged both on-farm and off-farm measures to improve the income of rural households in its policy documents. Moreover, rural households are well aware of the risks in agriculture and employ off-farm measures to ensure their families' FNS. Thus, we used a holistic approach in this study to examine the household-level adopted measures of surveyed rural households. This research presents valuable information for governmental agencies on the household-level measures (on-farm and off-farm) taken by rural households to ensure FNS.

The results show that the majority of the rural households belonged to the low food and nutrition category. The descriptive analysis of adopted strategies show that rural households with higher FNS adopted more practices at the household level (on-farm and off-farm) as compared to the lower FNS category. The results also show that off-farm practices are more beneficial than traditional and cultural strategies, which may change from society to society. Rural households with diversification strategies on their farms are more likely to have high FNS. Moreover, the adoption of off-farm income strategies was also positively associated with the FNS of rural households. Similarly, family size

was found to be negatively associated with the FNS of rural households. The government should take help from local religious scholars in each area to educate people about the benefits of having a small family.

In conclusion, diversification strategies (crop diversification, intercropping, and farm diversification) can be vital to the FNS of rural households. Government agricultural policies should aim to increase farm diversity to improve the FNS of the people instead of only increasing the total production of food crops, as has been the tradition. Secondly, rural households should be encouraged to adopt other off-farm income-generating measures, such as the value addition of dairy products and women's empowerment, in order to improve FNS. Moreover, farmers should be encouraged to sell their products directly to consumers without the involvement of middlemen. For this, the government must guide and educate farmers in rural areas.

Agricultural and rural extension is one of the means available to assist policymakers to realize improved FNS in rural areas of developing and poor countries. Extension workers play a central role in new technology adoption and knowledge dissemination and have connections with individuals at the ground level. Therefore, policymakers in developing countries can utilize the already-present network of extension workers for educating and encouraging rural households to take measures such as farm diversity, value addition, and women's economic participation for better FNS. Policymakers should launch programs to inform farmers through the extension network and by organizing different seminars about the economic, ecological, and nutritional benefits of farm diversity. In particular, the value addition of dairy products needs knowledge, skills, and machinery.

Therefore, policies aiming to increase the knowledge and skills of rural households should be implemented in rural areas. Policymakers can also persuade farmers to seek credit from banks for purchasing machinery necessary for value addition. Moreover, subsidies on this machinery can also be a strategy to encourage farmers to add value to their products. Furthermore, policymakers should adopt gender equality strategies to enhance women's participation in economic activities in developing countries. Moreover, programs aiming at enhancing women's skills should be implemented in rural areas of developing countries to alleviate poverty and food and nutrition insecurity. As fruit and vegetable markets are the only places available to farmers for selling their agricultural commodities, the government should establish facilities and places (farmers' bazaars) in each city where farmers can sell their produce on a daily basis without involving middlemen.

It is also pertinent to mention here the strengths and limitations of the study. The study has important policy implications in the context of achieving the United Nations' Sustainable Development Goal of zero hunger (SDG 2). The other main strength of this study that makes it unique from previous studies is that this study considers household-level strategies (farm and off-farm) to analyze the association between these strategies and the FNS of rural households. However, we used cross-sectional data for our analyses that do not allow for developing a causal relationship between household-level practices and the FNS of rural households. The other limitation of the study is the exclusion of some important variables such as income and size of agricultural land due to the unavailability of the data from the respondents. Despite these limitations, this study provides important results and policy recommendations for improving the FNS of rural households in developing countries, and researchers in developing countries can build upon this work and extend this research by collecting longitudinal data.

Author Contributions: Conceptualization, S.U.H., P.S., B.A.A. and A.A.; data curation, P.S.; formal analysis, Z.B. and S.U.H.; investigation, P.S. and Z.B.; methodology, P.S. and B.A.A.; project administration, A.T.; resources, A.T.; supervision, A.A. and B.A.A.; validation, Z.B. and A.T.; suggestions, A.T.; writing—original draft, P.S., A.A., and S.U.H.; writing—review and editing, A.T. and B.A.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Researchers Supporting Project Number (RSP2022R443), King Saud University, Riyadh, Saudi Arabia.

Institution Review Board Statement: The study was approved by the University of Education, Lahore, Pakistan (UE/S&T/2020/43).

Informed Consent Statement: Informed consent from survey respondents was duly received.

Data Availability Statement: Data are contained with the article.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Household FNS Indicators.

Household FNS Statements	Mean	Std. Dev.
Had enough money to buy food	0.74	0.44
Had availability of good quality food	0.25	0.43
Had availability of required quantity of food	0.59	0.49
Got worried whether food would run out before getting money *	0.79	0.41
Had storage facility to store staple food items	0.71	0.45
Got enough production of wheat for home consumption.	0.86	0.35
Instant availability of food or kitchen items	0.82	0.39
Availability	4.75	1.38
Lost the weight because there was not enough money to buy food *	0.82	0.39
Government's development activities to improve accessibility to food markets	0.65	0.48
Having easy access to fruit and perishable commodities on daily basis	0.87	0.34
Able to eat balanced meals	0.67	0.47
Rise in prices of food affected food quantity *	0.82	0.39
Relied only on low-cost food to feed your children *	0.46	0.50
Food accessibility problem faced by the family members *	0.46	0.50
Adult did not eat whole day *	0.51	0.50
Eating less than the adult felt hungry *	0.46	0.50
Adult skipped meal *	0.40	0.49
Children did not eat whole day *	0.40	0.49
Eating less than the children t felt hungry *	0.39	0.49
Children skipped meal *	0.82	0.39
Accessibility	7.70	2.49
Ate three meals per day	0.73	0.45
Regular nail cut for secure utilization of food	0.74	0.44
Covered hair during handling and cutting food items	0.90	0.30
Used spoon for eating food.	0.74	0.44
Used leftover cooked stored meal	0.92	0.28
Preferred to consume fresh cooked meal	0.96	0.21
Cut food expenditure	0.48	0.50
Utilization	6.06	1.39
Had stable individual income	0.61	0.49
Had stable family income	0.45	0.50

Table A1. *Cont.*

Household FNS Statements	Mean	Std. Dev.
Full time farming	0.47	0.50
Sold animals *	0.40	0.49
Received announced prices (support prices) for crops	0.17	0.38
Easy access to veterinary hospital for treatment of sick animal to stabilize the milk production	0.52	0.50
Received payment of sold crops on time	0.65	0.48
Availed credit facilities	0.64	0.48
Stability	4.53	1.57
Cleaning	11.01	3.76
Keep separate raw and cooked food items	4.56	1.51
Cook well-done	2.57	0.68
keep food safe	2.57	1.17
Safe water and raw material	5.54	1.95
Sanitary environment (food safety)	26.24	6.92
Fruit consumption	4.14	2.11
Vegetables consumption	8.39	1.91
Dairy food items consumption	4.57	2.17
Bakery item's consumption	7.51	2.88
Drinks consumption	7.67	4.19
Food diversity	32.28	12.13
Education of family head	0.53	0.50
Education of spouse	0.51	0.50
Cared to avoid food borne diseases	0.50	0.50
Cared to avoid growth of food born bacteria	0.49	0.50
Cared about duration for keeping the raw food material in refrigerator (2-4 days).	0.44	0.50
Cared to avoid cross contamination.	0.67	0.47
Cared about arrangement of different food items in refrigerator.	0.64	0.48
Avoided cutting in open air to save food from particles	0.47	0.50
Education and care	4.23	1.57
Stress problem *	0.57	0.50
Had easy access to primary health services	0.65	0.48
Had availability of expert doctor near to house	0.41	0.49
Conducted regular checkups of the sick family members	0.64	0.48
Faced problem in paying the medical expenses *	0.47	0.50
Prevalence of Hepatitis, blood pressure, and sugar among family members *	0.44	0.50
Availed government health card scheme	0.35	0.48
Compromised on diet of sick house members *	0.82	0.40
Health status	4.33	1.42

* Assigned 1 if the response was "No", 0 otherwise.

References

1. FAO. *The State of Food Security and Nutrition in the World 2019: Safeguarding Against Economic Slowdowns and Downturns*, 2019th ed.; Food and Agriculture Organization: Rome, Italy, 2019; pp. 1–215.
2. Shahbaz, P.; Ul Haq, S.; Khalid, U.B.; Boz, I. Gender-based implications of the COVID-19 pandemic on household diet diversity and nutritional security in Pakistan. *Br. Food J.* **2021**, *in press*. [CrossRef]
3. Shahbaz, P.; Ul Haq, S.; Boz, I. Implications of COVID-19 related non-pharmaceutical measures on household livelihood and food security in Pakistan. *J. Agribus. Dev. Emerg. Econ.* **2021**, *in press*. [CrossRef]
4. Weingärtner, L. The concept of food and nutrition security. *Achiev. Food Nutr. Secur.* **2009**, *3*, 21–52.
5. Shahbaz, P.; Boz, I.; Haq, S.U. Adaptation options for small livestock farmers having large ruminants (cattle and buffalo) against climate change in Central Punjab Pakistan. *Environ. Sci. Pollut. Res.* **2020**, *27*, 17935–17948. [CrossRef] [PubMed]
6. Ali, A.; Erenstein, O. Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan. *Clim. Risk Manag.* **2017**, *16*, 183–194. [CrossRef]
7. Hussain, S.S.; Mudasser, M. Prospects for wheat production under changing climate in mountain areas of Pakistan—An econometric analysis. *Agric. Syst.* **2007**, *94*, 494–501. [CrossRef]
8. Issahaku, G.; Abdulai, A. Can farm households improve food and nutrition security through adoption of climate-smart practices? Empirical evidence from Northern Ghana. *Appl. Econ. Perspect. Policy* **2020**, *42*, 559–579. [CrossRef]
9. Darmon, N.; Ferguson, E.L.; Briend, A. A cost constraint alone has adverse effects on food selection and nutrient density: An analysis of human diets by linear programming. *J. Nutr.* **2002**, *132*, 3764–3771. [CrossRef]
10. Radimer, K.L.; Olson, C.M.; Greene, J.C.; Campbell, C.C.; Habicht, J.-P. Understanding hunger and developing indicators to assess it in women and children. *J. Nutr. Educ.* **1992**, *24*, 36S–44S. [CrossRef]
11. Reddy, S.; Anitha, M. Culture and its influence on nutrition and oral health. *Biomed. Pharmacol. J.* **2015**, *8*, 613. [CrossRef]
12. Benjamin, N.; Mbaye, A.A. *The Informal Sector in Francophone Africa: Firm Size, Productivity, and Institutions*; The World Bank: Washington, DC, USA, 2012.
13. Bennett, J. Informal firms in developing countries: Entrepreneurial stepping stone or consolation prize? *Small Bus. Econ.* **2010**, *34*, 53–63. [CrossRef]
14. Mhando, P.C.; Kiggundu, M.N. Introduction to special issue—managing Africa’s informal economy: Research, practice and advocacy. *Afr. J. Manag.* **2018**, *4*, 219–224. [CrossRef]
15. Armah, F.A.; Odoi, J.O.; Yengoh, G.T.; Obiri, S.; Yawson, D.O.; Afrifa, E.K.A. Food security and climate change in drought-sensitive savanna zones of Ghana. *Mitig. Adapt. Strateg. Glob. Chang.* **2011**, *16*, 291–306. [CrossRef]
16. Islam, A.H.M.S.; von Braun, J.; Thorne-Lyman, A.L.; Ahmed, A.U. Farm diversification and food and nutrition security in Bangladesh: Empirical evidence from nationally representative household panel data. *Food Secur.* **2018**, *10*, 701–720. [CrossRef]
17. Mbow, C.; Van Noordwijk, M.; Luedeling, E.; Neufeldt, H.; Minang, P.A.; Kowero, G. Agroforestry solutions to address food security and climate change challenges in Africa. *Curr. Opin. Environ. Sustain.* **2014**, *6*, 61–67. [CrossRef]
18. O’Mara, F.P. The role of grasslands in food security and climate change. *Ann. Bot.* **2012**, *110*, 1263–1270. [CrossRef]
19. Shahbaz, P.; Boz, I.; Haq, S.U. Determinants of crop diversification in mixed cropping zone of Punjab Pakistan. *Direct Res. J. Agric. Food Sci.* **2017**, *5*, 360–366.
20. Cochran, W.G. *Sampling Techniques*; John Wiley & Sons: New York, NY, USA, 1991.
21. Georg Bokeloh, G.; Maria Gerster-Bentaya, S.; Lioba Weingärtner, R. *Achieving Food and Nutrition Security: Actions to Meet the Global Challenge*; Klennert, K., Ed.; Internationale Weiterbildung und Entwicklung gGmbH: Feldafing, Germany, 2005.
22. Coleman-Jensen, A.; Gregory, C.; Singh, A. *Household Food Security in the United States in 2013*; USDA-ERS Economic Research Report; United States Department of Agriculture: Washington, DC, USA, 2014. Available online: https://www.ers.usda.gov/webdocs/publications/45265/48787_err173.pdf (accessed on 15 March 2021).
23. Haq, S.U.; Boz, I.; Shahbaz, P. Adoption of climate-smart agriculture practices and differentiated nutritional outcome among rural households: A case of Punjab province. *Pakistan. Food Secur.* **2021**, *13*, 913–931. [CrossRef]
24. UNICEF. *The State of World’s Children: Focus on Nutrition*; The United Nations Children’s Fund: 1998. Available online: <https://www.unicef.org/reports/state-of-worlds-children-2019> (accessed on 5 June 2021).
25. Regmi, M.; Paudel, K.P. Impact of remittance on food security in Bangladesh. In *Food Security in a Food Abundant World*; Emerald Group Publishing Limited: Bingley, UK, 2016.
26. Levin, C.E.; Ruel, M.T.; Morris, S.S.; Maxwell, D.G.; Armar-Klemesu, M.; Ahiadeke, C. Working women in an urban setting: Traders, vendors and food security in Accra. *World Dev.* **1999**, *27*, 1977–1991. [CrossRef]
27. Shahbaz, P.; Boz, I. Linking climate change adaptation practices with farm technical efficiency and fertilizer use: A study of wheat–maize mix cropping zone of Punjab province, Pakistan. *Environ. Sci. Pollut. Res.* **2021**, 1–14, *in press*. [CrossRef]
28. Obi, C.; Bartolini, F.; D’Haese, M. International migration, remittance and food security during food crises: The case study of Nigeria. *Food Secur.* **2020**, *12*, 207–220. [CrossRef]
29. Materia, V.C.; Linnemann, A.R.; Smid, E.J.; Schoustra, S.E. Contribution of traditional fermented foods to food systems transformation: Value addition and inclusive entrepreneurship. *Food Secur.* **2021**, *13*, 1163–1177. [CrossRef]
30. UC Sustainable Agriculture Research and Education Program. *Direct Marketing: What is Sustainable Agriculture?* UC Division of Agriculture and Natural Resources: Davis, CA, USA, 2017.
31. Ahmed, A. 80pc of Pakistan’s poor live in rural areas, says World Bank report. *Dawn. Novemb.* **2018**, *11*, 2018.

32. Joshi, P.K.; Gulati, A.; Bithal, P.S.; Tewari, L. Agriculture diversification in South Asia: Patterns, determinants and policy implications. *Econ. Political Wkly.* **2004**, *39*, 2457–2467.
33. Snapp, S.S.; Blackie, M.J.; Gilbert, R.A.; Bezner-Kerr, R.; Kanyama-Phiri, G.Y. Biodiversity can support a greener revolution in Africa. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 20840–20845. [\[CrossRef\]](#)
34. Chaudhry, Q.U.Z. *Climate Change Profile of Pakistan*; Asian Development Bank: Mandaluyong, Philippines, 2017.
35. Schoeneberger, M.; Bentrup, G.; De Gooijer, H.; Soolanayakanahally, R.; Sauer, T.; Brande, J.; Zhou, X.; Current, D. Branching out: Agroforestry as a climate change mitigation and adaptation tool for agriculture. *J. Soil Water Conserv.* **2012**, *67*, 128A–136A. [\[CrossRef\]](#)
36. Belete, T.; Wato, T.; Bonga, E. Challenges and Prospects in the Adoption of Modern Agricultural Inputs in Gimbo District, Kaffa Region, Southern Ethiopia. *Public Policy Adm. Res.* **2020**, *10*, 1–13.
37. Olayemi, A.O. Effects of family size on household food security in Osun State, Nigeria. *Asian J. Agric. Rural Dev.* **2012**, *2*, 136–141.
38. Idrisa, Y.; Gwary, M.; Shehu, H. Analysis of food security status among farming households in Jere Local Government of Borno State, Nigeria. *Agro-Sci.* **2008**, *7*, 199–205. [\[CrossRef\]](#)
39. Oduniyi, O.S.; Tekana, S.S. Status and socioeconomic determinants of farming households' food security in ngaka modiri molema district, South Africa. *Soc. Indic. Res.* **2020**, *149*, 719–732. [\[CrossRef\]](#)
40. Bickel, G.; Nord, M.; Price, C.; Hamilton, W.; Cook, J. Guide to Measuring Household Food Security: Revised 2000. 2000. Available online: <https://naldc.nal.usda.gov/download/38369/PDF> (accessed on 21 January 2021).
41. Eneyew, A.; Bekele, W. Causes of household food insecurity in Wolayta: Southern Ethiopia. *J. Stored Prod. Postharvest Res.* **2012**, *3*, 30–43.
42. GoP. *Economic Survey of Pakistan 2018-19*; Ministry of Finance, Government of Pakistan: Islamabad, Pakistan, 2019.
43. ILAB. *Child Labor and Forced Labor Reports, Pakistan*; Bureau of International Labor Affairs: Washington, DC, USA, 2012. Available online: <https://www.dol.gov/agencies/ilab/resources/reports/child-labor/pakistan> (accessed on 6 August 2021).
44. Gregory, P.J.; Ingram, J.S.; Brklacich, M. Climate change and food security. *Philos. Trans. R. Soc. B Biol. Sci.* **2005**, *360*, 2139–2148. [\[CrossRef\]](#) [\[PubMed\]](#)
45. Haq, S.u.; Boz, I.; Shahbaz, P.; Murtaza, M.R. Rural families food intake behaviour in relation to livelihood diversification, income differences and family size. *Int. J. Consum. Stud.* **2020**, *44*, 481–498. [\[CrossRef\]](#)
46. Zhou, D.; Shah, T.; Ali, S.; Ahmad, W.; Din, I.U.; Ilyas, A. Factors affecting household food security in rural northern hinterland of Pakistan. *J. Saudi Soc. Agric. Sci.* **2019**, *18*, 201–210.
47. WHO. *World Health Organization Assesses the World's Health Systems*; World Health Organization: Geneva, Switzerland, 2000.
48. FAO. *Voices of the Hungry*; Food and Agriculture Organization: Rome, Italy, 2018.
49. Bogale, A. Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia. *Food Secur.* **2012**, *4*, 581–591. [\[CrossRef\]](#)
50. Mehra, R.; Rojas, M.H. *Women, Food Security and Agriculture in a Global Marketplace*; Working Paper of International Centre for Research on Women (ICRW): Washington, DC, USA, 2008; pp. 1–20. Available online: <https://www.icrw.org/wp-content/uploads/2016/10/A-Significant-Shift-Women-Food-Security-and-Agriculture-in-a-Global-Marketplace.pdf> (accessed on 15 April 2021).
51. Agarwal, B. Gender equality, food security and the sustainable development goals. *Curr. Opin. Environ. Sustain.* **2018**, *34*, 26–32. [\[CrossRef\]](#)
52. Kuma, B.; Getnet, K.; Baker, D.; Kassa, B. Determinants of participation decisions and level of participation in farm level milk value addition: The case of smallholder dairy farmers in Ethiopia. *Ethiop. J. Appl. Sci. Technol.* **2011**, *2*, 19–30.
53. Rahmato, D. Agrarian change and agrarian crisis: State and peasantry in post-revolution Ethiopia. *Africa* **1993**, *63*, 36–55. [\[CrossRef\]](#)
54. Barraclough, S. *An End to Hunger?: The Social Origins of Food Strategies*; United Nations Research Institute for Social Development (UNRISD): London, UK, 1991; pp. 1–284. Available online: [https://www.unrisd.org/unrisd/website/document.nsf/\(httpPublications\)/2FFA9CBB88CDD91C80256B670065CDF5?OpenDocument](https://www.unrisd.org/unrisd/website/document.nsf/(httpPublications)/2FFA9CBB88CDD91C80256B670065CDF5?OpenDocument) (accessed on 22 May 2021).
55. Ashfaq, M.; Hassan, S.; Naseer, M.Z.; Baig, I.A.; Asma, J. Factors affecting farm diversification in rice–wheat. *Pak. J. Agric. Sci.* **2008**, *45*, 91–94.
56. Ibrahim, H.; Rahman, S.; Envulus, E.; Oyewole, S. Income and crop diversification among farming households in a rural area of north central Nigeria. *Agro-Sci.* **2009**, *8*, 84–89. [\[CrossRef\]](#)
57. Agyeman, B.A.S.; Asuming-Brempong, S.; Onumah, E.E. Determinants of income diversification of farm households in the western region of Ghana. *Q. J. Int. Agric.* **2014**, *53*, 55–72.
58. Pellegrini, L.; Tasciotti, L. Crop diversification, dietary diversity and agricultural income: Empirical evidence from eight developing countries. *Can. J. Dev. Stud.* **2014**, *35*, 211–227. [\[CrossRef\]](#)
59. McNamara, K.T.; Weiss, C. Farm household income and on-and off-farm diversification. *J. Agric. Appl. Econ.* **2005**, *37*, 37–48. [\[CrossRef\]](#)