ESSAYS ON INCIDENCE OF THE FOOD POVERTY IN PAKISTAN

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

By

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PIDE 2016FPHDECO16

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Dedication

I dedicate this work to my Parents

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ABSTRACT

Food poverty or food insecurity is very crucial issue hurting millions of people. it is important to critically examine it. In this regard an attempt is made to assess the food poverty by conducting three essays with reference to Pakistan. In first essay the study made an effort to investigate the key determinants that influence various levels of food poverty. Various states of household food poverty are calculated by integrating the two measures of food security, per capita food expenditures (FOOD EXP) and average dietary energy consumption (ADEC), which represent food affordability or availability and accessibility respectively. The combined two indicators can be further categorized into four possible states of food poverty, including total food insecurity (on the base of both indicators), food insecurity on the base of only food expenditure, food insecurity on the base of only ADEC, and food insecurity based on ADEC and food expenditure both. Multinomial logit model is applied to conduct the empirical investigation using HIES data for 2018–19. Empirical findings are likely to verify the presence of various states of food poverty/food insecurity issues that need to address properly. The empirics also show how the impacts of household socioeconomic characteristics vary considerably among the various food poverty states defined for the investigation. It is concluded in order to ensure human wellbeing and to plan food security strategies to address this hot issue, it is crucial to understand the causes of household food poverty states.

The second essay investigates the role of spatial variation on food poverty states. The role of spatial dependence or spatial heterogeneity is very important and cause biasedness if existed but neglected. Many studies are conducted regarding the incidence of food poverty

and food security with reference to Pakistan but none could be find addressing the spatial non-stationarity, which states that a simple global model cannot describe how certain sets of variables are connected. The study used join count statistics and a spatial binary autoregressive probit model, which shows changes in the relative weight of numerous factors that affect poverty based on location. The join count statistics confirms the spatial clustering of the food secure districts than the spatial randomization distribution. It verifies spatial autocorrelation between the food insecure regions. The spatial autoregressive binary probit model also confirms the spatial non-stationarity between food insecure districts. The empirical results found that cultivated area for crop has negative and significantly impact the food insecurity. The livestock has negative but insignificant impact. Roads are main infrastructure and results also verify and indicating negative and significant effect on food insecurity. Average rainfall has negative and significant impact on food insecurity. It is concluded that food poverty is not randomly distributed in case of Pakistan and it demonstrate high degree of spatial clustering.

In third essay the study has attempted to assess the role of cash transfer in food insecurity. Cash transfers e.g BISP have the potential to support each of the four pillars of a sustainable food system by raising household income. Household income can boost the 'availability of food" as it can also boost local demand for goods, causing a supply response in the market. Such arrangements can also result in improving agricultural productivity and production by removing financial barriers for farmers and making it easier for them to buy seeds, fertilizer, and other inputs for their fields. The results indicated that increase the amount of cash transfer has likelihood to decrease the food insecurity. Hence, the study finds the conditional transfer program effective in reducing the food insecurity.

Taking into account the aforementioned situation, in four essay we tried to structure an understanding of the diverse policies and research initiatives carried out by specialists and interested parties from different ministries and esteemed establishments. Determining the nature of the action in the area of food and nutrition security is the primary objective of the chapter.

Keywords: Food poverty, food affordability, food availability, ADEC, food expenditure, autocorrelation, randomization, clustering Cash transfer, BISP

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LIST OF ABBREVIATIONS

ADEC	Average Dietary Energy Consumption
BISP	Benazir Income Support Programme
CPR	Contraceptive Prevalence Rate
CCS	Conditional Cash Transfer
DDI	Dietary Diversity Index
DDS	Dietary Diversity Score
ECD	Early Childhood Development
FAO	Food and Agriculture Organization
FCA	Federal Committee on Agriculture
FEI	Food Energy Intake
FIES	Food Insecurity Experience Scale
FLFP	Female Labor Force Participation
FOOD EXP	Food Expenditures
FP&PHC	Family Planning and Primary Healthcare Program
FPS	Food Poverty States
GDP	Gross Domestic Product
GFIS	Global Food Security Index
GHI	Global Hunger Index
GIS	Geographic Information Systems
GWR	Geographically Weighted Regression
HIES	Household Integrated Economic Survey
IUDs	Intrauterine Device
IYCF	Young Child Feeding

MDER	Minimum Dietary Energy Requirement
MDGs	Millennium Development Goals
MLM	Multinomial Logit Model
MNMIS	Multi-sectoral Nutrition Management Information System
MoNFSR	Ministry of National Food Security and Research
MPI	Marginal Propensity to Consume
NFPS	National Food Security Policy
NFSC	National Food Security Commission
NHSR&C	National Health Services, Regulations and Coordination
NNF	National Nutrition Forum
NNS	National Nutrition Survey
NNTMP	National Nutrition Thought Management Program
NSC	National Steering Committee
PARC	Pakistan Agriculture and Research Council
PASSCO	Pakistan Agriculture Storage &Services Corporation Limited
PMNS	Pakistan Multi-Sectoral Nutrition Strategy
PSLM	Pakistan Social and Living Standards Measurement
SDGs	Sustainable Development Goals
SDPI	Sustainable Development Policy Institute
SUN	Scaling Up Nutrition
TFR	Total Fertility Rate
UCCS	Unconditional Cash Transfer
UHC	Universal Health Coverage
UN	United Nations

WFP	World Food Program

ESSAYS ON INCIDENCE OF THE FOOD POVERTY IN PAKISTAN

Introduction

The household food poverty is an emerging idea that's well known in both developing and developed nations. According to Conor et al. (2016) "*food poverty is the insufficient economic access to an adequate quantity and quality of food to maintain a nutritionally satisfactory and socially acceptable diet*". Food poverty often is used as a synonyms word to food insecurity, particularly at a household level (Maslen, et al., 2013). At the household level, the biggest barrier is usually income rather than availability. As a result, food insecurity and food poverty are occasionally conflated (Wight et al., 2014). At the macro level, food security includes distribution and production systems. The idea of food poverty is closely related to the emphasis on household and microeconomic access to food. When applied to households, these terms characterize the same experience of deprivation (Dowler & O'Connor, 2012). Household with food insecurity is regarded as lack of food to meet everyone's needs for nutrients and energy. Within this approach, the terms "food insecurity" and "household food poverty" are sometimes used interchangeably. The reason is that we cannot separate debate of food insecurity from hard core poverty, as accessibility of adequate nutrition is one of the crucial constituents of United Nations' "Millennium Development Goals (MDGs)" meant for achieving low poverty across the globe (Kolawole, 2013). Similarly, no poverty and zero hunger are again one of the central goals of "Sustainable Development Goals (SDGs)". Food and Agriculture Organization (FAO) elaborates that "*food security exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs in accordance with inclinations for a healthy and active life*". Another essential prerequisite for achieving food security is having a minimal level of health that converts food intake into healthy and active body (UN, 2001). Health and nutrition are directly correlated

with food security. Malnutrition and poor health are two of the core effects of food insecurity. Therefore, ensuring access to food is essential for promoting nutrition and overall health. On the other side, food secure households may be capable to acquire more balanced diet and receive more nutritional content from the foods they. To ensure that food nutrients are effectively absorbed by human bodies, the food utilization component calls for the promotion of food processing and value addition.

Production and distribution are related to accessibility and availability, while Amartya Sen's ideas of "endowment" and "exchange entitlements," or the resources at one's disposal that define one's capacity to purchase, are related to affordability (Krishnaraj, 2005). Food availability and food access are the two necessary components of food security; however, food availability does not guarantee the access of the food. Food might be globally available but not necessary to all countries especially in developing countries or households within countries or even to individuals within the household (Austin et al., 2011). Therefore, we can differentiate between national food security and household food security. National food security demands both food production and the ability to import food from foreign markets in order to meet a nation's consumption demands. Basically, household food security is the ability to meet each household's nutritional needs year-round by having access to a sufficient supply of safe food. (Carletto, 1988). This division is essential because a country's ability to feed its population, whether through domestic production, imports, or both, is a necessary condition but not sufficient condition. In other words, having enough food available in a country on a per capita basis does not necessarily mean that there is enough food for every resident. Food security at household level is a subgroup of the national level and it entails that all individuals and households have access to sufficient food either by self-production or by creating sufficient income to demand for it (Omonona & Adetokunbo, 2007). The household food

security not only a depends on food supplies but also on ability to purchase to demand it (Adepoju et al., 2015).

As far as Pakistan is concerned, country is facing the issue of food poverty and insecurity. This is because of inadequate economic access by the poor and most susceptible, mostly women suffer for a sufficient and diverse diet. Evidence shows that 15 percent children below than 5 years are hit by severe malnutrition that is the second highest percentage in the region. On the other hand, the majority of children below 2 years of age take less than half of their day-to-day energy requirements and have inadequate levels of minerals and vitamins, while 44 percent of toddlers in the similar age range are stunted and 32 percent children are underweight. (National Nutrition Survey, 2022).

Food poverty in Pakistan is a complex problem that is intricately linked to social inequality, governance issues, and economic instability. Even though Pakistan is an agrarian nation, a sizable section of its population experiences food insecurity, with many of them living below the poverty line. Low-income households find it challenging to afford essential food items due to fluctuations in economic growth and high inflation rates, which have reduced their purchasing power. Inadequate infrastructure, inconsistent regulations, and a lack of assistance for small farmers have made it more difficult to distribute and access food effectively. Food poverty is greatly impacted by gender differences. Household food security is impacted by women's often restricted access to economic and educational opportunities, particularly in rural areas. Improving food security results requires empowering women through employment and education.

Food poverty has broad effects on economic productivity, education, and health. Malnutrition increases a child's vulnerability to illnesses and impairs their cognitive development, which feeds

the poverty cycle. Furthermore, as families turn to desperate means of surviving financially, food shortages can fuel societal instability and problems like forced marriages.

Keeping in view that food poverty or food insecurity is very crucial issue hurting millions of people, it is important to critically examine the issue. An attempt will be made to assess the food poverty in following essays with reference to Pakistan.

Essay 1- Determinants of Food Poverty States (FPS) in Pakistan.

Essay 2- Exploring the spatial variation of Food Poverty in Pakistan.

Essay 3- Social Safety Nets and Food Security in Pakistan: The role of Benazir Income Support Program (BISP)

Essay 4- Review of Policies

Each essay follows in sections below.

ESSAY I: DETERMINANTS OF FOOD POVERTY STATES (FPS) IN PAKISTAN

Abstract

One of the major issues facing developing nations like Pakistan is food scarcity. The study made an effort to investigate the key factors that influence various levels of food poverty. Various states of household food poverty are calculated by integrating the two measures of food security, per capita food expenditures (FOOD EXP) and average dietary energy consumption (ADEC), which describe food affordability or availability and accessibility respectively. The combined two indicators can be further categorized into four probable states of food insecurity, including total food insecurity (on the base of both indicators), food insecurity on the base of only food expenditure, food insecurity on the base of only ADEC, and food insecurity based on ADEC plus food expenditure both. The problem is examined using HIES data for 2018–19. A multinomial logit model is used to conduct the empirical research. Empirical findings are likely to verify the presence of various states of food poverty/food insecurity issues that need to address properly. The empirics also show how the impacts of household socioeconomic characteristics vary considerably among the various food poverty states defined for the investigation. It is concluded in order to ensure human wellbeing and to plan food security strategies to address this hot issue, it is crucial to understand the causes of household food poverty states.

Keywords: Food poverty, food affordability, food availability, ADEC, food expenditure, household

1.1 Introduction

Food is a basic daily need for growth of life and physical function of human body. Access to food is basic human right. According to Bidisha et al., (2021) the incapability of a household to constantly afford a diet that is appropriate regarding the nutrition requirement is symbolized to as food poverty. Malnutrition or food poverty decreases the productivity of an individual thus decline national productivity and economic development. It causes to increase in crimes and other social evils, while food security helps to enhance national stability through increased productivity which resultant in rapid economic growth. Food insecurity rests a key problem in development discourse across the globe, as it undermines people's productivity, health and even their survival (Smith and Subandoro, 2007). It generates adverse effects on mental, physical and social health (Grimaccia and Naccarato, 2020). It exhibits worse impacts across the lifespan of an individual resulting in poor nutrition and diet intake which translates in severe negative health consequences and even in social isolation (Kleve et al. 2021)

Food insecurity is universal issue. According to Pollard and Sue (2019), household food security is also a serious issue with reference to public health of developed countries like New Zealand, Australia, Canada and United States because of inequality. It indicates that social protections are not sufficient and indicating the ineffective government policies.

Most of the under developed countries are struggling with the problem of food insecurity. The sensation is most stroked in the countries with low income and Pakistan is one of those. In Pakistan, food poverty is still a serious problem that is caused by a number of social, economic, and environmental variables. Pakistan's population experiences food insecurity, despite the nation being a significant producer of wheat and a food surplus.

Pakistan is graded at 109 number (GFSI, 2024) from total of 127 countries. With the score of 26.1, Pakistan has a serious and alarming level of hunger. Tharparkar is of the poorest and most malnourished regions in the world placed in the Sindh Pakistan. Most of the land in the area is desert, people depends on seasonal rainfall (FAO, 2016). Pakistan is one of the third world countries where daily millions of people have to sleep without having appropriate meal. The country is having fertile land with adequate water, climate and weather which are agriculture friendly. Similarly, it is nuclear power and the industrial sector is making decent progress. Despite these, incidences are reported that due to hunger mothers sell their kids, and of children are dying because of illness due to nutrient insufficiency (Talpur, 2016). Following are the Key Factors Contributing to Food Poverty in Pakistan:

Economic Constraints: A significant portion of the population lives below the poverty line, limiting their ability to afford nutritious food. According the report of world food program (2024) nearly half of an average household's monthly expenditure is allocated to food, yet 82% of the population cannot afford a healthy diet.

Climate Change and Natural Disasters: Pakistan is the eighth most vulnerable nation to the effects of climate change. Food supply systems have been disrupted, agricultural productivity has been damaged, and food insecurity has been made worse by events like the historic floods in 2022 (wfp.org).

Social and Gender Inequalities: Food security in households is impacted by ingrained social and cultural norms that limit women's access to resources and services. More than half of the 26 million children between the ages of 5 and 16 who are not in school are females, which feeds the cycles of food insecurity and poverty (wfp.org).

Political Instability and Conflict: Because of road closures and security measures, areas hit by sectarian strife, such the Kurram district, suffer from acute food and medication shortages. Access to necessary resources is impeded and local economies are disrupted by these conflicts. (theguardian.com).

1.1.1 Significance of the Study

How much a nation is poor or wealthy can be gauged through the level of food consumption of its residents. When people have access to food, it means they have the means to support a vibrant, active lifestyle that includes sufficient food consumption according individual's requirement (Ullah at.al, 2022). Hence, we can define poverty line on the basis of food consumption level. To investigate the food poverty states in the country, the study is presenting the novel idea by combining two food security pillars, food availability and accessibility (representing respectively by the Average Dietary Energy Consumption (ADEC) and food Expenditure), which represent both food demand as well as the supply side at household level. According to Ozughalu (2016), households in poorer nations spend significantly more income on food relative to food products. As a result, poverty is frequently equated with hunger, hence it is more suitable to examine food poverty within households rather than poverty as a whole. In Most of the studies, conducted for Pakistan are based on Dietary Energy Consumption (represents availability) which captures the "supply side" only at household level. The study is using the household food Expenditures along with (ADEC) which represent the accessibility, covers the "demand side" as well at household level. So the study will attempt to capture the both supply and demand side at household level.

This study can be beneficial for targeting and policies and interventions to target individuals and households facing different type of food insecurity. So understanding the connection between indicators of household food poverty and socio economic features of household and gender are

essential for policy formulation and to design the intervention plans. Most helpless and vulnerable members of society could be helped to come out from trap of food poverty and food insecurity to a better state of food security.

In contemporary situation food poverty is one of the crucial issues that indulges the whole world in pain and in the worst situation of emotional well-being. So it is need of hours to take in consideration the important factors in context of the food poverty which is the main motivation and significance of this study.

1.1.2 Objective of the Study

The main objective of this study is to analyze:

- The underlying factors that determine food poverty states across households in Pakistan.
- The influence of women's socioeconomic standing and their role within the household on the likelihood of experiencing food poverty.

1.2 Literature Review

This section has two parts. First part covers the literature about the factors determining the food poverty. In second part women's role regarding the food poverty is discussed.

1.2.1 Factors Effecting Food Poverty

Various theoretical approaches have played role in formulation, revision and extension in the description of food insecurity. However, two theoretic approaches Food availability and Entitlement approach played key role in this regard. The first approach "food availability" approach is linked with "An Essay on the Principle of Population," by Thomas Malthus published in 1798. According to his writing the growth and progress of human was strictly restricted because of the burden that growth of population put on the accessibility of food. This methodology was

predicted on the equilibrium and disequilibrium between population and available food. To sustain this equilibrium, the progress and pace in food production should not be slighter than the rate of population growth. This approach took massive attention at both political and academician level until early 1970s.This approach gave dual policy implications. Proceeding the “demand side”, it requires to decrease fertility rate by reducing the growth rate of population through correct policies whereas on the “supply side”, the requirement is to rise production of food by boosting agricultural sector. For this purpose, generally recommended and implemented prime policy is to rise agricultural yield. Malthus assumed that population is increasing at higher rate than supply of food. This shows that population increases at a geometric rate, while the production size grows arithmetic rate. Resource will be scarce in that country and would be difficult to cope with growing number of population and resultant in food insecurity. This approach that food insecurity is due to short fall of food was challenged by second approach “Amartya Sen’s entitlement approach”. This second approach emphasis that people face food insecurity because of their incapability to obtain the food regardless that of food is available (Devereux, 2006). People faces starvation, does not indicate that there is lack of food to meet their needs. At the theoretical ground, Amartya Sen’s 1981 article on deprivation and entitlement postulated that food insecurity is mainly a demand side issue rather than supply distress. This line focusses on each individual’s entitlements to goods bundles which also includes food. So famine is result from a deprivation to be entitled and attained any package including abundant food. Main appreciated input of this approach related to food insecurity theorization is that it moves the analysis attention away from mania on food provisions, Malthusian view point “too many people, too little food” and on to the failure of masses to obtain food. So, it hits individuals who are not able to access satisfactory and sufficient food due to lack

of resources despite availability of sufficient food. This perception is that food uncertainty may happen even if food availability is satisfactory and markets are operative in well manner.

A number of approaches are used for calculation of the food insecurity measure to identify the factors of household food insecurity position (Ayantoye et al. 2011). “The Cost of Basic Needs (CBN) approach, the Food Energy Intake (FEI) method” adopted by Greer and Thorbecke (1986), “the expenditure method, the per capita daily calorie intake method, dietary diversity measures” and others.

Poverty is multidimensional phenomenon and food poverty is one of its dimension. It goes beyond income, capturing deprivations in health, education, and living standards. nutrition and food access are essential for health and survival; food poverty is embedded within the health dimension of multidimensional poverty. (Alkire & Foster, 2011). In Pakistan, poverty has varied over the years based on growth, agricultural performance, remittances, and policy changes. It was relatively low in the 1980s (high remittances, agricultural growth), but it increased sharply in the 1990s due to slow growth and macroeconomic instability. Rural poverty has always been higher than urban poverty, and it is closely related to land distribution, agricultural productivity, and the lack of non-farm employment opportunities. Punjab has consistently outperformed Balochistan and interior Sindh in terms of poverty, as it has benefited from irrigation, agricultural growth, and industrial linkage. Furthermore, there isn't a single, consistent approach for calculating poverty is used so for as estimates from different studies differ significantly. Until the middle of the 2000s, non-monetary and multidimensional poverty were not well explored, and the majority of research relied on income or consumption-based approaches. It is suggested that there is need for land reforms, human capital investment, and integrated rural development. For more precise policy formulation,

it is suggested that data collecting and poverty monitoring mechanisms should be improved (Naseem ,2012).

There are number of factors causing food poverty in Pakistan. Empirical evidence regarding food insecurity and poverty are presenting alarming situation. Numerous studies have pinpointed important causes of Pakistan's food poverty, including:

There are many economic constraints which are cause of food poverty. Access to sufficient nutrition is severely hampered by low purchasing power, high unemployment rates, and inflation (Shabnam et al.,2023). Khalid et al. (2005) investigated the issue of food poverty in Pakistan for national level and further decomposed at the urban, rural level to find out its important determinants including impact of credit, loans and financial assets on food poverty. Determinants of food poverty in Punjab are investigated by Sidhu & Vatta (2008) and revealed that only increase in production alone cannot ensure food and nutritional security. The household with low income are being more exposed to it. Income and employment opportunities for more poor and vulnerable segment of the society are expected to help to lessen their food insecurity and malnutrition. Bashir et al. (2012) also probed the situation of food security for the rural landless households of the Punjab. Around 27% households from the sample were identified to be food insecure from 576 landless households. Monthly income was determinant of food poverty. Same issue is also addressed by Nadeem et al. (2016) with reference to Punjab. It is concluded that low purchasing power is one of the main factors affecting malnutrition or food poverty. Akbar et al., (2020) found that in order to improve food security household's income, employment, revenue from agriculture, donations, parental education level, and certain household features are crucial. Shahzad et al., (2021) investigated the factors that influence food security and coping mechanisms in relation to

the COVID-19 epidemic. During the COVID-19 epidemic, food insecurity significantly increased. However, financial aid contributed to a decrease in this situation. Families that experience negative economic shocks reduce their intake of foods they prefer and seek assistance from the government and nonprofit organizations. To improve food security, it is recommended that government should increase financial support to households with low-income (Shahzad et al., 2021). Ullah (2023), also found a positive correlation has been observed between food security and household income, household expenditures. Likewise upsurge in food prices caused to increase in poverty. Price elasticities shows that urban households are hit harder than rural households in calorie-poverty model. Overall, rising food prices are likely to lead higher poverty in Pakistan. Therefore, effective strategy for eliminating poverty is far more concerned with price increases (Shabnam et al.,2023).

Demographic factors are significant determinants of food poverty. Pakistan's food poverty is a complex problem driven by a number of demographic variables. Demographic factors such as household size, gender, age, education, marital status, and geographic location significantly influence food poverty in Pakistan.

Food insecurity and household size are positively correlated. Due to a lack of resources, larger households may have more difficulty reaching their dietary demands. Furthermore, food poverty is made worse by a larger dependence ratio, which occurs when there are more dependents than working-age members. Due to the impact on household finances caused by this mismatch, obtaining enough food is challenging (Iram & Butt,2016). According Nadeem et al. (2016) large number of dependents and large household size are the main factors causing malnutrition or food poverty in Punjab. Akbar et al., (2020) analyzed socioeconomic and demographic characteristics

affect household food insecurity and concluded these factors play important role in shaping food poverty.

The results of food security are significantly influenced by the gender of the head of the household. Studies have shown that, in Pakistan, households headed by women are less likely than those headed by men to face food insecurity, which defies popular belief. According to this research, women may choose to manage their homes and allocate resources more skillfully (Hameed &Salam,2020)

One of the most important factors influencing food security is the age and level of education of the household head. Due to their greater means and knowledge, older age heads may be less likely to endure food poverty. Additionally, better income and work prospects are linked to higher education levels, which allow households to purchase enough wholesome food. The stability of the household and the availability of resources are influenced by marital status. Dual incomes and shared duties can improve food security for married household heads. On the other hand, those who are bereaved, divorced, or single may experience financial difficulties, which raises the risk of food poverty (Ullah,2022). Bashir et al. (2012) studied the situation of food poverty of landless households of the Punjab. Around 27% households from the sample were identified to be food insecure from 576 landless households. Education level of household head have positive impact, while the family size and the age of the household head were negatively correlated with food security of the household Akbar et al., (2020) analyzed how socioeconomic and demographic characteristics affect household food insecurity and found that parental education level, and certain household features are crucial. When compared to paternal education and paid employment, mother education and paid employment have a significant favorable impact on reducing acute food insecurity.

The degree of food security is strongly influenced by geographic location. Pakistani rural households are more likely than their urban counterparts to experience food insecurity. This disparity is caused by a number of factors, including restricted market access, inadequate infrastructure, and less job prospects (Parveen et al.,2024). Khalid et al. (2005) investigated the issue of food poverty in Pakistan for national level and further decomposed at the urban, rural level to find out its important determinants. Results identified that at the national level, on average 40 percent of households are falling lower than poverty line. Poverty is relatively high in rural areas, with 46 percent of the households, whereas in urban areas 41 percent of households are food poor. Asghar and Muhammad (2013) examined the factors causing food insecurity for general household and farmer both using PSLM (2007-08) survey. Study revealed that 50.4 percent households were food insecure. Food insecurity among urban households is 52 percent compared with 48 percent among rural households. Sindh, with 60 percent, is revealed to be highest vulnerable region in the study.

Climate changes has direct effect on food security. Approximately 412.9 million people in South Asia suffer from acute food insecurity, and climate change is making matters worse. The region's vulnerability is a result of its varied climate, which includes both coastal and drought-prone regions. Recent occurrences, such crop failures after natural disasters, highlight how closely agricultural productivity and food security are related in the face of climate change. Research examining data from 2000 to 2019 shows that South Asian countries' access to and availability of food are directly jeopardized by climate-related agricultural disturbances (Behera et al.,2024; Rehman et al.,2024)

Focusing on Pakistan, food poverty in Pakistan is also worsened by climate change, mainly because of its detrimental impacts on water resources, agriculture, and socioeconomic stability. Heatwaves have become more common in Pakistan since 1950 as a result of a rise in hot days and

a fall in cold days. Crop yields, particularly for staples like wheat and rice, have suffered as a result of these temperature anomalies and changed precipitation patterns. According to projections, Pakistan may lose almost US$20 billion by the middle of the century as a result of climate change if substantial action is not taken.

(Shahzad & Amjad,2022)

A vital component of Pakistan's economy and food supply, agriculture is extremely vulnerable to changes in the environment. Variations in precipitation and temperature have a negative impact on groundwater levels, soil quality, and crop production. Food insecurity and poverty in rural areas are directly caused by these changes, which lower agricultural production (Fahad et al.,2020)

The deterioration in agriculture brought on by climate change has significant economic repercussions. Reduced crop yields cause rising food prices, which disproportionately affect the poor and make poverty levels worse. Furthermore, millions of Pakistanis have been impacted by extreme weather disasters like the floods of 2022, which have raised poverty rates and caused large economic losses. (Ajani & Kees ,2021). A study of 1,080 farmers in 12 districts by Usman et al., (2023) revealed the crucial relationship between climate change, irrigation water availability, and food security, indicating that declining water resources, exacerbated by climate change, directly threaten agricultural output and rural livelihoods. Climate change has also made Pakistan's water shortages worse, affecting the productivity of crops and livestock.

Some areas of Pakistan are particularly susceptible to the combined impacts of food insecurity and climate change. For example, the coastal city of Gwadar has experienced increasing erosion and floods as a result of rising sea levels and higher rainfall, upsetting local lives and economies (apnews.com). Climate-induced food insecurity has significant socio-economic consequences. Extreme weather events have caused devastating floods in areas such as Sindh province,

destroying agricultural lands and livelihoods. As a result, families experiencing financial difficulties have turned to marrying off young daughters as a coping mechanism, which has increased the number of forced marriages (lemonade.fr).

1.2.2 Role of women's status

Conventional Economic theories are developed and established on the assumption that the economic behavior of human being is uniform and gender is ignored to have any impact on economic decision making. On the basis of its focus towards rationality, theories observe no differences in the man and women involvement in decision making regarding to resource allocation, production, consumption etc. (Kalansooriya & Chandrakumara, 2014). However, some studies highlighted below exposed that females are distinct from males with reference to above defined behaviors. Underlining food security situation in some Asian and African countries, researchers revealed that women play an important role in improving household food security. Women play a vital role in attaining the household food security in all dimensions of food security. They perform and significantly contribute to farming and hence resultant in household food availability. Their involvement to generate income is important in household food access particularly in low income households (Kalansooriya and Chandrakumara ,2014).

Quisumbing et al. (1995) found that in developing countries, as compared to a male, a female gives priority to household food related issues like need of food, intake, improvements of food and its nutritional implementation on family members specially children. Women are more sensitive for improving the household food intake and the nutritional statue of children, especially in developing countries.Likewise, Khasnobis and Hazarika (2006) found that in Pakistan, children's food security increases with improvement in women's intra-household status [1] relative to men.

[1] Women's intra household status is measured by the difference between the educational achievements of wife and household head and by the percentage difference of age between wife and household head.

Kennedy and Peter (1992) argued that the proportion of the income controlled by women has positive affect on the caloric intake of households in Kenya and Malawi

Numerous studies reported that women's education, in general has an improving effect on nutritional status and dietary quality of children and overall agricultural productivity (Quisumbing, 1996; Garret & Ruel, 1999; Gunesekara, 1999; Levin et al., 1999; Ekanayake et al., 2003; Olumokaiye & Ajayi, 2006; Sraboni and Quisumbing 2018;Ingutia and Sumelius 2022; Rasheed et al., 2022).

This debate is further heated by a controversy reported with respect to the women's employment and job decisions; which further confirms the importance of gender. Dimension of empowerment plays important role in agriculture regarding the nutrition status of women and children. Women empowerment is significantly related with infant quality and practices young children feeding (Malapit Quisumbing 2015 ,Sraboni and Quisumbing ,2018).On the other hand some studies found that a household's dietary quality and value is badly affected by women's employment and career (Haddad & Hoddinot, 1991; Levin et al., 1999; Rao, 2005). These studies reasoned that the women's participation in income generating activities cause them to bear tradeoff and compromise between time allocation in employment hours and household chores. Likewise, there is also a discussion regarding the food security realizations with the female-headed household compared to men headship. Some studies claimed that food security situation is better off and improves with female headship (Kennedy & Peter,1992; Levin et al., 1999), while other studies found the contrary (Babatunde et al., 2008; Zhou et al. (2019 ;Guirindola et al., 2023) that female-headed households were found to be more vulnerable and food-insecure than male-headed households. Nevertheless, few studies found no significant difference in the food security situation between female headed and male headed households (Kassie et al., 2014). The international organizations

and particularly government therefore need to pay attention more precisely on female headed households because they make decision about household consumption and other matters. Recognizing the role of gender, particularly of the female in household food security, is of great and valuable importance in policy formulation, as policies can be riveted at most powerful and influential groups to take action to reduce food insecurity/food poverty at household level (Kalansooriya & Chandrakumara, 2014).

Numerous studies have examined the connection between women's status and food security, emphasising the positive effects of increasing women's empowerment on household food security and nutrient intake. In this scenario, education becomes a significant factor. The need for policies that support women's educational chances is shown by Smith and Haddad's (2000) finding that 43% of the overall decrease in child malnutrition was attributable to improvements in women's education. In a similar vein, Olumakaiye and Ajayi (2006) found that educated Nigerian women were better equipped to feed their family a variety of nutrient-dense foods, improving household food security. Active involvement in household decision-making and economic empowerment are also essential. According to Ramachandran (2006), women from low-income households in South Asia work in a variety of occupations and are frequently the main breadwinners. Compared to homes managed by men, those where women have personal income and decision-making authority typically show distinct, frequently more favorable spending patterns. Accordingly, Babatunde (2008) discovered that food insecurity was more likely to affect households headed by women in Nigeria, indicating the need for focused initiatives to improve women's access to economic opportunities and nutrition education.

Gender equity has a major positive impact on the agricultural sector. According to a comprehensive review by Ruel et al. (2020), better household food security and child nutrition are

linked to women's empowerment in agriculture. In a similar vein, Sraboni et al. (2014) showed that dietary diversity and calorie availability in Bangladesh Notwithstanding the favourable correlations, challenges still exist. Despite generating a large amount of the world's food, women frequently have restricted access to resources like land, credit, and agricultural inputs, which makes it difficult for them to make sure food security, according to Ivers and Cullen (2014). Furthermore, a study conducted in Ghana by Malapit and Quisumbing (2015) discovered that although women's empowerment was associated with better infant feeding practices, it was not as strongly associated with nutritional status. its association with nutritional status was less pronounced, suggesting that empowerment alone may not suffice to overcome all barriers to food security.

Pakistani women's participation in employment is expected to rapidly increase in the coming years in all sectors of the economy. They are actively engaged in income generating activities. They are making vast contributions to economies, either in farms, businesses or in any role in other sectors as entrepreneurs or employees along with the unpaid home chores and family care activities(Akram, N. 2018). In case of the women's role about the food security, women are involved in all perspective and dimensions of the food security, such as production, availability and accessibility and utilization of the food. At household level, women perform a critical role in food security, dietary diversity and other matters related to children's health and nutrition. Pakistani women are actively involved and playing their role in various phases of food production not only in their own family farms but also in others farms in the village. They play a central role and get involved in producing, purchasing, processing, providing, storing and utilizing food for household and though contribute to handle food related problems to assure household food security (Bhattacharya, 2014).

Literature indicates mixed evidences about the role of women. Therefore, a comprehensive analysis which explores role of the gender in household food security will be useful for policy making to overcome and tackle the issue of food insecurity. In this perspective, this study in its second objective attempted to examine the role of women's socioeconomic and intra household status on household food poverty states in context of Pakistan. As women constitutes approximately half of the total population and their contribution is increasing rapidly. So this study will be valuable addition in literature about the contribution and role of Pakistani women with reference to food security.

1.2.3 Historical Development of Food Poverty Measurement Methods

In order to reduce hunger and malnutrition, policies and interventions have been greatly influenced by the development of food poverty assessment techniques. This development shows a growing awareness of the complexity of poverty and the need for precise, situation-specific measurements. If we discuss early foundation of poverty, the conceptualization of poverty has long been intertwined with access to essential commodities, notably food. In 1776, Adam Smith articulated that poverty encompasses the inability to afford not only life's necessities but also what societal norms deem essential for decency

The late 19th and early 20th centuries saw the emergence of empirical methods for calculating poverty. The foundation for contemporary poverty evaluation techniques was established by groundbreaking research conducted in Britain by Charles Booth and Seebohm Rowntree (Walter et al.2021). When economist Mollie Orshansky of the U.S. Social Security Administration created the Official Poverty Measure (OPM) in the middle of the 1960s, it was a major breakthrough. In order to account for other family expenses, Orshansky's method multiplied the cost of a basic food

diet by three to determine poverty criteria. This strategy was supported by data showing that, in 1955, families' food expenses accounted for about one-third of their after-tax income (Atkinson, 2019).

Efforts to measure food insecurity directly increased as it was realized that income-based methods had limits. In the United States, the National Nutrition Monitoring and Related Research Act of 1990 required the creation of standardised instruments to assess food insecurity at the federal, state, and municipal levels. The U.S. Department of Agriculture's (USDA) food security measure was developed as a result of this effort, and it has been crucial in supplying reliable data for the development of policies and the assessment of programs (Arteaga,2023)

The Committee on National Statistics (CNSTAT) carried out a thorough analysis of food security measurement techniques at the beginning of the new millennium. The goal of their assessment was to improve the instruments and make sure they appropriately represented the frequency and intensity of food insecurity in a range of demographics.

Current methods for quantifying food poverty place a strong emphasis on the value of context-specific information. Food poverty thresholds differ depending on local food prices and consumption trends, in contrast to the universal extreme poverty limit. This variation emphasises the necessity of customized approaches that tackle the particular difficulties encountered by various populations (Bartelme,2022).

Measuring food poverty is determining how many people or households do not have access to enough wholesome food that is safe and sufficient for a healthy life. To quantify this problem, several approaches have been devised, each with unique advantages and disadvantages.

1. Method of Food Energy Intake (FEI)

The FEI technique uses the minimum income needed to meet a set calorie intake to define the poverty line. This method accounts for regional pricing variations when calculating the cost of a

basket of foods that supply the required energy. It may not, however, take into consideration differences in dietary requirements and frequently ignores non-food necessities.

2. Cost of Basic Needs (CBN) Method

Expanding on the FEI, the CBN method accounts for both food and non-food necessities, such as clothing, housing, healthcare, and education, and determines the total amount of money needed to meet these needs, establishing a more comprehensive poverty line. This method provides a more comprehensive view of poverty, but it requires comprehensive household spending data.

3. The Orshansky Method of Food Sharing

This method calculates the non-food allowance by examining the proportion of household expenditures on food, especially for those who are close to the food poverty threshold. It creates a poverty criterion that accounts for both food and non-food needs by calculating non-food expenses based on food costs. Although useful, it makes the assumption that expenditure on food and non-food is always related, which may not be the case for all populations.

4. The MPI, or Multidimensional Poverty Index

The MPI evaluates several deprivations across a range of aspects, such as living conditions, health, and education, in order to determine poverty. It offers a more comprehensive perspective on poverty that goes beyond just food consumption or money. The MPI's implementation requires extensive data collecting and analysis, which might be challenging.

Every measurement technique provides a different perspective on food poverty, and the method selected can have a huge impact on how resources are allocated and how policies are made. As a result, choosing a strategy that complements the assessment's particular context and goals is essential.

In conclusion, a growing comprehension of the complexity of poverty is reflected in the historical evolution of food poverty measuring techniques. Effective policies and interventions aiming at reducing food insecurity internationally have been greatly influenced by these developments, which have progressed from early conceptualizations to complex, data-driven tools.

1.3 Theoretical Framework

When someone cannot afford a diet that satisfies nutritional standards, they are considered to be living in food poverty, which can have a negative impact on their health. Income levels, food costs, and the availability of reasonably priced food options are some of the elements that affect it. Understanding the causes and effects of food poverty is made easier by a number of frameworks:

• **Absolute Poverty Framework**: According to this approach, poverty is defined by a predetermined criterion, such as the minimal amount of money needed to cover essential expenses, such as enough food. Those who fall below this cutoff are categorized as being in food poverty.

• **Social Exclusion Theory**: According to this viewpoint, systemic obstacles that keep people from fully engaging in society, such as limiting their access to resources like reasonably priced and healthy food, are the cause of food poverty.

• **Capability Approach**: This concept, which was created by Amartya Sen, highlights people's capacity to live the lifestyles they wish. In this context, food poverty is defined as the inability to get and use food for a healthy lifestyle.

Below household utility model incorporates all these approaches to generate theoretical framework.

1.3.1 Household utility model and Food Security

The household utility model is used for modeling the theoretical background for the analysis of household food poverty or food insecurity. In this context, household utility function is modeled within the framework of theories of production and consumer demand that some households are

both producer and consumer. For this purpose, general household utility function is adapted suggested by Singh et al. (1986), here we modeled utility of household to incorporate simultaneous decisions about consumption, production and leisure as,

$U_{i=}f(C_i, l_i|X_i)$ ……(1.1)

Here, U_i is a utility function and it differentiable twice, strictly quasi-concave and increasing in its arguments. C_i is a vector of consumption demand of i_{th} household, comprise both food (C_{food}), and nonfood (C_{nfood}) consumption, l_i is devoted period for leisure while X_i is vector of the variables presenting the socio and demographic characteristics of household. These characteristics are encompassed to identify that household utility is derived from decisions of households and these decisions rest on inclinations of household's members.

C can be elaborated as,

$C_i\left(C_{food,}C_{nfood}\right)$……...(1.2)

We know that it is assumed some households are both producer and consumer, so it can be measured as a vector of food produce at home and then consumed (f_{homep}) and food purchased from market (f_{mktp}). In this regard, it can define as,

$C_{food}= (f_{homep}, f_{mktp})$ …….....(1.3)

We get Singh et al. (1986) specification by substituting equations number 1.2 and 1.3 into equation 1.1. So that , generalized utility function is specified as,

$U_i\left[\text{f}(C_{food,}C_{nfood}), l_i|\text{xi}\right]$…….....(1.4a)

$Ui\left[\text{f}((f_{homep}, f_{mktp}), C_{nfood}), l_i|\text{xi}\right]$……..... (1.4b)

However, for optimization of equation 1.4b, needs decisions about household's production and consumption done by households that are furnished independently, specifically for households those are both producer and consumer. These decisions depend on certain production, earnings

and time constraints. In this regard, decisions related to production are made first and afterwards income is utilized between purchasing of the commodities and leisure (Strauss, 1983). Conferring to Feleke et al. (2005), it is essential to incorporating the particular hypothesis since it is significantly believed that food consumption or food security rest on production of the food.

Consequently, in consistent with utility function formulated Singh et al. (1986), the constraints related to production, income and time levy in expansion of optimizing equation 1.4 (b) is demonstrated as follows:

Production constraint:

$$f\left[Q_{homep}, LA^0K^0 = 0\right] \text{.....(1.5)}$$

Equation 1.5 is traditional household production function for home produced products Q_{homep}. Production function is supposed to be differentiable twice, strictly convex, decreasing in inputs, increasing in outputs. Q_{homep} is vector of the amount of food produced in the farmsteads, A^0 is the size of the farmstead, K^0 is the fixed capital stock, L is total labor engaged to produce food in the farm.

Income constraint:

$$P_i = \left(Q_{homep} - f_{homep}\right) - P_{mktp}f_{mktp} - P_{nfp}C_{nfood} - w\left(L - l_f\right) + N \text{ .....(1.6)}$$

Equation 1.6 shows the price of food produced in farms. $Q_{homep} - f_{homep}$ is the excess of food produced, w indicates the wage rate, l_f is the entire labor supply by household in the farm, P_{mktp} is the price of market bought food , P_{nfoodp} is the price of nonfood goods; f_{mktp} is amount of food purchased from market; C_{nfood} is demand of nonfood item like health, housing ,education etc. N is the income from other than farm income used to make sure to equation 1.6 equal to zero.

Time Constraint:

$T = l_f + l$ and $l_f = T - l$ ……...(1.7)

Here, T indicates time endowment of a particular household obtain in respective period, which is allocated between time consumed working in the farm l_f and l leisure

By substitution of right hand side (RHS) of equation 1.7 into 1.6 we get:

$P_i(Q_{homep} - f_{homep}) - P_{mktp}f_{mktp} - P_{nfoodp}C_{nfood} - w(L - T + l) + N$ …… (1.8)

Expanding equation 1.8 we get

$P_iQ_{homep} - P_if_{homep} - P_{mktp}f_{mktp} - P_{nfoodp}C_{nfood} - wL + wT - wl + N$ ……..(1.9)

Re-arranging equation 1.9 we get household income and expenditure

$P_iQ_{homep} + wT + N - wL = P_if_{homep} + P_{mktp}f_{mktp} + P_{nfoodp}C_{nfood} + wl$ ……..(1.10)

In equation 1.10 the left hand side (LHS) shows the household earnings , which includes the value of farm produce P_iQ_{homep}, household's time endowment value wT, value of labour wL, and income other than farm N. Similarly, the RHS of the equation is equal to the spending of household, which includes the value of food produced at home P_if_{homep}, value of food buying from market food $P_{mktp}f_{mktp}$; value of nonfood Expenditure $P_{nfoodp}C_{nfood}$ and acquisition of leisure wl. By optimizing the equation 1.4b we obtain income and expenditure equations incorporating the "separability assumption", compulsory to meet first order conditions.

The input demand such as labor and the demand of output produced, particularly for the households those has home produce food, can be develop by maximization of the first order condition of the LHS of equation 1.10 with reference to labour (L) and output produced (Q) as,

$L^* = [l^*P_i\, wA^0K^0]$ ……..……(1.11)

$Q^* = \left[Q^*_{homep}l^*P_i\, wA^0K^0\right]$…….....(1.12)

L* is the optimal quantity of labour used in production and Q* is the optimal quantity of output produced. Substituting equations 1.11 and 1.12 into LHS of equation 1.10 we get optimal income (Y*) taking into account the assumption of profit maximization π* as

$Y^* = P_i Q^* + wT + N - wL^*$…….. …….(1.13a)

$Y* = wT + \Pi^*(P_i\, wA^0K^0)$ +N……...…..….(1.13b)

Where $\Pi^*(P_i\, wA^0K^0) = P_iQ^* - wL^*$

We can also derive household demand equation for food consumption C_f by resolving the first order conditions expenditures presenting in the RHS of equation 1.10. As explained earlier in equation 1.3 that C_f is a vector of f_{homep} and , f_{mktp}, however the several components of C_f are determined by their respective prices as well, specified as

$C_f = C_f(P_i, P_{mktp,}P_{nfoodp}, w, Y^*)$ ……...(1.14)

As food consumption demanded by household also depends on the likings of the members of household, it is imperative to include demographic features in the analysis, symbolized by X in equation 1.15 to figure the preferences of the households. Therefore, in order to obtain wide explanatory factors of C_f, we can further express equation 1.14 with reference to equation1.13b as,

$C_f = C_f\left(P_i, P_{mktp,}P_{nfoodp}, w, Y^*(\ P_i, w, A^{0,}K^0\ |x)\right)$…….(1.15)

Thus, if demand of household food consumption or food itself could be state as a measure of food security of household represented by FS_i, the C_f in compact form of utility function of equation 1.1 allows to incorporate factors that influencing food insecurity.

Assuming C_f linear function, following Felke et al. (2005) we can write the food security equation by incorporating factors effecting food security as

$$C_{f=} FS_{i=} \sum_{j=1}^{n} \beta_j x_j + \varepsilon_i \quad \ldots\ldots 1.16$$

Here x indicating the factors which determinants the food security. These factors can be economic, social and demographic as well (Carter et al.,2010). Economic factors can be household income, employment status, occupation, land ownership and other financial assets like house occupancy status as describe by absolute poverty framework. Education as a social indicator is included in the analysis. The demographic characteristics include sex and age of the household members, and number of household member along with women status in a household which describe the role of women in household food related decisions as described by social exclusion theory. In conclusion, the economic, social, and personal elements that lead to insufficient access to food are all integrated into the theoretical framework of food poverty.

1.3.3 Indicators of Food Poverty

As already described the inability of people or households to obtain enough safe, nourishing food for a healthy life is referred to as food poverty. A variety of variables that represent the financial, social, and physical aspects of food access are used to identify and quantify food poverty. Important indicators consist of:

1. **Economic Indicators**

• **Income Levels**: Determining the ability to buy enough food is aided by evaluating household income. Food poverty is more likely to affect low-income households since they have fewer financial means.

• **Food Expenditure Share**: This measure calculates the percentage of household income allocated to food expenses. Since more money is spent on essential food necessities, a higher percentage indicates economic vulnerability.

2. Physical Access Indicators

• **Proximity to Food Retailers:** Physical accessibility is indicated by the distance to markets or grocery stores. Living in places with poor access, sometimes referred to as "food deserts," might make people more food insecure.

• **Transportation Availability:** Having access to reliable means of transportation has an impact on getting to food sources, particularly in underdeveloped urban or rural locations.

3. Health Indicators

• **Malnutrition Rates:** The prevalence of undernutrition, especially in children, is a result of insufficient availability to and quality of food.

• **Diet-Related Health Issues:** Prolonged food poverty is associated with an increased risk of diseases including anaemia or stunted growth.

4. Food Consumption Indicators

• **Dietary Diversity:** A lack of diversity may be a sign of food poverty and possible nutrient deficits. Tracking the range of food groups consumed shows nutritional quality.

• **Meal Frequency:** Monitoring the quantity of meals eaten each day can help identify food inadequacy. Reducing portion sizes or skipping meals are coping mechanisms linked to food scarcity

FS_i, is considered as a vector of a number of indicators of household food security. These indicators could be food Expenditure (Foodexp), nutrient intake represented by average Dietary energy consumption (ADEC) dietary diversity score (DDS), dietary diversity index (DDI)), production index etc. The study will use two indicators, the food Expenditure and average dietary consumption to assess the food insecurity for given sample.

1.3.4 Women intra household status and Food Security

Food poverty and women's status have a complicated and multidimensional link that includes social, cultural, and economic factors. A theoretical framework that emphasizes how societal roles and women's empowerment affect household food security is necessary to comprehend this interaction.

Investigation about the effect of women's intra-household status relative to male on household's food security is also a chain of testing between two opposing views of researchers. Mainstream economists have traditionally believed the household is a monolithic unit[2]Later on this 'unitary model has been resilient to the view that decision of a household about the allocation of resources is a result of bargaining between family members. The unitary model, credited to Becker (1965, 1981), classically assumes that, the household by using market inputs combines its labor to produce a composite good for consumption, taking into account the budget constraint. These goods are disseminated among its members according to a uniform set of household preferences. The outcome of this view is that intra household distribution may be not effected by improvement and development in women's status.

[2] Monolithic unit means that all household members have same perspective and choices irrespective of gender.

On the other hand, Collective models of intra-household allocation view that intra-household distribution is result of Nash Bargaining between its members. Therefore, the allocations to a member are dependent on her bargaining power. So, these models foresee that improvement in women's status shall translate in rise and increase in allocations to children, women and other members of the household. It is compulsory to test these opposing views of as mistaken observance to the unitary model can result in lessen the effectiveness and efficacy of policy (Haddad, Hoddinott, and Alderman 1997). For Example, public transfers for assistance[3] the children may be less beneficial if the specific adult recipient is not fully worried and concerned about children while women are more anxious to their household members particular to children.

It is vibrant, therefore, that tests and investigation of the collective models vs unitary models of households have comprised of the exploration of links between, credible measures of bargaining power of the household members. On the other hand, need of interrogation is whether demand for certain goods and services by household such as health care and food are subject to this bargaining power and ultimately effect on different states of household's food poverty.

From above discussion we can conclude following aspect related to women's role regarding food security:

1. Gender and Household Food Security

Women's role in households have a massive effect on the outcome of food security. Women who have more control over family finances tend to spend more on nutrition, which improves the quality of the diet. This emphasizes how crucial women's resource management is to improving f

[3] Nash bargaining means that people have different alternatives they reach in a decision after bargaining with each other for choice from available alternatives

• **Social Exclusion Theory:** According to this viewpoint, structural obstacles keep women from fully engaging in the social and economic arenas, which restricts their access to resources required for food security. Food poverty can worsen when women are marginalised due to discrimination and traditional gender norms.

• **Capability Approach:** This concept, which was created by Amartya Sen, highlights people's capacity to live the lifestyles they wish. Empowering women increases their capacity to provide themselves and their family with enough food.

3. Economic Participation and Empowerment

In order to combat food poverty, women's economic empowerment is essential. Systemic, structural reforms that support women's rights and access to resources are essential, according to Oxfam's conceptual framework on women's economic empowerment. Food security is more likely to be achieved by households when women's economic standing improves.

In conclusion, empowering women and advancing gender equality are essential to addressing food insecurity and food poverty. Society can improve the food security and general well-being of households by tackling the structural obstacles that women encounter. Besides other factors women status in household plays an important role in determining food security. So the study has attempted to investigate the role of women’s socioeconomic and intra-household status (Relative status highlights the bargaining power) on household’s food security and whether bargaining is the apparatus of intra household allocation of resources in food consumption.

1.4 Data and Variables

This analysis used the Household Integrated Economic Survey (HIES) data for year 2018-19. There may be many social, economic and demographic factors that can be a reason a household to be fall in different states of poverty. Economic factors can be household income, employment status, occupation etc. Education as a social indicator is included in the analysis. The demographic characteristics include sex and age of the household members, and number of household member etc. Use of transportation is included by expenditure on transport services by household while use of mobile and internet facility is included as ICT indicators in the study. To analyze the role of women a sample of wives of the household head is selected. The women's income and education is used as a proxy to measure the socioeconomic status[4] of women. Socioeconomic status is the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation. Income and education play important role to improve food security of household. Kennedy and Peter (1992) argued that the share of the income handled by women has positive affect on the caloric intake of households. Women's education, in general has an improving effect on nutritional status and dietary quality of children and overall agricultural productivity (Gunesekara, 1999; Levin et al., 1999; Ekanayake et al., 2003; Olumokaiye & Ajayi, 2006) Following Schultz (1990), Thomas (1990) and Khasnobis and Hazarika (2006) women's intra household status is measured by the difference between the educational achievements of wife and household head and by the percentage difference of age between wife and head of the household**.**

[4]Socioeconomic status is the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation

The description and summary statistics of the explanatory variables (continues variables) is given bellow in the Table No 1.1 and 1.2 respectively.

Table 1.1: Variables Description (Determinates of Food Poverty States)

Variables	Description
Monthly Income	Average monthly income of the household in Pakistani Rupees from all sources
Employment Status	
Self Employed	If self-employed = 1,0 otherwise
Paid Employee	If paid employee = 1,0 otherwise
Agriculture	If occupation is agriculture = 1,0 otherwise
Dependency Ratio	Dependency Ratio is ratio of the people typically not included in the labour force (1 to 17 years and 65 plus) to the number of people included in labour force (18 to 65 years)
Family size	Number of family members residing in a household
Transportation	Expenditures on transport services by household in Pakistani Rupees
ICT Indicators	
Mobile	If mobile user =1,0 otherwise
Internet	If internet user =1,0 otherwise
Age	Age of household head in years
Gender	If gender is male = 1,0 otherwise
Education of Household Head	
No education	People having no formal education
Below matric	Below 10 years of education of household head
Matric-Intermediate	Matric or Intermediate level of education of household head
Bachelor and above	14 or above years of Education
Region	If urban=1,0 otherwise

Table 1.2 Variable Description (Role of Women's Status)

Variables	**Description**
Socio-Economic Status	
Female Monthly Income	Women's monthly Income in Pakistani rupees
Employment	Women's employment status: if employed=1,0 otherwise
Intra Household Status	
Percentage age Difference	Percentage Difference in age of household head age and women (spouse)
Difference in Education	Difference in education in years of women (spouse) and household head
Other Variables	
Education	Women's education in years
Dependency Ratio	Dependency Ratio is ratio of the people typically not included in the labour force (1 to 17 years and 65 plus) to the number of people included in labour force (18 to 65 years)
Region	Urban=1, Rural=0

Table. 1.3: Summary Statistics of Explanatory Variables

Determinates of Food poverty states			**Role of Women's status**		
Variables	Mean	Standard Deviation	**Variables**	Mean	Standard Deviation
Monthly Income	34508.28	3.6205	**Socio-Economic Status**		
Family size	7.4020	3.6821	Female Monthly Income	879.86	4.9812
Dependency Ratio	1.2684	0.8317	**Intra Household Status**		
Age	22.5749	20.5496	Age Difference	1.7453	5.5247
			Education Difference	0.8490	1.9301
			Dependency Ratio	1.1770	0.9759

1.5 Methodology

Household food poverty states are developed by combining the two measures, per capita food expenditure (FooD Exp) and average dietary energy consumption (ADEC), which represent food affordability or availability and accessibility respectively. The two combined measures or indicators can be further divided into four different food poverty states, complete food insecurity state (on the base of both indicators), food insecurity on the base of ADEC only, food insecurity on the base of food expenditure only, and state of complete food security (on the base of both indicators).

Given this, this study intended to find out household's socio economic variables which play an important role in food poverty states perspective.

1.5.1 Food Security Indicators in the Study

As described above the analysis is designed to combine household per capita food expenditure and ADEC to quantify the household food-poverty states. The details of measures are given below.

1.5.1.1 Per Capita Food Expenditure (Food Exp)

Literature has well-documented the usage of per capita food Expenditure (Food Exp) as an indicator to measure food security at household level (Smith and Subandoro, 2007; Faridi and Wadood, 2010; Heady and Ecker, 2012). Food expenditure is considered as significant indicator of food security because it takes in account the notion of susceptibility to food insecurity and which is used as a proxy for household food poverty level. Higher proportions of food Expenditures are crucial factor of intertemporal vulnerability to food insecurity (Faridi and Wadood, 2010). In literature a number of studies were constructed food security line in term of household per capita expenditure along 2/3 of weighted mean of per capita expenditure to be considered as threshold.

Canagarajah and Thomas (2001), Omonona and Adetokunbo (2007), Kuku and Liverpool (2010), Adepoju et al. (2015) and Adebayo (2016) too have used this threshold level. The observed household is considered food insecure (or food secure) when per capita food Expenditure of the particular is less (or greater) than 2/3 weighted mean of per capita expenditure of all households in given sample. So food secure household is defined as one whose per capita monthly food Expenditure remains equal or above to two third of mean per capita food Expenditure of all households. The food security measure is as given below;

$$FI = \frac{\text{per capita food Expenditure for the ith household}}{2/3 \text{ mean per capita food Expenditure of all households}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1.17$$

FI indicates Food security index, FI ≥ 1 = food secure household, FI < 1 = food insecure household. Same approach is often used by World Bank to investigate household poverty in the less developed countries in the world (Canagarajah and Thomas, 2001). Directed by past literature, the study used the threshold as 2/3 of the mean per capita monthly Expenditure on food as food poverty line to identify whether households are food secure or in given sample.

1.5.1.2 Average Dietary Energy Consumption (ADEC)

Per capita average dietary energy consumption of household is an indicator which calculates calorie consumption by an individual on average. To form this indicator, current household expenditure and consumption surveys data can be used, based on the entire sum of food acquirement or consumption by the household. Individual household's described consumption of foods is transformed into dietary energy (kcals) by matching distinct foods with a Food Composition table. The ADEC is calculated by accounting for the serving bought or consumed divided by the entire number of persons in that particular household. If data are collected for

number of days or if recall periods is for more than one day, the calculation of ADC require to be divided by the number of days of recall to form the number of calories per day by per person.

HIES Pakistan provides food consumption statistics at household level only, but the consumption need of food varies for the individual by sex and age. The number of “adult equivalents” is used to adjust for sex and age variances between them. Each individual in the household is allotted an adult equivalent factor that compare and relates his or her energy requirements with the adult energy requirement per person per day (2350 kcal) for moderate activity. Calculation of sum of individual household’s adult equivalent size is done through Equation 1.18 given below.

$$AE_N = \sum_{i=1}^{N} AE_i \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \; 1.18$$

Where AE_N shows household total adult equivalent size and AE_i is equivalent factor of an individual where N= i……………N

Adult equivalent factor or size is picked up from equivalence scale specified in “Poverty reduction strategy paper Pakistan [PRSP-I (2003)]”

Table 1.4: Equivalent Factor

Age (Measured in years)	Daily Requirement of Energy per Individual	Equivalent Factor
Children		
<1	1010	0.429787
01-04	1304	0.5548936
05-09	1768	0.7523404
Males		
10-14	2816	1.1982978
15-19	3087	1.3136170
20-39	2760	1.1744680
40-49	2640	1.1234042
50-59	2460	1.0468085
> 60	2146	0.9131914
Females		
10-14	2464	1.04851063
15-19	2322	0.98808510
20-39	2080	0.88510638
40-49	1976	0.84085106
50-59	1872	0.79659574
>60	1632	0.69446808
National average	2350	1

Source: " PRSP-I (2003)".

To find out the average dietary requirement we divide total calories consumed by a household to the sum of the respective household equivalent factor

$$ADEC = \frac{Tkcl}{AE_N} \text{ ……..(1.19)}$$

ADEC is matched with minimum dietary energy requirement (MDER) of individuals to make decision about a specific household whether he/she is food secure or insecure. If ADEC < MDER household would be considered as food insecure and if ADEC>MDER household is food secure. According to FAO (2008), MDER of a distinct individual is described as the cut off threshold caloric intake, a person would have to take to achieve a minimum standard weight for height to keeping a healthy life to perform moderate level of physical activity.

This is measure of the diet quantity taken and insights an estimate of the energy accessible to a household. It can be used to evaluate the food insecurity of a people in order to plan a suitable policy intervention to overcome the issue (Smith & Subandoro, 2007).

1.5.2 Household Food Poverty States (FPS)

Using predetermined threshold discussed earlier in first approach an observed household is considered food insecure (or food secure) when pe(Adepoju et al., 2015 and Adebayo ,2016). r capita food Expenditure is less (or greater) than 2/3 weighted mean of per capita expenditure So food secure household is defined as one whose per capita monthly food Expenditure remains equal or above to two third of mean per capita food Expenditure of all household. Secondly ADEC is matched with minimum dietary energy requirement (MDER) of individuals to make decision about a specific household whether he/she is food secure or insecure. If ADEC < MDER household would be considered as food insecure and if ADEC>MDER household is food secure.

We derive FPS by combining Food Expenditure and ADEC to categorize households into mutually exclusive states of food poverty. The four states are identified as;

(1) State of complete food insecure (evident by both indicators)

(2) Transiently food insecure state on the base of ADEC but food secure on the base of Food Exp

(3) State of transiently food insecure on the base Food Exp but food secure on the base of ADEC

(4) Complete food secure state (evident by both indicators).

We construct FPSi in such a manner that a households in complete food insecure state identified through both indicators have FPS=3, households in state of transitorily food insecure on the base of ADEC and food secure on the base of Food Expenditure has FPS=2 , households in state of transitorily food insecure on the base of Food Expenditure and food secure on the base of ADEC has FPS=1 and households in complete food secure state evident by both indicators have FPS=0

1.6 Empirical Model

As discussed earlier there are four possible states food poverty described by discrete number as complete food secure has FPS =0, food insecure on the base of Food Exp has FPS =1, food insecure on the base of ADEC has FPS=2, and completely food insecure has FPS =3. So the discrete variable represented by the FPS is dependent variable investigated in the study. Conferring to Rose and Bliemer (2008), when dependent variable has more than two discrete possibilities, such regression is a generalized form of the "logistic regression" technique. Therefore, the study used a multinomial logit model (MLM) to evaluate food poverty states of household as there are more than two categories of food poverty.

The MLM will assess how socio economic variables of household impact on the possibility that a particular household in given sample falls in any of the defined N-1 potential FPS discussed above. According to Bhat (2003), when the choices are unordered the usage of MLM is often a suitable strategy. Following Greene (2008), we have chosen the MLM for the analysis for M discrete alternatives (m = 0, 1,….M) through an odds ratio Z_{mj}, if the first product or state which is 0 in our case ,works as the reference category as:

$$Pr_{mi} = \Pr[fp_{im}\,] \forall m \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1.20$$

Where m=1…….M

$$Z_{im} = \ln \left[\frac{pr\ [fp_i\, m = 1,2 \dots \dots \dots \dots \dots \dots M/x]}{\left[pr\ [fp_i\, m = 1,2 \dots \dots \dots \dots \dots \dots M]\right]} \right]$$

$$Z_{im} = \ln \left[\frac{[fp_i\, m = 1,2 \dots \dots \dots \dots \dots \dots M/x]}{\left[\ [fp_i\, m = 1,2 \dots \dots \dots \dots \dots \dots M]\right]} \right]$$

$$Z_{im} = \ \alpha_{im} + \sum_{k=1}^{k-1} \beta_{ikm}\ x \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 1.21$$

$$pr[fp_i\ , m = 1,2 \dots \dots \dots \dots . . M/x] = \frac{\exp[Z_{im}]}{1 + \sum_{m=0}^{M} \exp[Z_{im}\ ]} \dots \dots .1.23$$

$$pr[fp_i\ , m = 0] = \frac{1}{1 + \sum_{m=0}^{M} \exp[Z_{im}]} \dots \dots \dots \dots \dots . \dots \dots .1.24$$

WhereZ_{im} is probability measure for the ith household in M state with reference to household's state m=0. ln is the natural log and x shows the households socioeconomic factors assumed to explain food poverty states and β defines the parameters to be estimate.

There could be the issue of the endogeneity in regression. Instrumental variables could be used to address both endogeneity and measurement error, but it is challenging to identify reliable tools that forecast long-term use. We tackle these problems in the absence of conventional instruments by employing a method created by Lewbel (2012) that builds instrumental variables by taking advantage of heteroskedasticity in endogenous or mismeasured explanatory factors (Courtemanche et.al.,2020).

To address the issue of the endogeneity between food poverty and income, before applying MLM we incorporated Lewbel Instrumental Variable approach. Valid instruments in standard IV

estimation must be uncorrelated with the error term and correlated with the endogenous regressors. However, it can be difficult to locate such tools. Lewbel's approach gets around this by creating instruments using the data's inherent heteroscedasticity. In particular, it takes use of the model's heteroscedasticity structure by building instruments as functions of the exogenous variables multiplied by the centered endogenous repressors.

So when external instruments are not accessible, the Lewbel Instrumental Variable (IV) technique in a Multinomial Logit Model (MNL) uses heteroscedasticity to construct instruments. This approach works especially well for dealing with endogeneity in discrete choice models. This estimator substitutes assumptions regarding the covariance of certain variables with the error terms. Tests of over identifying restrictions and well-known first-stage F-statistics can be used to evaluate these covariance assumptions.

To demonstrate the Lewbel approach, we have the following general illustration of a simultaneous system of equations:

$y_1 = \beta_1 y_2 + \beta_1 X + \varepsilon_1$……1.25

$y_2 = \beta_2 y_1 + \beta_2 X + \varepsilon_2$……1.26

Where y_1 represents food poverty and y_2 income of the household and X represents vector of endogenous variables. Correlations between the errors ¸ε_1 and ¸ε_2 are permitted in the Lewbel technique. Each instrument is derived from the residuals of auxiliary equations multiplied by each exogenous variables in the following mean-centered form:

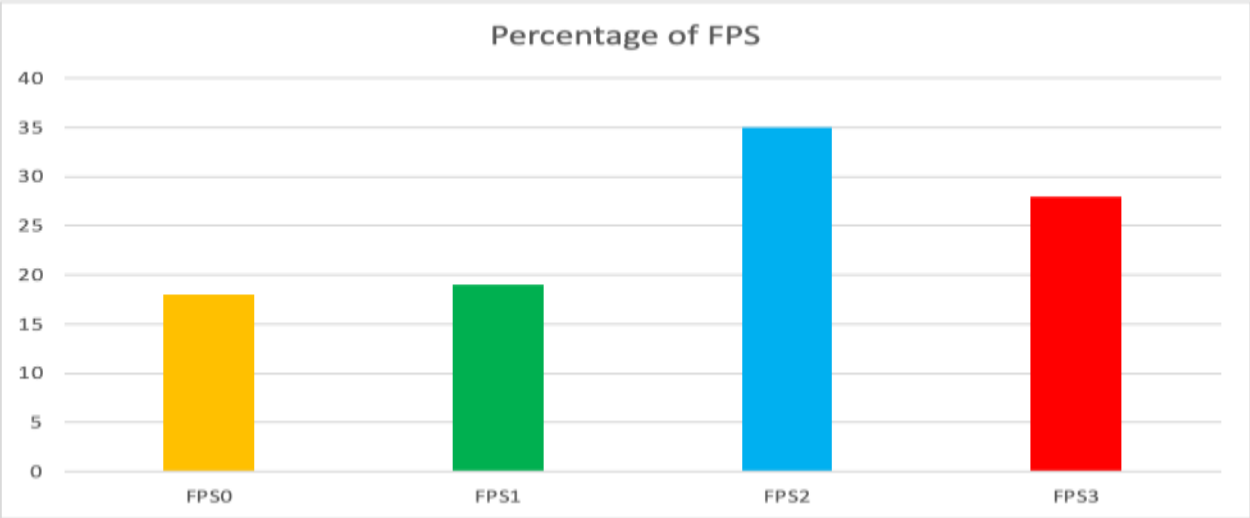
$Z_I = (X - \bar{X}), \in$ … … … … … … … … ….1.27

Each endogenous regressor's residual vector from a regression on all exogenous regressors, including a constant, is represented by ∈ (Vladimir et al.,2022).

1.7 Results and Discussion

The study used two food insecurity measures or indicators average diversity energy consumption (ADEC) and food Expenditure (Food Exp), which represents food availability and food accessibility, respectively.

Figure.1.1 **:** Percentage of Food Poverty States



Above figure shows that about in the specified sample, 17.2%, 19.8%, 35% and 28% of the households are referred to in the state of complete food secure, food insecure based on food expenditure only, food insecure on the base of ADEC only, and complete food insecure on the base of both indicators, respectively.

Table 1.5: Distribution of Food Poverty States by Regions

Food Poverty States	Urban	Cumulative	Rural	Cumulative
0	31.92	31.92	14.04	14.04
1	10.65	42.57	23.23	37.27
2	47.14	89.71	34.40	71.67
3	10.29	100	28.33	100

Table 1.5 shows region wise food poverty distribution.31.9 percent are food secure in urban areas, while 10.65 % and 47.14 % are in transitory food poverty (Food insecure by one indicator but insecure by other one).10 % is food poor by both indictors in given sample.

In rural areas 14.04 percent are food poor, while 23.23 and 34.40 percent are in situation of transitory food poverty (Food insecure by one indicator but insecure by other one) and 28.33 percent population is food poor by both indictors in given sample.

Table 1.6 : Distribution of Food Poverty States at Provincial Levels

Food Poverty States	**KP**	**Punjab**	**Sindh**	**Baluchistan**
0	18.55	17.28	21.47	18.98
1	13.15	21.70	23.19	15.89
2	48.87	34.07	31.96	48.83
3	19.43	26.96	23.38	16.30

Table 1.6 shows province wise food poverty distribution.KP has witnesses 18.55 % non-poor by both indicators,13.15 % and 48.87 % are in transitory food poverty (Food insecure by one indicator but insecure by other one) and 19.43 % population is food poor by both indictors in given sample. In Punjab 17.28 % population is non-poor, 21.70 % and 34.07 % are in transitory food poverty (Food insecure by one indicator but insecure by other one) and 26.96 % population is food poor by both indictors. 24.47 % population is non-poor in Sindh by both indicators, 23.19 % and 31.96 % are in transitory food poverty (Food insecure by one indicator but insecure by other one) and 23.38 % is food poor by both indictors. In Sindh both indicators indicated that 18.98 % is non-poor, 15.89 % and 48.83 % are in transitory food poverty (Food insecure by one indicator but insecure by other one) and 16.30 % population is food poor by both indictors in given sample.

Table 1.7: Distribution of Food Poverty States by Male-Female Headed Households

Food Poverty States	Male Headed	Cumulative	Female Headed	Cumulative
0	21.91	21.91	22.06	22.06
1	24.98	46.89	33.49	55.55
2	30.94	77.84	22.14	77.68
3	22.16	100	22.3	100

Table 1.7 depicts the distribution of different food poverty states by male and female headed household. It is indicated that 21.91 % and 22.06 % households are food secure by male and female headed households respectively by both indicators.24.98 and 33.49 % are food poor by "food expenditures only "in male and female headed household respectively. 30.94 and 77.84 % is food poor by food "ADEC only" in male and female headed household respectively. There is no significant difference in state of food poverty by both indicators in male and female headed houseolds.22.16 % are food poor in male headed household while 22.3 % is food poor by female headed household in given sample.

Table 1.8: Distribution of Income Quantiles and percentage of Food Poverty States

Food Poverty States	Lowest quintiles	Com.	Second quintile	Com.	Third quintile	Com.	Fourth quintile	Com.	Highest Quintile	Com.
0	5.24	5.24	13.64	13.64	18.64	18.64	26.59	26.59	36.73	36.73
1	24.01	29.25	21.95	35.59	21.69	40.33	17.56	44.15	12.11	48.84
2	26.11	55.36	41.58	77	44.46	84.80	44.99	89.14	44.17	93.01
3	44.64	100	22.83	100	15.20	100	10.86	100	6.99	100

Above table shows the distribution of income [Quantiles based on HIES (2018-19)] and percentage of food poverty states. It is indicated that as per capita monthly income increases food poverty decreases. The results show that on average 5.24 percent households are food secure in lowest

quintile, while 44.64% s food poor by both indictors in given sample. 13.64 percent households are food secure. Second quintile shows that 13.64 % is food secure while 22.83 % s food poor by both indictors in given sample. 18.64 percent households are food secure in third quintile, while 15.20 % s food poor by both indictors. 26.59 percent households are food secure in fourth quintile, while 10.80 % s food poor by both indictors in given sample. 36.73 percent households are food secure in highest quintile, while 6.99 % s food poor by both indictors in given sample.

1.7.1 Determinants of Food Poverty States.

The impact of socioeconomic structures of household on the different food poverty states is explored in the present study. The multinomial logit model is estimated for the purpose. To tackle the issue of endogeniety between dependent variable (Food poverty) and endogenous regressor (income) Lewbel instrumental variable (IV) is used. When conventional external instruments are insufficient or unavailable, the Lewbel instrumental variable (IV) technique provides a way to deal with endogeneity in regression models.

The value of Kleibergen Paap rk LM statistic[5] is 1558.615 with with Chi-sq(8) P-value = 0.0000 demonstrating that the model has been identified and that the instruments have a sufficient correlation with the endogenous variables.The vaue of the Kleibergen-Paap rk Wald F statistic[6] is 170.088 (A common rule of thumb is that a value exceeding 10 suggests that the instruments are

[5] In instrumental variables (IV) regression, the Kleibergen-Paap rk LM statistic is a diagnostic tool used to determine whether the model is under identified. Unreliable estimates result from under identification, which happens when the instruments do not offer enough information to separate the endogenous components of the explanatory variables.

[6] The Kleibergen-Paap rk Wald F statistic is a diagnostic tool used in instrumental variables (IV) regression to assess the strength of instruments, particularly in the presence of heteroscedasticity or clustering. It evaluates whether the instruments are sufficiently correlated with the endogenous regressors to provide reliable and valid estimates.

sufficiently strong, reducing concerns about weak instrument bias) indicating that the instruments are sufficiently correlated with the endogenous regressor.

After applying Lewbel (IV) technique we replaced the endogenous variables with their instrumented predictions and estimate the multinomial logit model. The Likelihood Chi-Square ratio in the model is significant as the ($p< 0.000$) which is used to test that at least one of the coefficient of explanatory variables is not equal to zero in given model. So null hypothesis is rejected that all coefficients are all together are zero which shows the goodness fit of the model.

Table 1.9 presents the outcome of odds[7] ratio from the estimated model. The coefficients given below are the odds ratio of a household's presence in the state of transitorily food insecure or completely food insecure compare to state of complete food secure household based on household's socioeconomic features or characteristics. The odd ratios of the coefficients show the risk of the outcome in the assessment group compare to the risk of the outcome dipping in the base category (food secured based on both measures) due to change in explanatory variables. The value of odds ratio greater than one designates that the risk of the outcome existing in the comparison or assessment group comparative to the risk of outcome dipping in the base group rises as the value of predictive or independent variable increases, shows positive association and vice versa.

[7] Value of odds ratio >1 indicates positive relationship between predictor and predicted estimating K-1 model and vice versa.

Table 1.9: Determinants of Food Poverty States

Explanatory Factors	**Odds ratio of food insecure household on the base of Food Exp only**	**Odds ratio of food insecure household on the base of ADEC only**	**Odds ratio of complete food insecure household identified by both Indicators**
Log of Monthly Income	0.0079 *** (0. 0004)	0.08400 *** (0. 0216)	0.0077 *** (0 .0003)
Employment Status			
Self-Employed	0. 0813 *** (0. 0264)	0.7890*** (0.0786)	0.0616 *** (0. 0218)
Paid Employee	0.8562*** (0. 0247)	0.9057 *** (0 .0173)	0. 8684 (0. 9287)
Agriculture	0.7787 *** (0.0748)	0.9839 (0.0411)	0.48037 *** (0. 1045)
Dependency Ratio	1.1456 *** (0.0155)	1.0723*** (0.0126)	1.1777 *** (0..0189)
Log Family Size	1.4890*** (0.0021)	1.3076 *** (0.0036)	1.5079 *** (0 .0044)
Transport Exp	1.0096 *** (1.37e-06)	1.0001 *** (0.3.49e-07)	1.9967*** (1.67e-06)
Mobile	0.7601 *** (0. .0189)	0.9323 *** (0.0155)	0.8575 *** (0 .0209)
Internet	0.4971 *** (0. 0189)	0..7243 *** (0. .0183)	0.5756 *** (0.0107)
Age	0.9867*** (0.0014)	0. 0013 *** (0 .0003)	0.9876 ** (0.00075)
Gender	0.3084 ** (0. .0229)	0.9656*** (0 .0187)	0 .9456*** (0.0237)
Education			
No education	1.8863 ** (0.0432)	1.0330 (1.0349)	1.8582 * (1. 1488)
Below Matric	0.6426*** (0.0496)	0.7694* (0.04555)	0 .5334 *** (0. 0534
Matric and intermediate	0.3954 *** (0.0846)	0.7393 *** (0. 0395)	0.6318 *** (0. 0750)
Graduation and above	0.5485*** (0. 1019)	0.6904*** (0 .0465)	0.5607 ** (0.1257)
Region	0.3456*** (0 .0063)	0.6879 *** (0.0138)	0.3347 *** (0..0071)

Multinomial Logit Model is estimated with LR chi2(48) = 125836.00 (p = 0.0000). N= 24323, Base category= food secure based on both indicators. Odd Ratios are presented in the columns with standard error in the parenthesis.(Note: * , ** and *** show significance at 10%,5% and at 1% respectively)

Above table indicates that odds of the household being food insecure on the base of Food Exp only is 0.0079 times lower and significant with increase in monthly income relative to completely food

secure household in the study. It illustrates that as the percentage in income of a household increases the food insecurity decreases. Similarly, odds of the household being food insecure on the base of ADEC only and food insecure on the base of both indicators is 0.08400 and 0.0077 times less respectively and significant with increase in the monthly income, comparative to the household in complete food secure state. Economic deprivation is the main cause of food poverty. Regular income from employment enables households to buy enough food that is safe and nourishing. This directly tackles the aspect of food security that deals with economic access. Employment status is measured in the study by the people who are self-employed, paid employee and the people who are employed in agriculture sector.

The odds for household being food insecure on the base Food Exp only ADEC only and complete food insecure based on both indicators compare to household being complete food secure is 0.0813, 0.7890 and 0.0616 times significantly lower, respectively if household is self-employed.

The odds for household being food insecure on the base of Food Exp, ADEC only, and complete food insecure based on both indicators compare to household being complete food secure is 0.8562, 0.9057 (significant) and and 0.8684 times lower higher respectively if household is paid employee.

The odds for household being food insecure on the base of Food Exp, ADEC only and complete food insecure based on both indicators compare to household being complete food secure is 0.7787 (significant) , 0.9839 and 0.48037 (significant) times lower, respectively if household is employed in agriculture sector. Above result indicates employment is likely to decrease the issue of food poverty of household

There are fewer members working in productive jobs when the dependency ratio and number of household members is high. Households that get little income may find it difficult to pay for a diet that is sufficient in nutrients. With a large number of dependents and few wage workers

raise the likelihood of food poverty by lowering per-capita food availability and purchasing power. The study indicates the same results as described below.

The odds for household being food insecure on the base of Food Exp only, ADEC only and complete food insecure on the base of both indicators comparatively to household being complete food secure is 1.1456, 1.0723and 1.1777 times higher and significant, respectively if household's dependency ratio increases.

The odds for household being food insecure on the base of Food Exp only, ADEC only and complete food insecure on the base of both indicators comparatively to household being complete food secure is 1.4890, 1.3076 and 1.5079 times higher and significant, respectively if size of household's family increases.

High transport expenditures can indirectly and directly rise the risk of food poverty because they effect to compromise food budget and affect access to markets. The odds for household being food insecure on the base of Food Exp, ADEC only and complete food insecure based on both indicators compare to household being complete food secure is 1.0096, 1.0001 and 1.9967 times higher (significant) with increase in transportation expenditures.

Mobile and internet usage is included as ICT indicators in the study. The odds for household being food insecure on the base of Food Exp, ADEC only and complete food insecure based on both indicators compare to household being complete food secure is 0.7601, 0.9323 and 0.8575 times lower (significant), respectively if household is mobile user relative to non-users of mobiles.

The odds for household being food insecure on the base of Food Exp, ADEC only and complete food insecure based on both indicators compare to household being complete food secure is 0.4971, 0.7243 and 0.5756 times significantly lower, respectively if household is internet user relative to non-user. The effectiveness of mobile phones and internet connectivity in lowering food poverty

is becoming more widely acknowledged. Although they play a less direct impact than income, they help households increase opportunity, efficiency, and access in ways that increase food security.

People usually gain education, work experience, and social networks as they become older and enter middle age

. This lowers the chance of food poverty by increasing their economic potential and household stability. The odds for household being food insecure on the base of Food Exp only, ADEC only and on the base of both indicators compare to household being complete food secure is 0.9867, 0.0013 and 0.9876 times significantly lower if age increases by one year. This indicates as the age of household increases the food poverty is likely to decrease.

It is commonly known that women experience greater food insecurity than men. Economic, social, and cultural disparities that restrict women's access to resources and decision-making authority are the cause of this gender gap. Same results are reported in the study.

The odds for household being food insecure on the base of Food Exp, ADEC only and on the base of both indicators comparative to household being complete food secure if the gender is male is 0.3084, 0.9656 and 0.9556 significantly times lower respectively, relative to if gender is female.

One of the most effective long-term strategies for lowering food poverty is education. Income, awareness, and decision-making are all influenced by education, and these factors either directly or indirectly increase household food security.

The odd of household being food insecure on the base of Food Exp only, ADEC only and complete food insecure on the base of both measures comparatively to household being complete food secure is 1.8863 significant , 1.0330 and 1.8582 times higher if there is no education

The odd of household being food insecure on the base of Food Exp only, ADEC only, and complete food insecure on the base of both measures comparatively to household being complete food secure is 0.6426, 0.7694 and 0 .5334 times significantly lower if the education of household head is below matric.

The odd of household being food insecure on the base of Food Exp only, ADEC only and complete food insecure on the base of both measures comparatively to household being complete food secure is 0.3954 , 0.7393 and 0.6318 times significantly lower if the education of household head is matric to intermediate. The odd of household being food insecure on the base of Food Exp only, ADEC only and complete food insecure on the base of both measures comparatively to household being complete food secure is 0.5485 , 0.6904 and 0.5607 times significantly lower if the education of household head education is graduation or above.

The odds for household being food insecure on the base of Food Exp only, ADEC only and based on both indicators compare to household being complete food secure reside in urban area is 0.3456, 0.6879 and 0.3347 times significantly lower respectively than the odds for the households reside in rural areas. Despite the fact that most food production takes place in rural areas, the result indicates that rural households are frequently more food poor than urban ones. Rural households experience a number of systemic disadvantages with regard to income, access, and services.Table 1.10 comprises the estimated results for poverty states (of household's food insecure by both indicators) from Multinomial Logit model for rural, urban and province level

Table 1.10: Determinants of Food Poverty States by region and Province (odd Ratios)

Explanatory Factors	Odds ratio of complete food insecure household identified by both Indicators					
	Rural	**Urban**	**KPK**	**Punjab**	**Sindh**	**Baluchistan**
Log of Monthly Income	0.0126*** (0.0002)	0.0185 *** (0 .0003)	0.0546 *** (0.0202)	0.0101 *** (0.0003)	0.0088*** (0.0002)	0.0741 *** (0. 0116)
Self Employed	0.8951*** (0.0372)	0.8582 ** * (0.0488)	1.0276 ** (0.2904)	0.8582*** (0.0488)	0.8863 *** (0.0432)	1.0330 *** (0.0349)
Paid Employee	0.8660 (0.9802)	0. 9683*** (0.0287)	0.9397*** (0.0147)	0.9667*** (0.0427)	0.9662 (0.99247)	0.9056*** (0 .0173)
Agriculture	0.2046*** (0.0566)	0.4903 (0.6035)	0.2939 (0.3317)	0.2177*** (0.0601)	0.2787*** (0.0758)	0.6756 (0 .7173)
Dependency Ratio	1.1371*** (0.0256)	1.2571*** (0.0186)	1.0559*** (0.0091)	1.1871*** (0.0156)	1.1566*** (0. 0164)	1.0833*** (0.0117)
Log Family Size	1.9406*** (0.0036)	1.6079*** (0.0045)	1.2066 *** (0.0026)	1.599*** (0.0031)	1.398*** (0.0031)	1.2066*** (0.0026)
Transport Exp	1.9994 *** (1.20e-06)	1.9838 *** (1.27e-05)	1.0001 *** (02.72e-07)	1.009 *** (1.37e-06)	1.009*** (1.37e-06)	1.007*** (0.349e-07)
Mobile	0.8481 *** (0.0152)	0.8696*** (0 .0209)	0.9142*** (0.01630)	0.8702 *** (0.0170)	0.8401*** (0. .0187)	0.9223 *** (0.0154)
Internet	0.4250 *** (0.0147)	0.4866*** (0.0206)	0.9006 *** (0.0121)	0. 4344 *** (0.0155)	0.4791*** (0. .0199)	0..8223*** (0. .0173)
Age	0.0011 *** (0.0004)	0.0888*** (0.00057)	0.0044*** (0.0003)	0.0377*** (0.0004)	0.0013 *** (0.0007)	0.0012 *** (0.0003)
Gender	0.9955* (0.0175)	0 .9556*** (0. .0227)	0.6743*** (0.0141)	0.9524*** (0.0184)	0.2094 *** (0.0219)	0.3556 (0. 9977)
No education	1.0523 *** (0.0148)	1.0616 *** (0. 0218)	1.6889** (0.5560)	1.0384*** (0.0115)	1. 0813 *** (0. 0264)	1.7890** (0.0786)
Below Matric	0.7328 *** (0.0510)	0 .6334*** (0.0524	0.8427*** (0.0382)	0.6003*** (0.0437)	0.7426*** (0.0596)	0.7626* (0.7196)
Matric and intermediate	0.4064*** (0.0388)	0.6318*** (0 .0650)	0.7064* (0.6388)	0.6024*** (0.0541)	0.3064*** (0.0388)	0.7393*** (0.0435)
Graduation and above	0.2289*** (0.0503)	0.6608*** (0.1257)	0.6102 *** (0.0437)	0.3995 *** (0.0694)	0.4455 (0.6719)	0.3102 (0.3337)
Region	0.2254*** (0.0047)	0.2327 *** (0..0062)	0.7689*** (0.0109)	0.2095 *** (0.0048)	0.2989*** (0.0627)	0.7989*** (0.0129)
N	14,794	9,529	3,817	11,605	6,758	2,143

Multinomial Logit Model is estimated. Base category= food secure based on both indicators. Odd Ratios are presented in the columns with standard error in the parenthesis. (Note: * , ** and *** show significance at 10%,5% and at 1% respectively)

Similar to the national level, table 1.10 shows the odd ratios of regional and provincial level. Estimated results shows that odd of income has likely to negative effects on the household being food insecure relative to complete food secure households. These effects remain consistent for urban, rural and all provinces Employment status such as head's employment as the self-employed status has negative and significant impact on both regions and all provinces on food poverty. The head's paid employee status has negative effect on all regions and in all provinces but insignificant for rural region and for Sindh. Employment status in agriculture has a negative and significant effect on food poverty in rural areas, while it has insignificant effect tin urban region and the rest of the provinces except Punjab and Sindh. Similarly, dependency ratio and household size are showing positive and significant impacts on the food poverty state of households in both regions and all provinces as compare to food secure household. Same impact is shown for transport expenditures. Mobile phone and internet are used as ICT indicators in the study and odd ratio shows both has negative and significant impacts on households being food insecure in both regions and all provinces as compare to food secure household

The age has positive and significant effects on the household's food insecurity for both regions and all provinces. The odds for household being food insecure comparative to household being complete food secure is significantly lower relative to if gender is female except the case of Baluchistan, gender does not have statistically significant results mean, it makes no statistical significance whether gender of is male or female.

All education levels have negative and significant impacts on the of the households in the case except the higher education level in case of Sindh and Baluchistan. The odds for household being food insecure is significantly lower than the odds for the households reside in rural areas

1.7.2 Role of Women's status

The impact of socioeconomics and intra household food poverty states is explored in the present study. The multinomial logit model is estimated for the purpose. To address the issue of endogeniety between dependent variable (Food poverty) and endogenous regressor (female income) Lewbel instrumental variable (IV) is used.

The value of Kleibergen Paap rk LM statistic is 227 with with Chi-sq(8) P-value = 0.0000 demonstrating that the model has been identified and that the instruments have a sufficient correlation with the endogenous variables. The vaue of the Kleibergen-Paap rk Wald F statistic is 29.0 (A common rule of thumb is that a value exceeding 10 suggests that the instruments are sufficiently strong, reducing concerns about weak instrument bias) indicating that the instruments are sufficiently correlated with the endogenous regressor.

After applying Lewbel (IV) technique we replaced the endogenous variables with their instrumented predictions and estimate the multinomial logit model.

The Likelihood Ratio Chi-Square in the model was significant as the ($p< 0.000$) which is used to test that at least one of the coefficient of explanatory variables was not equal to zero in given model. So null hypothesis is rejected that all coefficients in the model are all together equal to zero which shows the goodness fit of the model. Table 1.6 given below describe the empirical findings of the analysis.

Table 1.11: Estimation Results; Role of Women's status (Odds Ratio)

Explanatory Factors	**Odds ratio of food insecure household on the base of Food Exp only**	**Odds ratio of food insecure household on the base of ADEC only**	**Odds ratio of complete food insecure household identified by both Indicators**
Socio-economic Status			
Income	0.377 * (8.88e-06)	0.889*** (3.25e-06)	0.396 (7.87e-06)
Education	0.607* (0. 0070)	0.809* (0.0071)	0.561* (0.0074)
Employment	1.704* (0.007)	1.127* (0.067)	3.341* (0.122)
Intra Household Status			
Percentage Difference in age	0.767* (0.018)	0.919** (0.018)	0.620* (0.017)
Difference in Education	0.643 * (0.006)	0.789 * (.006)	0.308* (0.006)
Dependency Ratio	1.587 * (0.017)	1.323* (0.025)	1.318* (0.027)
Region	0.235* (0.010	0.858* (0.027)	0.325* (0.011)

Multinomial Logit Model is estimated with LR chi^2 (21) = **7831.29** (p = 0.0000). Base category= food secure based on both indicators.Odd Ratios are presented in the columns with standard error in the parenthesis.

Base category= food secure based on both indicators. (Note: * , ** and *** show significance at 10%,5% and 1% respectively)

The odds of the household being food insecure on the base of Food Exp only is 0.377 times less and significant with increase in monthly income relative to completely food secure household. Similarly, odds of the household being food insecure on the base of ADEC only and food insecure on the basis of both indicators is 0.889 and 0.396 times significantly lowers respectively with increase in the monthly income comparative to completely food secure household.

The odds of being food insecure on the base of Food Exp only, ADEC only and on the base of both indicators comparative to complete food secure households is 0.6o7, 0.809 and 0.561 times significantly lower with increase in one level of female education.

The female employment has surprising result than expected. The odds of being food insecure on the base of Food Exp only, ADEC only, and on the base of both indicators comparative to complete

food secure households is 1.704, 1.127and 3.341 times significantly higher with increase in one level of female employment level.

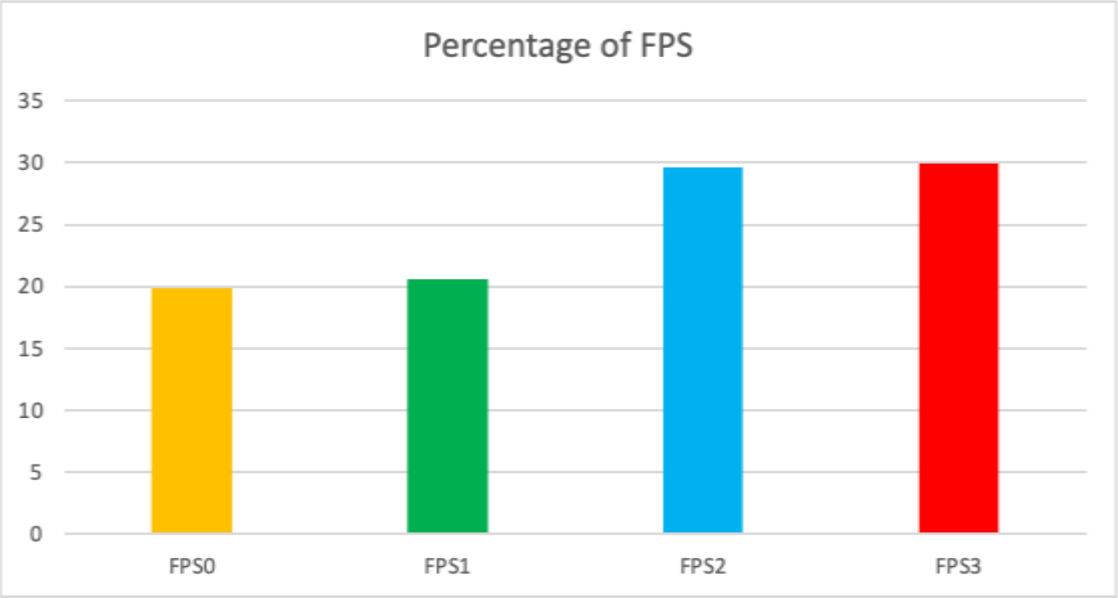
Female intra household status is measured thorough percentage age difference between head of the household and spouse age and difference between their educational attainment.

The results indicate that the odds of being food insecure on the base of Food Exp only, ADEC only and on the base of both indicators comparative to complete food secure households is 0.767 and 0.789 and 0.308 times significantly lower with age difference between wife and husband. The odds of being food insecure on the base of Food Exp only, ADEC only and on the base of both indicators comparative to complete food secure households is 0.643, 0.938 and 0.790 times significantly lower increase in one level of female education relative husband.

The dependency ratio is negatively related to all states of food poverty. The odds of being food insecure on the base of Food exp only, ADEC only and based on both indicators relative to complete food secure households is 1.587, 1.323 and 1.323 times significantly higher with reference to increase in dependency ratio.

Furthermore, the odds for household being food insecure on the base of ADEC only, Food Exp only and based on both measures relative to household being complete food secure reside in urban area is 0.235, 0.588 and 0.325 times significantly lower respectively than the odds for the households reside in rural areas. It shows that relative risk of household being food insecure with reference to all indicators is more in rural areas compare to urban areas. Rural areas are relatively less developed relative to urban areas and cities, thus has less earning and educational opportunities to its residents which are main determinants of food security of households**.**

***Figure 1.2*:** Distribution of Food Poverty States



Above figure shows that about in the specified sample, 19.86%, 20.56%, 29.64% and 29.94% of the households are referred to in the state of complete food secure, food insecure based on food expenditure only, food insecure on the base of ADEC only, and complete food insecure on the base of both indicators, respectively.

1.8 Discussion

Food security is one of the major issues facing Pakistan. The study made an effort to investigate the key factors that influence various levels of food poverty. Various states of household food poverty are calculated by integrating the two measures of food security, per capita food expenditures (Food Exp) and average dietary energy consumption (ADEC), which represent food affordability or availability and accessibility respectively

The factors influencing food poverty (FPS) states exhibit that odds of being food insecure household comparative to complete food secure households reduces by increase in income. As increase in income enables to purchase more variety of nitrous food. This result is consistent with

the findings of Bashir et al., (2010), Sindhu et al., (2008) and Onianwa and Wheelock, (2006). Improvement in household head education is likely to decrease in odd of household to be food insecure. More educated household has better employment opportunities and nitrous knowledge (Bashir et al., 2010; Titus and Adetokubo, 2007). No one can deny the importance of ICT to increase welfare of masses. ICT development on food security are prompted by mobile phone and Internet development. Internet and mobile usage can improve food security not only of small farmers but also of big landlords by providing the information about market, market linkages and awareness about climate variability etc. (Ezoha et al.,2019 ; Twumasi et al.,2021).Our results shows that the odd of being food insecure decreases by usage of mobile and internet facility. The household residing in the urban regions are more probable to food secure as compare to rural areas. It rises with increase in household size and dependency ratio. As number of family members expand, fewer working individual's hands have to provide for a larger number of non-working members. An increase in the number of dependent depends on meagre incomes to survive, hence result in a decrease in the amount of resources and food consumed per person (Sindhu et al., 2008); Hahn et al., 2009; Bashir et al., 2010; S. Sharaunga et al., 2016). Agriculture plays a significant role in mitigating food insecurity because farmers and their families can cultivate a variety of fruits and vegetables on their farms, providing them with more options for a varied and easily accessible diet than people in non-farm jobs. Households associated only with farm income indicated if engage in agriculture are likely to decrease in food security (Azeem et al.,2016; Aziz et al.2020). Transport services have the power to drive social and economic growth, which would lower poverty, boost productivity and food security, and diminish the hunger. Having cheap access to public transit lowers the likelihood that a household would experience food insecurity (Baek,2016).

It is found that food insecurity is likely to be increase with rise in transportation expenses of households.

Whereas the empirical findings look to upkeep the presence of different kinds of food poverty/food insecurity issues that need precise essentials. The findings also show how the impacts of household socioeconomic characteristics considerably vary among the various food poverty states elaborated for the investigation. It is concluded that in order to ensure human wellbeing and for scheming and implementation food security strategies it is essential to address this hot and panic issue. For this purpose, it is essential to understand the components and factors that contribute to household food poverty conditions.

Second objective of the study is to investigate impact of women's socioeconomic and ultra-household status on food poverty The summary of the results shows that determinants of food poverty (FPS) states related to women's socio-economic status shows that odds of being food insecure household compared to complete food secure households reduces as the female income increases (see Table 1.10). The reason is as the portion of income controlled by women positively impact on dietary diversity and caloric intake (Kennedy and Peter, 1992). It also reduces through attainment of education as numerous studies reported that women's education in general has an improving effect on nutritional status and overall agricultural productivity (Levin et al., 1999; Ekanayake et al., 2003; Olumokaiye and Ajayi, 2006). However, it increases by employment status of women. The possible reason may be that the women's participation in income generating activities cause them to bear tradeoff and compromise between time allocation in work hours and household tasks (Haddad and Hoddinot, 1991; Levin et al., 1999; Rao, 2005).

The intra household status shows that odd of being food insecure declines with education attainment of wives relative to household head and with percentage difference in age of spouse

and household head. The study confirms the results of Khasnobis and Hazarika, (2016). Other variables i.e households in the urban areas has lower odd to being food insecure relative to a household reside in rural areas but it rises with increase in dependency ratio of household**.**

Table 1.11: Income Levels and Food Poverty States

Income Levels	**FPS=0**	**FPS=1**	**FPS=2**	**FPS=3**	**Total**
0-20000	5257	5583	7958	8140	26938
21000-50000	111	9	87	7	214
51000-100000	30	1	16	0	47
>1000000	6	0	3	0	9
Total	**5404**	**5593**	**8064**	**8147**	**27208**

1.9 Policy Implications

In the insight of empirical results of the study;

- It is imperative for government to create cognizance and knowledge on reproductive health and decision about their household size to ensure small household size and dependency ratio by forming health centers with free guidance on these issues.
- Since it is evident that increase in income of the household declines food insecurity, it is vital for government to promote policies that efficiently work to enhance the earnings, receiving capacity and opportunities for the households.
- Agriculture is major sector of Pakistan. It is need of time to reduce the cost of agriculture production through increasing the farm level supply of authentic and certified seeds, quality fertilizers and provision of pesticides along with easy institutional credit and appropriate farm machinery.

- Further, it is found that education of the household head is a crucial to increase household food security. Government should launch policies to improve the education not only the for head of the household but education of females should be also encouraged particularly the women in rural areas.
- It would be imperative to encourage and support women for small scale income receiving opportunities. Through these opportunities they can involve within the home or nearby home, rather than providing employments with high income far away from home but decreasing the attention on household activities. Women has to bear the opportunity cast of household care and attention because of tradeoff between time allocation to household chores and employment hour as result indicated it has negative effect on attainment of food security.

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ESSAY II: EXPLORING THE SPATIAL VARIATION OF FOOD POVERTY IN PAKISTAN

Abstract

Food insecurity is crucial issue and indulged the huge masses in pain. The role of spatial dependence or spatial heterogeneity is very important and cause biasedness if existed but neglected. Likewise, qualitative investigation of limited geographical level does not permit a countrywide assessment of the factors of insufficient food consumption and malnutrition. Many studies are conducted regarding the incidence of food poverty and food security with reference to Pakistan but none could be find addressing the spatial non-stationarity, which states that a simple global model cannot describe how certain sets of variables are connected. The study used join count statistics and a spatial binary autoregressive probit model, which shows changes in the relative weight of numerous factors that affect poverty based on location. The join count statistics confirms the spatial clustering of the food secure districts than the spatial randomization distribution. It verifies spatial autocorrelation between the food insecure regions. The spatial autoregressive binary probit model also confirms the spatial non-stationarity between food insecure districts. The empirical results found that cultivated area for crop has negative and significantly impact the food insecurity. The livestock has negative but insignificant impact. Roads are main infrastructure and results also verify and indicating negative and significant effect on issue of food insecurity. Average rainfall has negative and significant effect on food insecurity. It is concluded that food poverty is not randomly distributed in case of Pakistan and it demonstrate high degree of spatial clustering.

Key words: location, join count, probit model, autocorrelation, randomization, clustering

2.1 Introduction

Every human has a basic need and right for food, but it is undeniable that there is a lot of food insecurity in the modern world. Despite the fact that Pakistan is among the world's top producers of cereals, but more than 500 million people there go to bed hungry every night. (Asghar & Muhammad, 2013). According to SDPI report (2022), there is a serious concern about food security despite the country's substantial food production, approximately half of the population faces food insecurity and undernourishment at the household level. According to the Scaling Up Nutrition (SUN) Movement Annual Progress Report (2020), the annual cost of malnutrition in Pakistan is $7.6 billion that is 3% of GDP, and includes loss of labors, healthcare costs, and poorer productivity. Food security at household level is not always guaranteed when it is achieved at the national level. Even if a household is individually food secure it does not guarantee that all members in the household are food secure. For their respective areas, the geographic, environmental aspects of food security are critical.

The decentralization process in Pakistan is now developed enough to put the policies into practice. The government at district levels have the power to take action to improve food security (Ejaz et al.2012). Therefore, here we have concentrated on district-level analysis of food poverty.

Many studies are conducted regarding the incident of food poverty in Pakistan. Most of the analyses are based on self-conducted household surveys, which represents few regions; often fail to expose the location of the effected.

The role of spatial dependence or spatial heterogeneity is very important and cause biasedness if existed but neglected. Spatial analysis[8] is very important in discussion of food security. We can

[8] Spatial variation explains how and why characteristics vary throughout the earth's surface. It is the investigation of the evolution of observable spatial patterns.
The effect of one region has an impact on the surrounding regions is spillover effect.

find hidden patterns in food consumption from raw data by using measures of spatial association. Hidden pattern means whether food consumption behaviors are clustered, dispersed, or randomly distributed behaviors in various geographic locations.It helps to investigate whether food poverty is regionally concentrated, has a high degree of spatial autocorrelation, or is distributed randomly across the nation or has spillover effects. In context of food poverty, the spatial analysis approach makes it possible to include environmental characteristics that help in the identification of trends in socioeconomic data (Farrow et al ., 2005.)

Food insecurity is not evenly distributed; it is more prevalent in certain regions, particularly in those with high rates of poverty, few economic prospects, or poor infrastructure.

Because of this, studies on place and food security frequently concentrate on areas or communities with high rates of unemployment or poverty as well as racial or ethnic segregation, where it is thought that Residents are the risk of experiencing food insecurity. (Coleman et al., 2013). Likewise, qualitative investigation of limited geographical level does not permit a countrywide assessment of the reasons of insufficient food consumption and undernutrition. Policies aimed to improving nutrition and reducing inequality should be grounded on exhaustive studies detailing these discrepancies and detecting the causes (Farrow et al., 2005).

There are number of advantages of spatial analysis. The display of the assessments in map form is an effective tool for preparation of policies to responses the food poverty. Spatial information can measure information and explain trends grasped in the maps Petrucci et al. (2003). Using spatial analysis maps to visualize food poverty assessments is an effective method to inform and influence successful policy responses. By using spatial analysis maps, policymakers can identify areas where

food poverty is more prevalent. Governments and organizations can spend resources more effectively if they have clear visual representations of the distribution of food poverty. It is possible to evaluate the efficacy of policies by mapping food poverty over time. To enhance results, policymakers can track shifts in the trends of food insecurity, assess the effectiveness of actions, and modify plans as necessary. In short this strategy makes it possible to implement focused, successful, and efficient interventions, which eventually helps to lower food insecurity and advance the welfare of the community.

Spatial econometrics will remain essential in tackling the complicated issues of food poverty as long as data quality and computing capabilities improve. A strong foundation for examining the geographic aspects of food poverty is provided by spatial econometrics, which helps researchers and policymakers spot trends, causes, and spillover effects that conventional econometric techniques would miss. Significant aspects of spatial econometrics in relation to food poverty are examined in this in-depth analysis.

1. Autocorrelation and Spatial Dependence:

Spatial dependence in food poverty is common, with neighboring regions having an impact on one region's level of food security. Biased estimations and poorly thought out policy initiatives may result from ignoring this geographical autocorrelation. These dependencies are explicitly taken into account by spatial econometric models, such as Spatial Lag Models (SLM) and Spatial Error Models (SEM), which yield more accurate assessments. Anselin and Bera (1998), for example, underline the significance of including spatial effects in econometric analysis when discussing diagnostic tests for spatial dependency.

2.Spatial Heterogeneity

Due to distinctive local characteristics, the ways in which factors impact food poverty may vary by region. This heterogeneity is addressed by spatial econometrics, which provides a deeper knowledge of local causes by permitting model parameters to vary across space. This method helps create focused regulations that take local characteristics into account (Mathenge,2023).

3. MAUP, or the Modifiable Areal Unit Problem:

When statistical findings differ according to the spatial units utilised for analysis, such as counties or districts, the MAUP occurs. This problem is relevant to studies on food poverty since the choice of aggregate can affect the outcomes. By using techniques that are resilient to various spatial scales, spatial econometricians reduce MAUP and produce more trustworthy findings (Deng.2024).

4. Problem of Uncertain Geographic Context (UGCoP):

Bias that arise when the geographic context influencing people is unclear or distorted are referred to as UGCoP. This issue may come up in food poverty research if the locations where people acquire food are not precisely documented. Addressing UGCoP involves integrating individual mobility data and considering activity spaces rather than static residential locations (Kwan,2012).

5. Models of Spatial Interaction:

These models look at how regional interactions—like migration or trade—affect food poverty. Policies intended to enhance food distribution networks and market accessibility must take these spatial fluxes into account.

6. Policy Diffusion in Space:

The study of the effects of policies enacted in one location on nearby areas is made possible by spatial econometrics. For instance, through economic spillovers, a successful food subsidy

program in one area may help lower food poverty in nearby areas, guiding the development of more comprehensive policy adoption techniques (Debru, et al.,2019).

7. Mapping Poverty:

It is easier to create comprehensive poverty maps that show the spatial distribution of food poverty when spatial econometrics and Geographic Information Systems (GIS) are combined. Policymakers can visualize and address regional imbalances with the help of these maps (Nawar,2007).

In conclusion we can say the integration of spatial elements into econometric analyses, spatial econometrics contributes to a better understanding of food poverty. By identifying spatial patterns and interdependencies, this method produces policy interventions that are more effective and regionally specific.

An effective tool for planning policies to respond the food poverty spatial structure allows spatially continuous ecological variables to be integrated into the study. Explicit spatial analysis incorporates the regional complexity of food poverty relationships with their determinants (Nashwari et al., 2017). The spatial approach is not only about location, distance, circumstance, correlation, pattern and access, but also about spatial structure and correlation between variables and spatial system (Muta'ali, 2012).

2.1.1 Significance of the Study

The study found hardly any analysis based on the role of spatial dependence or spatial heterogeneity with reference to Pakistan and there is significant gap in the literature. Present study will attempt to explore the geographic perspective of food consumption in Pakistan. Spatial analyses will be done to observe the distribution of food poverty at the district level.

The role of spatial dependence or spatial heterogeneity is very important. If it neglected (as in case of Pakistan is ignored) it may cause some misspecification errors if some forms of spatial heterogeneity or spatial correlations had in fact existed but ignored. Understanding the spatial distribution of food insecurity in particular contexts is essential for effective solutions that satisfy the needs of the most vulnerable communities. It is important that household food insecurity spatial patterns be understood at the micro level in order to find the most affected geographical localities, to plan local interventions and efficiently disburse scarce resources to the most affected regions, to persuade policy and to ensure equity in the community. The study used a spatial binary autoregressive probit model, which shows changes in the relative weight of numerous factors that affect poverty based on location. It will help implications on poverty mitigating interventions specific to the different regions If food insecure people are clustered in specific areas and a significant cluster is found, it will have positive effects for poverty reduction interventions tailored to the different regions, with a significant cluster identified. Policies aimed to improving nutrition and reducing inequality should be based on exhaustive research detailing these discrepancies and detecting their causes.

2.1.2 Objective of the Study

The key objective of the study is to analyze the spatial variation of food poverty in Pakistan. The study will address;

- Is there a random distribution of food insecurity ?
- Is it demonstrating a strong spatial autocorrelation.?
- Is it spatially clustered?

2.2 Review of the Literature

Many studies are conducted regarding the incidence of food poverty and food security with reference to Pakistan but none could be find addressing the spatial non-stationarity, which states that a simple global model cannot describe how certain sets of variables are connected. Few international studies about the issue are discussed here.

The spatial aspects of food consumption in Ecuador were investigated by Farrow et al. (2005). Spatial analyzes was done to investigate food poverty and food consumption distribution and to evaluate and develop hypotheses of district-level levels of food poverty. Results show that in certain locations the food poor are concerted with a big cluster found in the central Andean zone and results support for national reforms in land tenure. Improvements in transportation infrastructure are likely to reduce food poverty levels across the country. Investment in the growth of rural businesses should be encouraged.

Pheng et al. (2005) examined the determinants of the spatial variation of poverty in Bangladesh. Study measured and mapped indices of poverty for 415 rural sub-districts, showing different areas with high incidence of poverty that correspond to areas which are ecologically depressed. Results indicated regional variations in the relative importance of different poverty effecting factors, which requires specific to the different regions of poverty alleviation strategies.

Hegai (2014) modeled the process of assessing food security using Geographic Information Systems (GIS) tools. The analysis was built on data reference to three dimensions of food security; food availability, food accessibility, and nutritional capacity. It is being found that application of GIS modeling approach is relatively efficient and appropriate than statistical usual techniques. Furthermore, food security information must be accessible so that administrators can make

decisions about developing fair systems of distribution of surplus food to the needy people to local level based on evidence-based understanding of food imbalances.

In order to examine food insecurity, Ratnasari and Kusumawardani (2015) used remote sensing to analyze crop failure risk, erosion, and land critical levels. Rainfall and slope, which is calculated by extrapolating rainfall stations and elevation points, have an impact on the erosion potential. The local government can effectively distribute food in accordance with community needs. It is found the population income below the poverty line has an impact on the distribution of the area of food insecurity in addition to physical variables.

A micro-level analysis that was conducted by Wossen, and Berger (2015) for Northern Ghana. Agent-based modelling was used to examine how adaptation impacts household food security in the current situation of price volatility. Results show that climate change and price volatility have a considerable detrimental influence on household wellbeing. Additionally, it is found that climatic and price volatility caused significant disparities in household poverty and food security. Access to off-farm work and the provision of agricultural loans are determined to be very successful policy entry points to study.

Kuai and Zhao (2017) used the two-step floating catchment area approach to gauge the availability of nutritious food in Louisiana's East Baton Rouge Parish. The study combined the population with and without private automobile to assess the spatial variation. The associations between nutritious food access and other non-spatial socio-economic features were also investigated by geographically weighted regression and ordinary least squares regression. According to the study, the middle-south region of urban areas performs better than the rest, while the suburbs close to the urbanized area's edge have the most access to nutritious food.

According to Nashwari et al. (2017), agriculture plays a significant role in Indonesia's food security but also significantly contributes to poverty, especially in rural areas. Geographically Weighted Regression (GWR) was used to analyze the variables affecting the poverty of farmers of food crops. Location in the upland area and road network had a greater impact on the western-southern poverty. In the east, precipitation has had a significant influence. Nonetheless, the effect of each aspect was not uniform, as the estimate of the parameter have a positive or negative value.

Zewdi et al. (2017) investigated the spatial distribution of household food insecurity in East Gojjam Zone across various agroecosystems. Multistage cluster sampling was used by conducting a cross-sectional survey among 3108 households. The research region is split into highlands with hills and mountains, plains in the middle with black soil, plains in the middle with brown soil, plains in the middle with red soil, and lowlands in the middle of the Abay valley. It is concluded that the most susceptible places were in the highlands and hills of the Abay valley with lack of sufficient food and there is need of serious interventions of the organizations working to reduce food insecurity at the micro level.

Amare et al. (2021) analyzed how the COVID-19 epidemic has impact the food security and labour market outcomes in Nigeria. The study used difference-in-difference approach to take in consideration of temporal variability in outcomes of interest and spatial variation in contact to COVID-19-related diseases and lockdown events in order to analyses these linkages and their consequences. It is find out that a significant rise in indicators of food insecurity is likely to increase COVID-19 case rates or mobility lockdowns. Looking at potential pathways for this effect's transmission, it is discovered that the pandemic's spread is linked to a large decline in labor market participation. For example, lockdown procedures are linked to an increase of 6–15

percentage in households' food insecurity. Likewise, lockdown procedures are linked to a 12 percentage point drop in the farm and non-farm activities.

Tsiboe et al., (2023) explored the variations in food poverty in Ghana. The study employed a spatiotemporal model based on the Foster-Greer-Thorbecke poverty measure. The mean unconditional food poverty rate was calculated to be 50% using the model that simultaneously takes into account both the spatial and intra-annual changing aspects. The Northern Region had the lowest rate in March (45%), and the Upper West Region had the highest rate in June (54%).

2.3 Theoretical Background

The literature on food security frequently highlights variables that are specific to an individual or household, yet it is widely acknowledged that eating and shopping food behaviors are deeply in-built in the neighborhoods and local communities where people live, work, and attain education. Research on the association between geographical context and food security makes the implicit application of Tobler's (1970) first law of geography, which states that "everything is related to everything else, but near things are more related than distant things" by assuming that food resources or opportunities locally matter more to observed outcomes than those farther away (Neckerman et al.,2009).

Understanding the intricate interactions between geographic location, socioeconomic circumstances, and environmental impacts is necessary to develop a theoretical model that uses spatial analysis to analyze food poverty while taking environmental aspects into account. For example, spatial distribution of food poverty recognize that food poverty differs across various geographic regions and is not evenly distributed. These regional differences are caused by a number of factors, including local economics, infrastructure, and urbanization. Environmental determinants determine the environmental elements that contribute to food poverty, such as local

agricultural Productivity is influenced by water availability, climate, and soil quality. Furthermore, the availability of food is influenced by the accessibility of markets, supermarkets, and food sellers. Food supply may be disturbed in areas that are vulnerable to pollution or natural catastrophes.

Most people assume that one's local access to food supplies and possibilities for related activities shapes one's eating habits. Here, a person's immediate neighborhoods and the places that are accessible there are considered their local places.

It is acknowledged that eating habits are ingrained in the local neighborhoods and communities where individuals live and work. The prevalent belief is that one's eating habits are influenced by the food options and associated opportunities in the vicinity of their residence. The immediate neighborhood around one's home and the areas that can be visited within or close to it are considered local places in this context (Allard, 2013).

According to studies on spatial context and food security, adjacent food resources or opportunities have a greater impact on observed achieving function than those located further away. Investigation about the spatial structure of food poverty can be guided by the presumption of linkage between nearby observations. It identifies trends in food intake by using measures of spatial association that are concealed or challenging to identify from raw data.

As for as concern to Pakistan spillover effects are especially noticeable in Pakistan because of a number of interrelated variables, particularly in the absence of strong district-level local government structures. Inter-District connectivity and resource sharing plays an important role. In Pakistan, districts frequently exchange resources like infrastructure, services, and marketplaces. Food poverty can be exacerbated regionally when a district's inadequate infrastructure has a detrimental effect on nearby districts. For example, poor road systems might make it more difficult to distribute food, which can impact several districts (Ullah et al.,2020). As addressing district-

specific issues requires strong local governance. Food poverty may worsen as a result of disorganized policies and resource misallocation brought on by the lack of district-level local government organizations. Districts might find it difficult to carry out focused interventions in the absence of localized decision-making, which could result in policy gaps that impact nearby areas. For policies to be implemented effectively, strong institutions are necessary. Delivering basic services like healthcare, education, and food aid is hampered in districts with insufficient institutional structures. When administrative borders do not correspond with the real distribution of communities and resources, this inefficiency may have repercussions for nearby districts (Ullah & Majeed,2023). In Pakistan environmental problems like floods and droughts transcend administrative borders. The food security of nearby districts may be impacted by a district dealing with such issues, especially if there are no coordinated disaster response systems in place. Regional food insecurity may result from ineffective disaster management caused by a lack of local government mechanisms Districts often rely on one another in economic perspective. The economic prospects in nearby districts might be impacted by high unemployment or poor literacy rates in one area, which can result in a regional drop in purchasing power and a rise in food poverty. Negative impacts can more readily spread among districts if local governments do not act quickly to address these problems (Ullah et al.,2020).

We can conclude that in Pakistan, the lack of district-level local government structures makes it more difficult to carry out focused and well-coordinated measures to tackle food poverty. This void causes regional clusters of food insecurity when unresolved problems in one district spread to nearby districts. To reduce these spillover effects and attain sustained food security, local governance must be strengthened.

Spatial analysis may determine if food insecurity is randomly distributed across the nation, highly geographically auto correlated, or spatially clustered. Establishing how food security differs by location is crucial before considering how spatial context might be causally related to it (Coleman et al.,2013).

2.4 Methodology

This section provides information about data, variables, poverty indicators, model and estimation techniques.

2.4.1 Data and Variables

The study used Pakistan Social and Living Standards Measurement (PSLM) 2019-20 data. PSLM district level survey is being conducted by Pakistan Bureau of Statistics. The survey gathers information on important social indicators. The additional significance of PSLM district level survey (2019-20) is that it included Food Insecurity Experience Scale (FIES) module with some other. These modules are included for the first time to monitor some of the most important indicators for SDG's. Inclusion of the FIES in nationally representative surveys can produce prevalence of food insecurity at sub-national levels.

Furthermore, data for development statistics is retrieved from statistics of provisional Bureaus of Statistics of four provinces (KP, Punjab, Sindh, Baluchistan) at district level with locational or environmental variables. Pakistan's provincial departments and statistics bureaus, which are essential to the gathering, processing, and distribution of statistical data, are the main sources of district-level data. Each Bureau of Statistics is responsible for compiling and disseminating data pertinent to the area. The unique identities of districts are used in merging process of data sets for robustness of data set. Unique keys present in both datasets that served as the basis for merging. We combined only the records with matching identifiers in both datasets included all records from

the first dataset and the matching records from the second by using stata software. Non-matching records from the second dataset result in null values was deleted from data set. Before analysis we manually verified a sample of merged records to confirm accuracy.

The study used data on land utilization for cultivated area for crops, stock of livestock, roads measured in kilometer, number of tractors, Population, temperature and rain fall as explanatory variables for selected districts. The description and summary statistics of explanatory variables used in the study is given bellow in the Table No 2.1 and Table 2.2 respectively.

Table 2.1: Variable Description

Variables	**Description**
Income	Average monthly income of the household in Pakistani Rupees from all sources
Education	Household head education
Age	Age of the household head
Migration	Migrated from rural to Urban =1,0 otherwise
Mobile	If mobile user =1,0 otherwise
Internet	If internet user =1,0 otherwise
Cultivated Area	Total cultivated area for crops measured in hectares
Livestock	District wise livestock population
Road Length	District wise road length measured in kilo meter
Population	District wise population in numbers
No of Tractors	District wise number of Tractors
Average Temperature	Mean Temperature of selected stations measured in centigrade
Average Rain	Rainfall in selected station in millimetre

Table 2.2: Summary Statistics

Variables	Mean	Standard Deviation
Income	34508.28	3.6205
Education	5.4020	3.6821
Age	23.5749	11.849
Cultivated Area	142,000	13.8976
Livestock	1496555	7.6754
Road Length	1882.48	16.007
Population	1,348,000	13.986
No of Tractors	4800.05	8.9873
Average Temperature	29.00448	21.7155
Average Rain	341.4593	17.0873

2.4.2 Food Poverty and Food Insecurity Indicators

The study used FIES to gauge the food insecurity and food poverty situation in the country. The Food and Agriculture Organisation (FAO) developed the FIES as part of the "Voices of the Hungry (VoH) programme". It is used to measure progress towards achieving Goal 2 and indicator 2.1 of the Sustainable Development Goals (SDGs) "End hunger, achieve food security and improved nutrition and promote sustainable agriculture", which ensures food access and ending hunger around the globe (Ballard et al., 2013). The FAO and increasing number of countries are currently using this metric to track developments in national and global food security. The main merit of the FIES is that it forms estimates of food insecurity at population level that can be compared across cultures, countries and sub-populations. Moreover, when the individual based survey module is incorporated, the FIES provides the benefit that the information can be disaggregated by gender (Brunelli & Viviani, 2014).

The FIES systematic technique includes a refined probabilistic tactic for categorizing households with reference to their food security status. The outcomes are statistically robust and analogous across countries and sub-populations (Ville et al., 2019). Table 2.3 shows the scale items, domains and severity of food insecurity.

Table 2.3: Scale Items, Domains and Severity of Food Insecurity

Scale items	**Domains of the food insecurity paradigm**	**Assumed severity of food insecurity**
"You were worried you would run out of food because of a lack of money or other resources?"	Uncertainty and worry about food	Mild
"You were unable to eat healthy and nutritious food because of a lack of money or other resources?"	Inadequate food quality	Mild
"You ate only a few kinds of foods because of a lack of money or other resources?"	Inadequate food quality	Mild
"You had to skip a meal because there was not enough money or other resources to get food?"	Insufficient food quantity	Moderate
"You ate less than you thought you should because of a lack of money or other resources?"	Insufficient food quantity	Moderate
"Your household ran out of food because of a lack of money or other resources?"	Insufficient food quantity	Moderate
"You were hungry but did not eat because there was not enough money or other resources for food?"	Insufficient food quantity	Severe
"You went without eating for a whole day because of a lack of money or other resources?"	Insufficient food quantity	Severe

(Source: Ballard et al., 2013)

As shown in above table, it contains of a set of brief (yes/no) questions inquired straight to individuals, usually in face-to-face interviews, though they may be acquiring by telephone. The questions concentrate on self-reported food related experiences and behaviors connected with growing problems in acquiring the food because of resource limitations. The response of each respondent will be graded by the question and then identified by the raw score as:

- Food secure or mild food insecure if raw score < 4
- Moderate if raw score = 4,5 or 6
- Severe if raw score = 7 or 8

The FIES is based on a well-founded model of food insecurity experience consisting of three domains: “uncertainty / anxiety, changes in food quality, and changes in food quantity” (Reagan, 2018).

As for as concern of the current study data of FIES module collected at district level by Pakistan Social and Living Standards Measurement (PSLM) 2019-20 is used to explore the spatial variation in food security or food availability.87 % population acquired score was below than 4 , lies in food secure or mild insecure catogery,9 % in category of moderate insecure while only 4 percent in lies severe food insecure category. For analysis two categories are formulated for investigation below 4 lies in food secure category while other two categories are merged in food insecure category as the variation for the third category is very low. 0 indicates food secure while 1 shows the number of household who are food insecure.

2.4.3 Spatial Data Analysis

In the context of spatial economic research, the issue of spatial dependence is being discussed quite frequently. This particular idea is quite significant since it suggests that the strength of some events

relies on their spatial position. The majority of socioeconomic processes naturally exhibit positive spatial dependence as one of their core characteristics.

First Law of Geography by Tobler (Tobler 1970), that "Everything is related to everything else, but near things are more related than distant things," was used to present this observation. Cognitive errors can occur if spatial dependence is not taken into account in economic studies (Paelinck and Klaassen, 1979; Anselin, 1988; Haining, 2003; Arbia, 2006; LeSage and Pace, 2009). When referring to socio-economic issues, the spatial autocorrelation function is most often used to identify spatial dependence. In exploratory spatial data analysis (ESDA), statistical tests that assess the statistical significance of spatial autocorrelation are frequently used as tools.

Anselin (1995) distinguished between global and local assessments of spatial autocorrelation. Local tests focus on the circumstances of distinct regions, identifying spatial clusters and outlier regions, global tests look at the overall spatial autocorrelation between regions.

LISA has been extensively studied in literature. It has been used since the original LISA framework was developed by Anselin (1995, 1996), the work was builds on Getis (1992, 1996) initial research and Ord and Getis (1995). However, most of the research work is done where the variable of the interest is continues variable. Moran's I or Geary's test are most frequently used to assess the autocorrelation considering the location as an important factor. Not much consideration is paid in case of categorical or binary variable. According to Long et al., (2010) Boots (2003, 2006) worked on LISA for categorical data but the work could not be generalized for irregular layouts as it was confined for regular lattice structures

Congdon (2016) offers a somewhat different viewpoint on the local join count statistic in both a univariate and bivariate context, where it is employed in a hierarchical Bayesian disease risk modelling specification rather than in an exploratory context.

In current study we incorporated local join count statistic's practical implementation as a special case of a LISA. Local form of the so-called BB join count in the univariate case is employed where observations with a value of 1 occur in spatially neighboring places, leading to positive spatial autocorrelation. The study has main focus in empirical scenarios where there are few observations with a value of 1, or uncommon events, compared to the sample size. We aim to pinpoint clusters of places where these incidents have occurred. Such co-occurrences would be uncommon in a spatially random environment; hence, diagnosing them offers an exploratory hint to "interesting" locales.

The join count statistic calculates the number of adjacent neighboring cells that share the same value or category in a map. It is computed by calculating the total of pairs of cells that share the same value and are adjacent to each other. This statistic provides information about the spatial pattern of the features in the map and helps in identifying the areas of high and low spatial autocorrelation.

Join count statistics can be used to test the hypothesis of spatial randomness or spatial dependence in a map. Spatial randomness refers to the absence of any systematic spatial pattern in the distribution of the features, while spatial dependence discusses to the presence of a spatial pattern or structure in the distribution of the features. Join count statistics can be used to measure the intensity of spatial autocorrelation and identify the areas of high and low spatial autocorrelation in the map.

A high value of the join count statistic indicates positive spatial autocorrelation, which shows that similar features are likely to cluster together in the map. Positive spatial autocorrelation can occur in many different types of maps, such as land use, population density, and species distribution maps. For example, in a species distribution map, a high value of the join count statistic can

indicate that the species tend to occur in patches or clusters, which can be important for conservation and management.

A low value of the join count statistic indicates negative spatial autocorrelation, which means that similar features tend to be dispersed or scattered in the map. Negative spatial autocorrelation can occur in many different types of maps, such as transportation networks, land use, and population density maps. For example, in a transportation network map, a low value of the join count statistic can indicate that the transportation infrastructure is dispersed or fragmented, which can have implications for accessibility and mobility.

In conclusion, join count statistics is a valuable method in spatial analysis and spatial statistics that can provide insights into the spatial patterns and relationships of the features in a map. It can be used to map the degree of spatial autocorrelation, test the hypothesis of spatial randomness or spatial dependence, and identify the areas of high and low spatial autocorrelation in the map.

The most common strategy is a contiguity matrix to capture the spatial effects, although there are other options as well, like using the k-nearest neighbor method.

Let suppose that "white" (W) means food insecure districts, while "black" (B) food secure districts in the region. The aim behind join-count statistics is to count the neighborhoods that are white-white (WW), white-black (WB), and black-black (BB) in the case of a two-color map (Cliff and Ord, 1973, 1981).

Following Anselin (1995), the join count statistics is:

$$\boldsymbol{BB = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}x_i x_j} \qquad \text{.....2.1}$$

$$\boldsymbol{WW = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(1 - x_{i})(1 - x_{j})} \qquad \text{.....2.2}$$

$$\boldsymbol{WB = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\left(x_i - x_j\right)^2} \qquad \text{.....2.3}$$

j = 1 for those locations where $x_i = 1$. For all locations with $x_i = 0$, the statistic is zero.This can be reduced to a count of the neighbors having an observation of $x_j = 1$ for those places where x i = 1 by using a binary spatial weights matrix. In all instances when $x_i = 0$, the statistic is 0.

As a result, the local join count statistic is significance when determining whether places that have a "event" (i.e., $x_i = 1$) are surrounding by more locations that have events than would be the case under spatial randomization.

If neighborhood districts are marked by the identical color relative to the districts marked by different color, there will be occurrence of positive autocorrelation while if neighborhoods are dominating by different color there will be negative correlation. If “one color” neighborhood districts are not dominant over the “two color” districts, this will be the case of random distribution of the variable.

If we look at the properties of the join count statistics following assumption are assumed about binary variable. First assumption is that each regional unit is assigned Bernoulli distribution b(p), p∈ (0, 1) to a random variable is the probability of occurrence of 1 in sampling with replacement. The second assumption is that random variable in each location has the value 1 or 0 with the same probability as happens without replacement sampling.

According Cliff, 1973 and Ord (1981) the assumption described above the BB and BW statistics exhibit “asymptotic normal distribution.

Following BB and BW statistics are used in the test

$$Z_{BB} = \frac{BB - E(BB)}{\sqrt{VAR(BB)}} \quad \text{.....2.4}$$

$$Z_{BW} = \frac{W - E(BW)}{\sqrt{VAR(BW)}} \quad \text{.....2.5}$$

If the calculated value of Z_{BW} statistics is found in left hand side of the rejected area or in right hand side of the rejected area specifies the occurrence of spatial autocorrelation and reject the hypotheses of no spatial autocorrelation.

Territorial units are frequently categorized in economic research according to their social and economic circumstances in order to study regional divergence. The research' findings can help in design of regional development policies and space management.

2.4.4 Econometric Estimations

As described above there are two categories of food security food secure and food insecure .1 indicates the secure household while 0 shows the insecure household. As our variable is binary in the form of 1 and 0 therefore the spatial autoregressive binary model will be used to estimate the model. When interacting with spatially dependent binary dependent variables, a spatial autoregressive (SAR) binary probit model is a suitable choice due to many reasons. Traditional linear regression models assume that the dependent variable is continuous and that variance is constant, making them inappropriate for binary outcomes. In SAR the probability of the binary outcome is modelled using the cumulative distribution function (CDF) of the standard normal distribution, which ensures that predicted probabilities fall between 0 and 1. Furthermore Observations in many real-world situations are not independent; rather, they display spatial autocorrelation, which means that the results of one observation may be impacted by results in adjacent or surrounding areas. This is specifically taken into account by the SAR component, which captures the impact of nearby observations by adding a spatial lag of the dependent variable. By including the SAR structure into the probit model, we are able to achieve more precise parameter estimates and reliable statistical inferences, which improves the model's explanatory power and predictive accuracy. Ignoring spatial dependency when it exists can result in biased and

inefficient estimations. In conclusion, because the SAR binary probit model concurrently handles the binary nature of the data and the spatial dependencies included in the observations, it is appropriate for binary dependent variables in spatial contexts.

Let we have a binary outcome model in which n × 1 vector Y be 0 or 1 where the observed binary response Y_i = 1 reflecting that household is food secure while Y_i = 0 indicating that household is food insecure in given sample.

According to the presumption that each observed outcome is independent of the others, a traditional probit model would use a n × k matrix of specific explanatory variables X and associated k ×1 vector of parameters to explain variation in the binary vector y.

A spatial autoregressive variant of the traditional probit model, known as the spatial binary probit model is presented by LeSage and Pace (2009, Chapter 10) to capture the spatial effect. In this model, the binary response variable Y_i is assumed to be a function of both the explanatory variables X_i and the spatial lag of Y, which captures the spatial dependence among the observations. The model can be represented as:

$$Y_i = \alpha + \beta X_i + \rho W Y_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots 2.6$$

$$\varepsilon = \lambda M_n \varepsilon + \mu \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.7$$

where α is the intercept term, X is the n × k matrix of explanatory variables β is the k × 1 coefficient vector for the explanatory variables, ρ and λ are spatial autocorrelation parameter explaining the extant of spatial dependence, W and M are the n × n spatial weight matrices , and ε_i is the error term , the n × 1 is vector of omitted variables while u is an n × 1 vector of inventions.

This model assumes few conditions as:ui has an i.i.d. normal distribution with mean E[ui] = 0 and variance E $[u^2_i] \equiv \sigma^2_u < \infty$. The diagonal elements of Mn and Wn are zero and each of the off-diagonal elements of Mn and Wn and is homogeneously confined in absolute value by one, and is

explained by a non-random function of wij(dW (i,j)) and mij(dM (i,j)), respectively, such that wij (κ), mij (κ) → 0 as κ ↑ ∞.d.(i,j) indicates the distance between i and j measured by a metric that has positive correlation with the Euclidean distance between i and j.

The elements of X are equally confined in absolute value and X has the full rank k and the values of repressors Xi are determined by a k × 1 vector.

The spatial lag of the dependent variable Y_i comprises the n × n spatial weight matrix W that involve components containing of each of one 0 / mi or 1, where mi is the number of districts contiguous to district i. If district j represents one of those contiguous to district i, then the i and j_{th} element of W encompasses the value 1 /mi. If an element in the ith row of the matrix W is not connected to nearby observations, then it has a value of 0 and W is non-negative and the sum of each row is equal to 1 (row stochastic). This translate the vector W*Y an average of the mi neighboring districts which provides a mechanism for modelling interdependence in district level food security. The scalar parameter ρ measures the degree of dependence A value of zero indicates independence between the districts. When ρ = 0, it is evident that a typical non-spatial probit model appears.

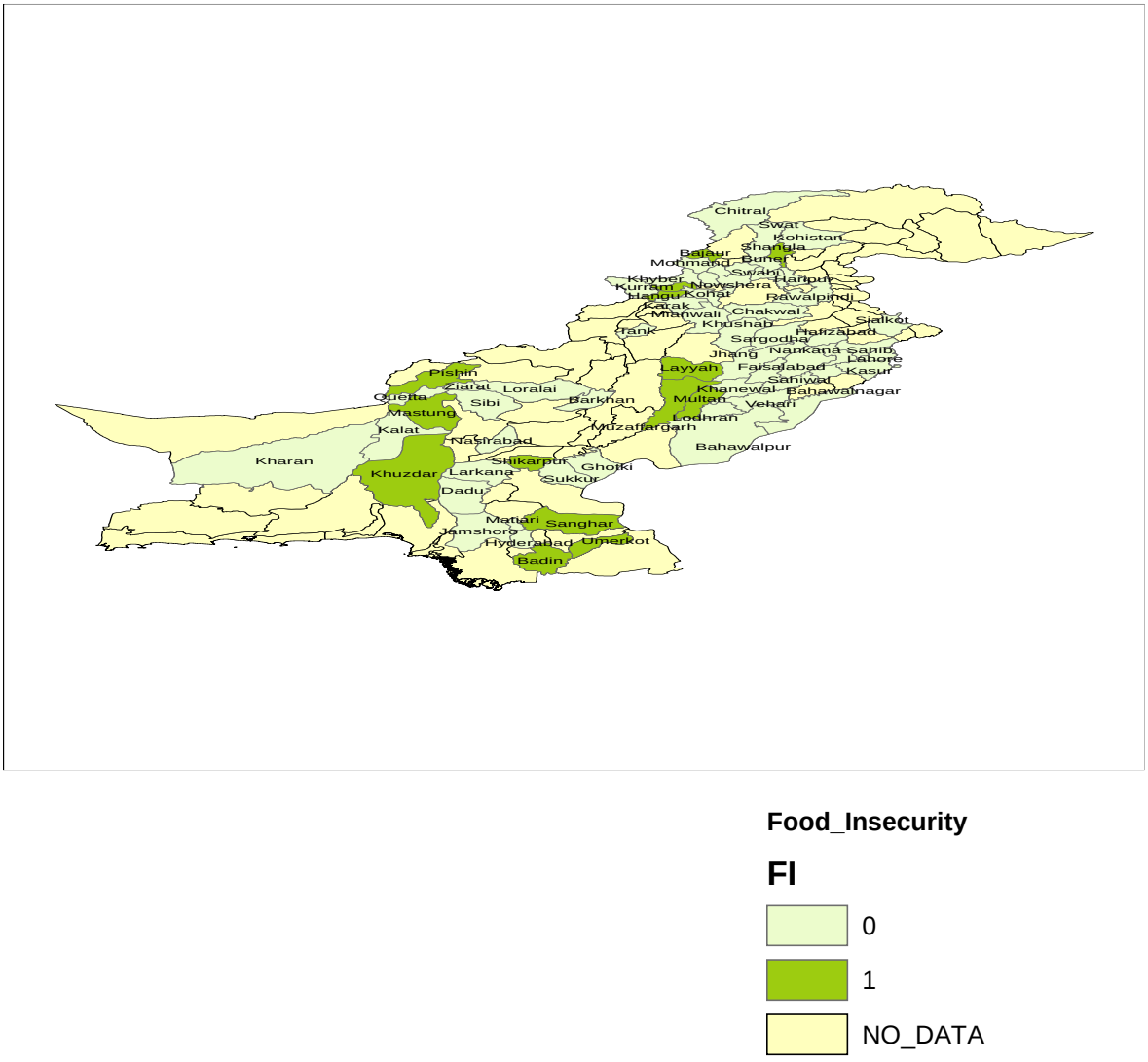
The spatial autoregressive binary probit model can be estimated through maximum likelihood estimation, which finds the parameter values that maximize the likelihood of observing the data given the model. The binary 0, 1 observations in y are treated by the Bayesian technique to modelling binary limited dependent variables as indications of latent, unobserved y utility linked to two districts, with the unobservable utility underpinning the observed food security outcomes. In this approach, the unobserved latent utility is swapped out for estimated parameters using the Bayesian estimation method.

2.5 Result and Discussion

2.5.1 Spatial Distribution of Food Insecurity

Map 1 shows the spatial distribution of the food-insecure households throughout Pakistan's administrative districts. Almost 13 per cent of households stated the incidence of food insecurity. Badin, Umerkot, Sanghar,Jacoabd,Mastung,Pishin,Chaman,Mulatan Layyah,Lodhran,Kark,Hngu, Kurram,Bajur, Shangla and Buner are stated food poor districts according given sample. Map is a valuable tool in identifying regions and provinces and detailed assessment for food insecurity across the geographic distribution. It helps policymakers and program planners for intervention intended at ensuring the right to satisfactory food to deprived one.

***Figure 2.1*:** Spatial Analysis



As discussed above our data is in binary form, so we cannot use traditional spatial autocorrelation test eg. Moran or Geary's test which are used most frequently in literature. In current study join count statistics is used to assess the spatial variation in food security. The join-count test was conducted on the base of identified division of districts into two classes in terms of food security;

food secure and food insecure. The application of the test confirmed two model hypotheses, the spatial clustering of food insecure districts more often than in case of spatial randomized dispersal and spatial clustering of food secure districts. The obtained results are presented in table No. 2.4

Table 2.4: Join count statistics

Join Count Test Type	Statistics	Expected Value	Variance	Z Value	P Value
WW (1-1)	10.465	8.213	0.6986	0.874	0.034
BB (0-0)	8.835	8.132	0.6976	0.913	0.067
WB (1-0)	12.65	11.3	2.003	-2.186	0.013

Significant positive Z-score ($p < 0.05$) for WW (1-1) means food-poor areas cluster together. Significant negative Z-score ($p < 0.05$) for WB (1-0) means food-poor areas are not randomly mixed with non-poor areas

Above results show that join-count tests verify the existence of positive spatial dependence in case of districts with food insecure and the insignificant spatial dependence for districts categorized by food secure population level was observed. It means that districts featuring food insecurity present the propensity for spatial clustering which is revealed in the system of occurrence of spatial clusters. For estimation the spatial autoregressive binary probit model is used to analyze binary data (0 for food secure and 1 for insecure) that is influenced by geographical aspects and has spatial dependence. It includes both spatial autocorrelation and binary response variables. The results are presented below in table No. 2.5

Table 2.5: Spatial Autoregressive Binary Probit model

Variables	Direct Effects	Indirect Effect	Total Effect
Income	-0.3544*** (0.1360)	-0.0772** (0.0352)	-0.4316*** (0.0172)
Education	-0.2203** (0.0855)	-0.0932 ** (0.0434)	-0.3135*** (0.0934)
Age	-0.5011*** (0.1402)	-0.0432** (0.0253)	-0.5443** (0.4078)
Migration	0.3605*** (0.1100)	0.2527 (0.1670)*	0.6132** (0.2359)
Mobile	-0.3600*** (0.0980)	-0.0275 (0.0643)	-0.3875** (0.2754)
Internet	-0.3670* (0.2300)	-0.0534 (0.0634)	-0.3945* (0.3427)
Cultivated Area	- 0.8660** (0.4198)	-0.4386* (0.3609)	-1.3046* (0.9625)
Live Stock	- 0.0497 (0.0632)	0.0015 (0.0345)	-0.0512 (0.0765)
Road Length	- 0.1763** (0.0451)	-0.0758** (0.0397)	-0.2521*** (0.0613)
Population	0.3559*** (0.0175)	0.1107*** (0.0237)	-0.4666*** (0.0846)
No of Tractors	- 0.2761** (0.0424)	-0.0948** (0.0478)	-0.3709** (0.2307)
Average Temperature	0.0433 (0.0726)	0.0585 (0.0919)	0.0718 (0.0918)
Average Rain	- 0.1323** (0.0676)	-0.0544** (0.0144)	-0.1867*** (0.0578)
P	0.676*** (0.0656)		
W	0.9741** (0.1765)		
σ^2	0.8578 (0.1362)		

A significant positive coefficient on the spatial lag means that food poverty clusters spatially across districts (Standard errors are presented in the parenthesis, *** , ** and * show significance at 1%,5% and 10% respectively).

The value of the ρ[9] is positive (0.676) and significant in above analysis. Positive values of ρ ($\rho > 0$) show positive spatial autocorrelation which means that similar values are likely tend to cluster together and suggests that the outcome variable food insecurity is influenced by the values of neighboring observations. Queen Contiguity contiguity-based weight matrix is used as the spatial weight matrix parameter (W)[10]. The Queen method considers two areas as neighbors if they share any part of their boundary as districts. These are most widely used when spatial spillovers are expected to diffuse in all directions and best for general spatial interactions (e.g., food poverty spread, economic activity). The positive value accounts for the potential spillover effects from neighboring observations on the probability of a particular event or outcome occurring. The inclusion of spatial dependence can affect the estimation of other model parameters and improve the model's goodness of fit. The coefficients outcome from autoregressive Binary Probit Model are presented in table 2.

Above results shows that coefficient of income is negative and significant indicating that higher income reduces the probability of food poverty. As increase in income enables to purchase more variety of nitrous food. This result is consistent with the findings of Bashir et al., (2010), Sindhu et al., (2008) and Onianwa and Wheelock, (2006). Coefficient of household head education has negative impact on food insecurity as improvement in household head education decreases the food poverty. More educated household has better employment opportunities and nitrous knowledge (Bashir et al., 2010; Titus and Adetokubo, 2007). The coefficient of household head age has negative and significant impact because as people age, they build up assets, gain life

[9] If ρ is significant and positive, high food poverty in neighboring areas increases the probability of food poverty in a given area. If ρ is significant and negative, food poverty in neighboring areas reduces the probability of food poverty in a given area. If ρ is insignificant, there is no spatial dependence.

[10] The spatial weight matrix (W) defines the spatial dependence structure. The presence of spatial dependence implies that a unit's probability of a particular outcome (e.g., food poverty) is influenced by neighboring units.

experience, and learn adaptive coping mechanisms, which reduces the likelihood of food insecurity in their household (Mthethwa and Wale, 2021). The study revealed that rural urban migration leads to increase in food insecurity Young and skilled workers migrate, leading to a shortage of agricultural labor in rural areas. Both rural and urban areas may see increased food prices as a result of reduced food production brought on by migration, while urban migration may raise food demand in urban areas. Urban food insecurity may result from low-income urban migrants' inability to purchase wholesome food. Due to unemployment and high food prices, urban slums experience significant levels of food insecurity (McGranahan et.al,2022).

No one can deny the importance of ICT to increase welfare of masses. ICT development on food security are prompted by mobile phone and Internet development. Internet and mobile usage can improve food security not only of small farmers but also of big landlords by providing the information about market, market linkages and awareness about climate variability etc. (Ezoha et al.,2019; Twumasi et al.,2021).Our results shows that food insecure is likely to decreases by usage of mobile and internet facility.

The production of grains depends on cultivated area. There is a substantial correlation between food security and the sustainable development of arable land. (Yu et al.,2006; Li et al.,2021 The cultivated area measured in hectares has negative and significant impact on food insecurity indicating that as the area used for cropping and cultivation increases the people will be supposed to increase the food consumption resultant in decline in food insecurity.

Livestock production plays a significant role in ensuring sustained food security, especially in low-income areas and marginal habitats that are unsuitable for crop production (Godber and Richard,2016). Malnutrition is caused by a lack of sufficient calories and proteins from animal source foods (Turk,2013). Pakistan is agriculture country and its farming sector primarily divided

in cropping and livestock. Livestock is not only an important source to fulfil the dietary need and supplies of the food but also to increase their income. It is also a valuable source of international trade in terms of providing skin, hides, eggs, meat and milk etc. The study revealed that the livestock has negative but insignificant impact on food insecurity.

One of the main concerns affecting the food security of small agricultural households is the lack of resources, together with limited market accessibility (Ahmad et al., (2017). Roads are main infrastructure for transportation and access to markets. If there are no proper roads, then formers would not be able to transport their surplus production to markets and most of the food become rotten and waste before consumption (Birtha,2019) It plays a significant role in improving agricultural production capacities in developing nations, stabilizing global food markets, increasing imports, and pursuing the strategic integration of agribusiness across the globe (Yao et al.,2020). Our results also confirm the importance of roads and has negative and significant impact on food insecurity indicating that good infrastructure plays important role to mitigate the issue.

The current rate of growth for the global population is 1.1% per year. The medium-variant estimate states that, if present trends continue, the world's population will reach 9.7 billion by 2050.It is anticipated that low-income nations having limited access to technology and resources, making it difficult to sustainably produce more food to feed expanding populations (Hall et al.,2017). Population of the Pakistan is increasing very rapidly indicating an alarming situation to cope the need of the masses regrading adequate food availability. Above result also indicating that increase in population has increasing and significant impact on food insecurity.

Adoption of modern machinery in agriculture sector cause to increase the agriculture produce hence play an important role to overcome the issue of food security. For example, more land may be cultivated with the use of tractors result with higher yields and rise agricultural output (Daum

2020). Above results also verify and indicating negative and significant impact of using tractors on food insecurity.

Climate is important factor to determine food security. South Asia has been known as one of the most susceptible regions in the world effected by the impact of climate change (Bandara et al.,2016). It has long been recognized that weather and climate have a significant impact on agriculture, particularly food production. Inadequate water or excessive temperature can impede crop growth and lower yields (Gornall et al., 2010). The coefficient of average temperature is has impact while coefficient of average rainfall is likely to have negative impact on food insecurity because appropriate temperature and rainfall are essential for increasing food production.

2.5.2 Discussion

Food insecurity is crucial issue and indulged the huge masses in pain. The role of spatial dependence or spatial heterogeneity is very important and cause biasedness if existed but neglected. Likewise, qualitative investigation of limited geographical level does not permit a countrywide assessment of the factors of insufficient food consumption and malnutrition. Many studies are conducted regarding the incidence of food poverty and food security with reference to Pakistan but none could be find addressing the spatial non-stationarity, which states that a simple global model cannot describe how certain sets of variables are connected.

The join count statistics confirms the spatial clustering of the food secure districts than the spatial randomization distribution. It verifies spatial autocorrelation between the food insecure regions. The spatial autoregressive binary probit model also confirms the spatial non-stationarity between food insecure districts. So in light of above analysis it is concluded that food poverty is not randomly distributed in case of Pakistan and it demonstrate high degree of spatial clustering

Pakistan is agriculture country and agriculture is not only major source of the income of the people but also responsible to feed the masses. The empirical results suggested that cultivated area has negative and significant effect on food insecurity. The livestock has negative but insignificant impact. Roads are main infrastructure for transportation has significant and negative effect on food insecurity while population has positive and significant impact. Usage of machinery is important in agriculture production. Our results also verify and indicating negative and significant impact of tractors on food insecurity. The coefficient of average temperature has positive while average rainfall has negative and significant impact on food insecurity.

2.6 Policy Implications

By explicitly taking into account geographic and environmental factors, this study provides an in depth understanding of the connections between food poverty and various patterns and processes. Consequently, this approach enables targeted policies and interventions that are customized to address the specific combination of factors associated with food poverty in particular areas. The study suggests following policy implications to target the issue of food insecurity.

- Along with crops livestock is also an important part of agriculture. It is not only an important source to fulfil the dietary need but it also contributes to increase the income. The study result also revealed the same conclusion. The country need to enhance genetic diversity of the cattle and poultry to increase milk and meat production. Its need of research and development to redefining the methods of animal's production, increase good health and increase in production to live better.
- Role of the infrastructure in undeniable especially road system of the country plays a significant role for uplifting of the economy. It is crucial to improve transportation network

by constructing new roads so that there should be rural urban bridging between people to ensure food security by providing access so that food would be available at household level.

- Population of the Pakistan is increasing with rapid growth and it is the main driver of increase in demand of the food especially staple food. There is need to control population through creating cognitive awareness to people especially by increasing literacy and women's education, educating people how it can be control so that they would be able to feed their family with available resources.
- Adoption of modern technology is imperative to cope the issue of food insecurity. Tractors are indispensable requirement of current farming. Government should encourage local industry to manufacture tractors at home and provide subsidies to farmers especially the small farmers who cannot afford modern technology. This will increase the per acer production and help to increase the food security at household level.

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ESSAY III: SOCIAL SAFETY NETS AND FOOD SECURITY INPAKISTAN: THE ROLE OF BENAZIR INCOME SUPPORT PROGRAM (BISP)

Abstract

Food insecurity refers to people's lack of access to safe, nutrient-dense food to fulfil the daily active life's requirement. The access of food is more concerning than availability of food in cases of food insecurity. In terms of food availability, the growth in per capita food production has outpaced world population growth by over 1%. Among local and international stakeholders, access to sufficient and safe food is constantly a hot socioeconomic issue because 1 in 3 people, or over 2.3 billion people, experience severe or moderate food insecurity. The study has attempted to evaluate the role of cash transfer in food insecurity. The results designated that increase the amount of cash transfer has likelihood to decrease the food insecurity. Hence, the study finds the conditional transfer program effective in reducing the food insecurity.

Key words: Food insecurity, Cash transfer, BISP

3.1 Introduction

Having access to enough safe, wholesome food to support an active and healthy lifestyle is known as food security. Conversely, food insecurity denotes the absence of or uncertainty about availability to food that is safe and meets nutritional requirements.

The Food and Agricultural Organisation (FAO) has identified four elements of food security: availability, access, usage, and stability (Shair et al., 2023). In terms of food availability, since 1960, the average rise in food production has been over 1% higher than the population growth, leading to an increase in the amount of food produced per person. Over the previous fifty years, food production climbed by 2.8% while the world's population increased by 1.9% (Bumb & Byrnes, 2017). Nonetheless, the ability to obtain enough food is dependent on the resources that are accessible, both today and in the future. Conversely, food stability pertains to the capacity to acquire food over an extended period. Natural catastrophes, droughts, war, internal strife, unemployment, disability, climate variability, and economic downturns are some of the possible causes of food instability (Van Woerden et al., 2019).

The issue of food insecurity at the household level typically emerges when family members experience a lack of access to suitable food for social, physical, and economic needs. This situation can occur at any time of the year or for a certain amount of the day. (Hadley et al., 2008). Proper nutrition is a basic need for human well-being, and lacking in certain nutrients negatively affects one's ability to work productively, especially when it comes to the development of human capital (Ogundari and Aromolaran, 2017). The biggest barrier to having healthy food is not having enough money to buy food. This is related to nutrient deficiency since low nutrient levels might compromise food security. As a result, food security and sufficiency have emerged as crucial indicators of a society's health and, consequently, as a reliable indicator of economic scenario

(Bauer, 2020). Many of the negative health impacts associated with irregular access to sufficient nutrition can be directly attributed to poor food quality (Seligman et al., 2010).

According to Eicher-Miller et al. (2009), adult food insecurity can result in high blood pressure, high cholesterol, diabetes, and nutritional deficiencies. Poor diet, diabetes, obesity, depression, and self-reported health are all commonly linked to inadequate access to food (De Araujo et al., 2018). According to Almeida et al. (2017), underweight is substantially associated with hunger in underdeveloped countries, but overweight is strappingly associated with hunger in developed countries (Cheung et al., 20).

One of the plausible way of reducing food insecurity for peoples that are at risk of it, is to implement social safety net programmes in form of cash transfer. The money transfer could be unconditional or conditional, depending on the targets' attributes. Conditional cash transfers target families with children of a specific age (often primary or secondary school age) and concentrate on the growth of human capital. Programmes for conditional cash transfers, have proliferated throughout the world, particularly in South and East Asia and Latin America (Adato and Hoddinott, 2010).

On the other side, unconditional cash transfers also commonly target household with children, but also target the elderly (pensions) and disabled persons. Government-run social safety initiatives for underprivileged populations and small-scale experimental projects, typically funded by donor organisations and carried out by non-governmental organisations, are the main examples of these kinds of programmes.

A higher quality and more varied diet will result from an increase in food intake brought on by an increase in money transfers (Holmes and Bhuvanendra, 2013). Financial transfers can also be used to increase access to agricultural inputs that raise resource levels and production (Tevera and

Simelane, 2014). Additionally, the cash transfer is associated with a rise in food demand, which boosts local income by bolstering the local market (HLPE, 2012). The cash transfers might help families cope with cyclical changes and unforeseen shocks by providing a steady income stream throughout the year (Bailey and Hedlund, 2012).

As concerned to Pakistan the percentage of the population living below poverty line is extent 39.4% in FY23, which is 5 percent higher than FY22 (World Bank, 2023). Decrease in economic activity and incomes, high food and energy costs, service disruptions, and the damage of crops and livestock during the devastating 2022 floods are all contributing factors to the notable rise in poverty. The manufacturing, trading, construction, and agricultural industries employ almost 80% of the impoverished workforce. For low-income households and those at danger of becoming impoverished, the quality of jobs and labour earnings have suffered as a result of the passive economic activity in these areas. Remittances from overseas have lost real value as well. Food inflation nearly tripled during this period, averaging 38.7 percent in FY23. Real household incomes and purchasing power decreased as a result. This is especially true for low-income and vulnerable households, where food accounts for almost half of their budgets. The inflation rate for these households is 7 percentage points greater in the poorest decile than in the richest decile. (World Bank, 2023).

In spite of obstacles related to guaranteeing high-quality education, gender equality, skill development, health and sanitation, infrastructure development, and job creation, Pakistan is working to advance towards the SDGs. Pakistan is dedicated to reducing poverty in all of its forms by 2030 in accordance with SDG Target 1, "No Poverty." Regarding this, social safety nets program (SSNP), via redistribution of resources, which helps the underprivileged and impoverished to sustain social concord. According to Nasim (2014), SSNP are specially designed

initiatives that target those living below the poverty line and are based on food assistance, cash transfers, social welfare, and employment programmes.

The primary SSNP in Pakistan are the unconditional and conditional cash transfer programs. Cash transfer have been utilized more frequently in middle-class and lower-class nations to combat poverty and vulnerability. Unconditional financial transfers are used to help those who are outside the employment market, extremely impoverished, and viewed as a marginalised group within society. Benazir Income Support Programme (BISP), Zakat, and Pakistan Baitul-Mall provide unconditional cash transfers to the chronically impoverished to support for their rehabilitation. The goals of each of these programmes are similar while their funding sources and methods vary (Hassan, 2015). In humanitarian situations, cash transfers have also been utilized more recently as an alternative to food donations (Holmes & Bhuvanendra, 2013).

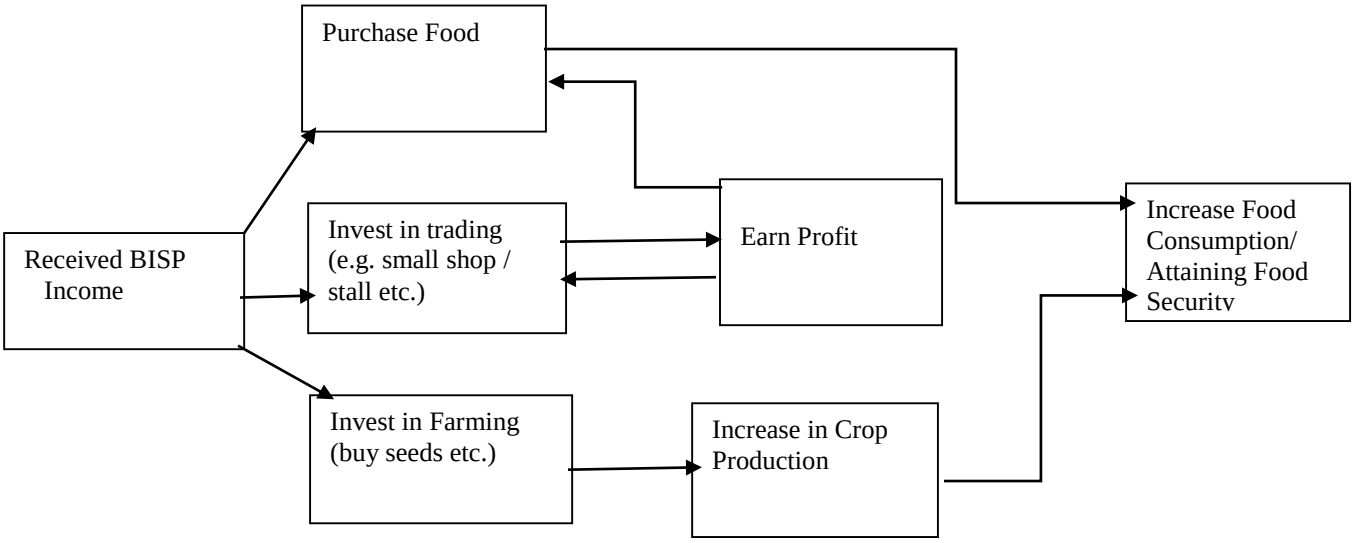
A household's ability to buy food and consume more calories can both directly and indirectly boost "access to food". Directly, this can be achieved by investing revenue in subsistence farming, for example through the purchase of agricultural supplies. Cash transfers improve a household's access to food, as well as its actual and proportional food expenditures. (HLPE, 2012). By enhancing the quality and variety of diet, higher household income can also directly enhance nutrition and "food utilization", leading to improvements in BMI, wasting, and stunting metrics. Other causes of malnutrition, such as disease, behaviour, knowledge gaps, and intra household inequalities, may also be addressed by cash transfers used as part of a larger package of interventions, such as it can connect recipients to health care, knowledge on health and nutrition, and/or dietary supplements (particularly through women's empowerment).

3.1.1 BISP and Food Security

Benazir Income Support policy (BISP) is a quite extensive and well managed unconditional cash transfer programme (UCT) among the UCT programmes that started in 2009 with 1.76 million beneficiaries and 15.85 billion Pakistani rupees. At the moment, the budget allocations increased from PKR 15.32 to 187.5 billion over the span of thirteen years (pp. 279, Economic Survey of Pakistan, 2022). In FY23, the number of BISP beneficiary households increased to 9.0 million from 7.7 million in FY22, and the BISP cash transfer amount had been raised by 25% starting in January 2023, which reflects the successful implementation of this program in a short span (pp.7, World Bank, 2023).

BISP was introduced to ensure consumption smoothing among the ultra-poor against negative economic shocks, in keeping with the global trend of cash transfers. Due to the program's positive income effect, BISP have shown a positive and considerable influence on food intake, assisting the recipients to improve their food security. (Mustafa et al. 2019; Iqbal et al. 2020). Cash transfers e.g BISP have the potential to support each of the four pillars of a sustainable food system by raising household income. Household income can boost the 'availability of food" as it can also boost local demand for goods, causing a supply response in the market. Such arrangements can also result in improving agricultural productivity and production by removing financial barriers for farmers and making it easier for them to buy seeds, fertilizer, and other inputs for their fields. Figure 3.1 explains the channel that how BISP may be effective to mitigate the issue of food insecurity.

Figure 3.1: Impact of BISP on Food Security



3.1.2 Motivation of the Study

Increases in food prices around the world and low household purchasing power due to persistent poverty have brought food insecurity issues back into the focus of international policy. Cash transfers that comprises conditional or unconditional income transfers to low-income households have been utilized more frequently in middle- and low-income nations to combat poverty and vulnerability. BISP is most extensive unconditional income support program targeting the vulnerable segment of the society. Main motivation of the study is to analyse the role of BISP targeting the food poor population in country.

3.1.3 Objective of the Study

The main objective of the study is to investigate the impact of cash transfer program from BISP on food security in Pakistan.

3.2 Literature Review

Social safety networks are widely regarded as protective mechanisms in developing nations like Pakistan that relief the weak and underprivileged and promote inclusive growth (Barrientos and Hulme, 2008). There is a lot of discussion on social safety nets assessing its effect on socioeconomic indices such as alleviating deprivation, increasing purchasing power, and improving food security. The theoretical underpinnings and welfare effects of social safety nets have been examined in this section.

Bishop and Hilhorts (2010) analysed the Ethiopia's safety network program in minimizing the hunger gap and providing food security to 500 million people. It is concluded that Ethiopian Productive Safety Net Programme is a comprehensive effort in ensuring to provide food security for those in need who have been dependent on food assistance for over 20 years. The program adopts an integrated strategy that blends emergency measures with development incentives, moving away from the haphazard and fragmented setup of relief-oriented support. This is a complex programme that unifies policy domains and relies on strong connections between many ministries, administrative levels, and units. Even if this is a difficult task for any professional apparatus, the surrounding political processes made it more difficult and hampered the process.

Oxford Policy Management (OPM) carried out the "BISP" the unconditional transfer payments' evaluation in three different years: 2013, 2014, and 2016. According to the study, monetary assistance improved women's empowerment and reduced poverty as shown by their mobility and financial management, as well as their food and energy intake.

Similarly, utilising primary data for the Peshawar district, Malik, et al. (2013) discovered that BISP cash assistance has positive impacts on poverty reduction. Using primary data from four cities (Multan, Mianwali, Sanghar, and Mirpurkhas), Shahzad (2011) investigated the effects of BISP cash assistance on women's empowerment and discovered a beneficial influence on household food consumption. Naqvi et al. (2014) used primary data from the Mankera district of Bhakkar, Punjab, to evaluate the impact of the BISP cash support on poverty. The findings indicate that financial aid has a favourable effect on food intake.

Nayab and Farooq (2014) used the Pakistan Panel Household Survey, 2010 (PPHS) to evaluate the welfare impact of the cash assistance provided by the BISP. It was discovered that the group receiving benefits is the most disadvantaged when compared to people who had never tried to apply for benefits and people who had tried to apply but were denied. The study discovered benefits for each household's food spending and health, but no effects on poverty, child education, or women's empowerment were discovered.

In order to address the issues of food insecurity faced by low-income urban households in Manzini, Tevera and Nomcebo (2014) explores the importance of both formal food-based social protection and informal safety nets. The findings show that there are significant issues with food security in Manzini's low-income neighbourhoods, but that a small percentage of the city's impoverished households rely heavily on various forms of intra- and community-wide food sharing. In this context, the federal government should think about bolstering food-based social safety net initiatives that support underprivileged and marginalised populations.

One of social protection's functions is to manage or reduce vulnerability. Devereux (2016) reviewed several instruments that aim to stabilise income and access to food across good and bad years, or between the harvest and the hungry season, such as weather-indexed insurance, public

works programmes, emergency food aid, and buffer stock management. In order to achieve viable food security, it is concluded that a comprehensive approach to social protection that combines interventions that raise or stabilize income or food production should be planned and implemented in a way that improves social justice.

Hassan and Bibi (2016) used primary data for Barikot, district Swat, Khyber Pakhtunkhwa (KPK) in an attempt to quantify the contribution of BISP financial support in attaining food security. Positive effects on the consumption of specific foods, such as sugar, wheat, milk, and vegetables, were found. The study concluded positive contribution of this cash transfer in improving food consumption.

Shuhung et al., (2017) investigated and assess social protection programmes in terms of their reach, scope, and coverage for Pakistan. The provincial and federal governments of the nation implement a variety of social security programmes for the welfare of its workforce, including old age benefits, disability benefits, health care, and medical facilities. These programmes, however, have not been able to provide benefits to agricultural, temporary, contract, home-based, or part-time workers.

Narayanan and Nicolas (2017) compiled the body of research on the Public Distribution System (PDS) and the Mahatma Gandhi National Rural Employment Guarantee Act (MGNRGEA) in India, providing a narrative analysis of the data regarding the effects on the recipients' nutrition, health, and food security. It is concluded that both initiatives are large-scale and have the power to influence the causes of under nutrition.

Hidrobo (2018) provided a comprehensive database of research on these initiatives that details their effects on asset creation and food security results. According -analysis, social protection and social safety programmes increase the amount and quality of food that recipients eat. These effect sizes' magnitudes have significance. The typical social protection programme results in an 8%

increase in calories acquired and a 13% rise in the value of food consumed or spent. Food expenditure increases more quickly than calorie acquisition because households employ transfers to enhance the nutritional value of their diets.

Badhan (2019) attempted to assess the social safety net programmes for ensuring food security and poverty reduction in char area of Jamalpur district. Prior to enrolling in SSNPs, roughly 77% of people experienced food insecurity; today, that number is 68%, and their daily caloric intake is 1834 kcal. The food insecure household falls eighteen percent short of the needed daily intake of calories, with a food security index of 0.79. Approximately 55% of respondents were found to be living below the poverty line, however since joining the SSNP, their circumstances had improved. In conclusion, the SSNPs are highly successful and may prove to be a fruitful approach to poverty alleviation for the Bangladeshi government.

Amrin and Muhammad (2020) investigated the impact of BISP on household food expenditures, ascertain the socioeconomic status of households, and provide recommendations based on the results. It is concluded that Beneficiaries' food expenses have improved relative to non-beneficiary food expenses. However, the relationship has a positive but marginal impact on household food expenditures Because people get such a little amount of BISP that its fail to have ample contribution in reducing food security.

Mustafa et al., (2022) investigated how the cash transfer programme affects the behavior of extremely poor people in terms of their food-seeking practices. The findings indicate that BISP recipients consume more calories overall than non-beneficiaries. They are able to diversify their food basket, maintain steady food availability, and raise their degree of food security over the long and short terms thanks to the financial transfer. In the long run, BISP cash transfer also makes high-quality food groups like meat, fish, and fruits relatively more accessible.

Khan et al., (2023) investigated the effect of social safety nets on household food security in the Torghar district of Northern Khyber Pakhtunkhwa. It was shown that respondents who were between the ages of 46 and 55, from extended family systems, and those with religious education were more vulnerable to food insecurity. Social safety nets might assist low-income locals who had trouble paying for food, but political involvement, nepotism, and favouritism had evident negative repercussions that required quick attention.

Shair et al. (2023) argued that families who are at risk, the social safety net programmes are the most efficient means of reducing food insecurity. They examined how Pakistan's safety net programme affects the country's food insecurity. Results indicate that households receiving food assistance are more likely than non-recipient households to experience food insecurity. Moreover, the probability of experiencing mild food insecurity decreases with an increase in the safety net.

3.3 Conceptual Framework about the Connection between Food Security and cash Transfers

The conceptual framework is based on BISP theory of change.[11] The BISP theory of change states that monetary transfers have an immediate impact on household expenditures, which can be divided into two categories: expenses for food and non-food items. It is anticipated that the medium-term effects will lead to an increase in caloric intake and food variety, which will eventually improve the recipients' nutritional condition over time. Food expenditures in long term may lead improve the nutrition status (Cheema et.al.,2016). BISP cash transfers can impact food security in a number of ways. Cash transfers directly increase household income, which can then be used to improve the quality and diversity of a household's diet and increase food consumption. These transfers are most likely to have the biggest impact on household "access" and "utilisation"

[11] A theory of change is a method that explains how a given intervention, or set of interventions, is expected to lead to specific development change, drawing on a causal analysis based on available evidence.

among the four pillars. Below Table 3.1 shows the potential contributions of cash transfer schemes to the food security system.

Table 3.1: Conceptual Framework

Components of Food Security	**Role of Cash Transfer**
"Food Availability"	Cash transfers can ease credit restrictions, encourage the purchase of agricultural inputs, and enable the employment of additional labor in the agricultural sector. Cash transfers have the potential to boost both local food supply and demand
"Food Access"	Cash transfers directly boost household income and allow for more access to food available in markets. By using cash transfers to purchase agricultural supplies, subsistence production can be increased.
"Food Utilization"	Cash transfers directly raise household income, which promotes better diet quality and diversity. Cash transfers have the potential to raise health care costs. However, when combined with supplementary services (like CCTs), they can also boost health service uptake, vaccination rates, and disease risk reduction. When paired with additional awareness and training services like education, health, and nutrition, cash transfers can enhance the way that children are cared for.
"Crisis prevention management"	During times of crisis, cash transfers can help households to smooth spending pattern by maintaining purchasing power in these adverse situations.

It's critical to distinguish between the outputs, outcomes, and impacts of cash transfer programmes when examining how these programmes truly affect food security and nutrition. These are presented in Table 3.2

Table 3.2: Impact of Cash Transfer

Input →	**Output** →	**Outcomes** →	**Impact** →
Cash transfer Cash "plus" e.g.	Increased household income	Increased quantity and diversity of diet (e.g. consumption of calories, more nutritious food)	Improved BMI, reduced stunting and wasting
complementary health care,	Awareness on nutrition	Increased knowledge put into practice (e.g. appropriate types of food)	
Nutrition knowledge	Access to health care	Utilization of health care	

3.4 Methodology

This section provides information about Model, data, variables, poverty indicators, and estimation techniques.

3.4.1 Empirical Model

The main purpose of the study is to evaluate the effect of the receipt of BISP on food insecurity. The Food Insecurity Experience Scale (FIES) is used to measure the amount and severity of food insecurity at the household level. The impact of receiving BISP coupled with socioeconomic and

demographic characteristics on a household's level of food insecurity. Following Shair et al.,(2023) Following model is used for empirical investigation ;

$$FoodI_i = \beta_0 + \beta_1 BISP_i + \beta_2 INCOME_i + \beta_3 \text{DWELLING} + \beta_4 AGRI\_OC_i + \beta_5 AGE_i + \beta_6 DR_i + \beta_7 F\ SIZE_i + \beta_8 GEN_i$$

Here $FoodI_i$ indicates the food insecurity, 1 for food insecure and 0 depicts for secure households. The description and summary statistics of explanatory variables (continues variables) is given bellow in the Table No 3.3 and 3.4 respectively.

Table 3.3: Variables Description

Variables	**Description**	**Definition**
BISP	**BISP**	Amount of Cash received from BISP in Pakistani Rupees
INCOME	**Monthly Income**	Average monthly income of the household in Pakistani Rupees
DWELLING	**Housing Status**	If household resides in his own house =1,0 otherwise
AGRI_OC	**Agriculture Occupancy**	If occupation is agriculture = 1,0 otherwise
AGE	**Age**	Age of household head in years
DR	**Dependency Ratio**	Dependency Ratio is ratio of the people typically not included in the labour force (1 to 17 years and 65 plus) to the number of people included in labour force (18 to 65 years)
F SIZE	**Family size**	Number of family members residing in a household
GEN	**Gender**	If gender is male = 1,0 otherwise

Table. 3.4: Summary statistics of the Explanatory Variables

Variables	Mean	Standard Deviation
BISP	17934.09	6646.661
Income	23362.64	9467.995
Age	21.84	20.12
Dependency Ratio	1.604	0.912
Family size	9.032	3.974

3.4.2 Data

This study used Household Integrated Economic Survey (HIES) data for year 2018-2019. There may be many social, economic and demographic factors that can be cause a household to be food secure or insecure.

3.4.3 Food Insecurity Indicator

Food insecurity is the term used to describe households' inadequate access to food as a result of financial or other resource constraints. The study used Food Insecurity Experience Scale (FIES) to gauge the state of food security situation of BISP recipients. The Food and Agriculture Organisation (FAO) developed the FIES as part of the "Voices of the Hungry (VoH) programme", Piloted in 2013 and formally launched in 2014, it became the first globally comparable survey instrument to measure food security through people's own experiences of constrained food access. By 2015, it was included in the Gallup World Poll, covering over 140 countries. It is now the official indicator for monitoring SDG 2.1.2 (prevalence of moderate or severe food insecurity in the population).

Data gathered with the FIES can be used to quantify the degree of food insecurity. Eight items make up the FIES, which asks respondents to self-report circumstances and events that are generally linked to having limited access to food. Numbers “1” and “0” are used to indicate the status of food insecurity: "1" for "yes" and "0" for "no."

If a household or individual responds by compromising on the quantity and quality of food, the FIES classifies them as somewhat food insecure. Reducing food intake or even skipping meals are symptoms of moderate food insecurity. For instance, going a day without eating or experiencing hunger are examples of severe food insecurity. If a home or individual answers "no" to each of the eight questions, they are deemed to be food secure. In response to "yes" for any of the questions Q1–Q3, "yes" for any of the questions Q4–Q6, and "yes" for any of the questions Q7–Q8 will result in mild food insecurity, moderate food insecurity, or severe food insecurity.

The FAO and increasing number of countries are currently using FIES to track developments in national and global food security. The main merit of the FIES is that it forms estimates of food insecurity at population level that can be compared across cultures, countries and sub-populations. Moreover, when the individual based survey module is incorporated, the FIES provides the benefit that the information can be disaggregated by gender. Due to the global recognition of FIES, the Pakistan Bureau of Statistics (PBS) preliminary included eight sets of FIES in the nationally representative survey Household Integrated Economic Survey (HIES) in the 2018–19 round.

The FIES systematic technique includes a refined probabilistic tactic for categorizing households with reference to their food security status. The outcomes are statistically robust and analogous across countries and sub-populations. Table 3.5 shows the scale items, domains and severity of food insecurity.

Table 3.5: Scale Items, Domains and Severity of Food Insecurity

Scale items	**Domains of the food insecurity paradigm**	**Assumed severity of food insecurity**
"You were worried you would run out of food because of a lack of money or other resources?"	Uncertainty and worry about food	Mild
"You were unable to eat healthy and nutritious food because of a lack of money or other resources?"	Inadequate food quality	Mild
"You ate only a few kinds of foods because of a lack of money or other resources?"	Inadequate food quality	Mild
"You had to skip a meal because there was not enough money or other resources to get food?"	Insufficient food quantity	Moderate
"You ate less than you thought you should because of a lack of money or other resources?"	Insufficient food quantity	Moderate
"Your household ran out of food because of a lack of money or other resources?"	Insufficient food quantity	Moderate
"You were hungry but did not eat because there was not enough money or other resources for food?"	Insufficient food quantity	Severe
"You went without eating for a whole day because of a lack of money or other resources?"	Insufficient food quantity	Severe

As for as concern of the current study data of FIES module collected by the Pakistan Bureau of Statistics (PBS) in the nationally representative survey, Household Integrated Economic Survey (HIES) 2018-19 is used to explore the effect of cash transfer by BISP in food security in selected

household who are BISP recipients. A sample of 2182 household is used from all four provinces. 76 percent population acquired score was below than 4 lies in food secure or mild insecure category, 14 percent in category of moderate insecure while only 10 percent in lies severe food insecure category. For analysis two categories are formulated for investigation, below number 4 lies in food secure category while other two categories are merged in food insecure category as the variation for the third category is very low. Zero indicates food secure while one shows the number of household who are food insecure.

3.4.4 Econometric Methodology

Due to the dichotomous nature of food insecurity, the binary logistic regression model is supposed to be the most suitable model for econometric analyses as both continuous and categorical independent variables can be used in analysis (Garson, 2006). Following Gujarati & Porter (2009) and Pindyck & Rubinfeld (1991) we can write commutative logistic model as :

$$P_i = E(Y = 1|X_i) = \frac{1}{1 + e^{-(\beta_0 + \sum \beta_i X_{i)}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

P is the probability that a household would be food insecure based on given Xi. where Y = 1 indicates that the household is food insecure; X is the explanatory variable of food security; β_0 and β_i and are regression coefficients; and e is the base of natural logarithm. The equation 1 can be written as;

$$\boldsymbol{P_i = \frac{1}{1 + e^{-Z_i}} = \frac{e}{e + 1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{3.2}$$

Where $Z = (\beta_0 + \Sigma\beta_i X_i)$. The commutative logistic distribution function that is represented by equation (2). The probability of a household being food secure is 1-P, where P is the likelihood of food insecurity. Where,

$$1 - P_i = \frac{1}{1 + e^{zi}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

The equation 3.3 can be written as

$$\frac{P^i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

Here $\frac{P^i}{1-P_i}$ is called odd ratio. The odd ratio is the ratio of a household's likelihood of experiencing food insecurity to its likelihood of experiencing food security. When equation (4) natural logarithm is calculated, then

$$L_i = ln\left[\frac{P^i}{1-P_i}\right] = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots + \beta_n X_n \ldots\ldots\ldots\ldots 3.5$$

L is the log of odds ratio and is called logit or logistic regression model for food insecurity. After introducing the disturbance term μ in above equation the logit model will be as;

$$L_i = \beta_0 + \sum_{i=}^{n} B_i X_i + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots 3.6$$

The maximum likelihood (ML) approach is used to estimate the parameters β_0 , β_1 , β_2 and ……β_n in the model mentioned above.

3.5 Results, Discussion and Policy Implications

3.5.1 Results and Discussion

Cash transfers that comprises conditional or unconditional income transfers to low-income households have been utilized more frequently in middle- and low-income nations to combat poverty and vulnerability..

Table 3.6, 3.7 and 3.8 presents the distribution of food security (0 indicates food security and 1 is for food insecurity) by region, province and gender respectively.

Table 3.6: Distribution of Food security by Region (%)

Food Security Index	Urban	Rural
0	73.46	79.03
1	23.54	20.97
Total (%)	100	100

73.64 % households are food secure in urban while 79.03 % are in rural areas. 23.54 % households are food insecure in urban while 20.97 % are food insecure in rural areas in given sample

Table 3.7: Distribution of Food security by Province (%)

Food Security Index	KP	Punjab	Sindh	Balochistan
0	77.10	67.96	70.32	50
1	22.90	32.04	29.68	50
Total (%)	100	100	100	100

In KP 77.10 % households are food secure while 22.90 % are insecure in given sample. Punjab is with 32.04 % household's food insecure and 67.96 % food secure. 70.32 % households are food secure and 29.68 are food insecure in Sindh. However, in Baluchistan 50 % households are food secure and 50 % are food insecure according given sample.

Table 3.8: Distribution of Food security by Gender (%)

Food Security Index	**Male**	**Female**
0	71.51	75.88
1	28.49	24.12
Total (%)	100	100

Above table shows 71.51 % males while 75.88 % females are food secure from BISP recipients in given sample. 28.49 % males are food insecure while 24.12 % females are food insecure.

BISP is most extensive unconditional income support program targeting the vulnerable segment of the society The study use the Binary Logit Model to analyse the impact of BISP's unconditional cash transfer on food security. To address the issue of endogeniety between dependent variable (Food poverty) and endogenous regressor (income) Lewbel instrumental variable (IV) is used. When conventional external instruments are insufficient or unavailable, the Lewbel instrumental variable (IV) technique provides a way to deal with endogeneity in regression models.

The value of Kleibergen Paap rk LM statistic is 990.415 with with Chi-sq(9) P-value = 0.0000 demonstrating that the model has been identified and that the instruments have a sufficient correlation with the endogenous variables.The vaue of the Kleibergen-Paap rk Wald F statistic is 90.058 (A common rule of thumb is that a value exceeding 10 suggests that the instruments are sufficiently strong, reducing concerns about weak instrument bias) indicating that the instruments are sufficiently correlated with the endogenous regressor.

After applying Lewbel (IV) technique we replaced the endogenous variables with their instrumented predictions and estimate the binary logit model

. The results are presented in below 3.9

Table 3.9: Estimates of Binary Logit Model (Marginal Effects)

Variables	National Level	Rural	Urban
BISP	-0.00022 *** (4.62e-05)	-0.00026*** (5.0e-06)	-0.00032*** (1.14e-06)
Monthly Income	-0.0025 *** (0.00012)	-0.00511*** (0.00014)	-0.00429*** (.00003)
Dwelling	-0.1046 *** (0.0075)	-0.1070*** (0.00866)	-0.10597*** 0 .01517
Agriculture Occupation	-0.2466 *** (0.00932)	0.24113** (0.16129)	-0.22601*** (0 .02176)
Age	-0.0036 ** (0.0016)	0.00369*** (0.00017)	-0.00204*** (0.0004)
Dependency Ratio	0.0329 *** (0.00321)	-0.34615*** (0.00347)	-0.00944 * (0 .00519)
Family size	0.1131 *** (0.0029)	0.11243*** (0.00320)	0.0964 *** (0 .0071)
Gender	0.3178 *** (0.0109)	-0.31797*** (0.01196)	-0.23676*** (0 .0260)

Binary Logit Model is estimated to capture marginal effects. Base category= food secure. Marginal effects are presented in the columns with standard error in the parenthesis. (Note: * , ** and *** show significance at 10%,5% and at 1% respectively)

The marginal effect of estimated logit model indicates that the BISP cash transfer decreases the likelihood of being food insecure by 0.02 % ,0.026 % and 0.032 % at. national level, urban and rural respectively. The results are significant but has quite marginal effect on food insecurity. It suggests that the food insecure household has very less purchasing power and that the presence of various sorts of dispossessions would prevent them from being able to raise them out of food insecurity. Thus, any action aimed at expanding economic options, such as lending money to start businesses, can assist them in escaping food insecurity. The main goals of the Benazir income support programme are unconditional cash transfers that empower women and give married women a monthly or quarterly income instead of just food assistance. In general, the BISP is only an unconditional cash transfer programme that offers help; unlike the conditional cash programme, it does not have any requirements to use in specific motives. Both the percentage of cash transfers

to total household income and the percentage of food expenses to total household expenditures are significant factors. It is a reality that having various social safety nets in a household might alter preferences more for future consumption than for current consumption. More safety net coverage can raise household income, which can then decrease labour force participation and household income, both of which contribute to food insecurity.

Furthermore, the results suggested that increase in household income has likelihood to decrease in food insecurity. Likewise, people who are residing in their own houses are likely to less food insecure relative to people without own residence. The likelihood of being food insecure is less in the people who are in agriculture occupation relative to non-agriculture occupation from the BISP cash transfer receiving community. The likelihood of food insecure decreases as age of household head increases. The dependency ratio and family size has more likelihood to being increasing effect on food insecurity. The male household member is less likelihood of being food insecure than female.

Table 3.10: Estimates of Binary Logit Model (Marginal Effects) by province

Variables	**Khyber Pakhtunkhwa**	**Punjab**	**Sindh**	Baluchistan
BISP	-0.0008 (0.00 656)	-0.000448** (0.000206)	-0.000680*** (0.0000178)	-0.00067*** (0.000017)
Monthly Income	-0.0001307*** (0.000012)	-0.00064*** (0 .000038)	-0.00069*** 0.000021	0-.00055*** 0 .00004
Dwelling	-0.11546*** (0 .00742)	-0.06467** (0 .02262)	-0.13908 *** 0 .01380	-0.19855*** 0 .03997
Agriculture Occupation	-0.14477*** 0.01509	-.036624*** (0 .02557)	-0.2975*** (0.01390)	-0.18696*** (0 .03568)
Age	-0.00060** 0.00020	-0.0035*** (0.00044)	-.00589*** (0.00026)	0-.00687*** (0.00075)
Dependency Ratio	0.00081 (0.00378)	0.03764*** 0 .00866	0.01125** (0.00531)	0.10954*** 0.01491
Family size	0.03213*** 0 .0029	0.13465*** 0 .00834	0.14662*** 0 .00493	0.10232*** 0.01145
Gender	-0.2979*** (0 .01259)	-0.34070*** (0.03083)	0-.43868*** 0.01801	-0.50611*** 0 .04039

Binary Logit Model is estimated. Base category= food secure. Marginal effects are presented in the columns with standard error in the parenthesis. (Note: * , ** and *** show significance at 10%,5% and at 1% respectively)

Table-3.7 comprises the estimated province-level results for food insecurity status from Logit model as we have discussed in previous section for national level. The discussed results will provide the role of BISP at provincial level. The marginal effect of estimated logit model indicates that the BISP cash transfer decreases the likelihood of being food insecure by 0. 0.08 % , 0.044 % and 0.0680 % 0.067 respectively for Khyber Pakhtunkhwa (KPK) ,Punjab ,Sindh and for Baluchistan respectively.

The results are significant but has quite marginal effect on food insecurity. Effects remains consistent except for Khyber Pakhtunkhwa the result are insignificant. The possible reason would be that the BISP program relies on the National Socio-Economic Registry (NSER) to identify beneficiaries, but some of the poorest households, particularly in remote areas of KPK, may not be accurately captured. Many deserving families may not be enrolled due to data inaccuracies or lack of awareness.

Similarly, the results suggested that increase in household income has likelihood to decrease in food insecurity. Likewise, people who are residing in their own houses are likely to less food insecure relative to people without own residence. The likelihood of being food insecure is less in the people who are in agriculture occupation relative to non-agriculture occupation from the BISP cash transfer receiving community. The likelihood of food insecure decreases as age of household head increases. The dependency ratio and family size has more likelihood to to increase food insecurity and has significant impact except in case of Khyber KPK because KPK has larger household sizes on average, meaning that the per-person impact of BISP cash transfers is diluted. The stipend may be insufficient to meet the food requirements of large families, limiting its effectiveness in reducing food insecurity. The male household member is less likelihood of being food insecure than female for all provinces.

3.5.4 Conclusion

Food insecurity refers to people's lack of access to safe, nutrient-dense food to fulfil the daily active life’s requirement. Food security remains a major socio-economic challenge in Pakistan, with millions facing hunger and malnutrition. Social safety nets (SSNs)—government-led welfare programs designed to assist vulnerable populations play a crucial role in reducing food insecurity by providing direct cash transfers, food subsidies, and nutritional support. BISP is most extensive

unconditional income support program targeting the vulnerable segment of the society The study has attempted to evaluate the role of cash transfer program “BISP” in food insecurity. The results designated that increase the amount of cash transfer via BISP has likelihood to decrease the food insecurity. The results are significant but has quite marginal effect on food insecurity. It suggests that the food insecure household has very less purchasing power and that would prevent them from being able to raise them out of food insecurity. In general, the BISP is only an unconditional cash transfer programme that offers help; unlike the conditional cash programme, it does not have any requirements to use in specific motives like purchasing of food.

3.5.3 Policy Implications

The above analysis revealed that cash transfer in form of BISP amount has significant but marginal role to address the issue of food insecurity. The reason is that these household has very low purchasing power to meet the daily requirement of the food. The BISP is an unconditional cash transfer programme is not specifically formulated to lower food insecurity.

On the other side, the Federal Government's social and economic assistance is based on regressive, poorly targeted subsidies. Compared to substantial public spending on subsidies, the FY24 budget's BISP allocation is a mere 0.6 percent of GDP, which needed to increase to enhance the purchasing power of the people.

Expanding the Benazir Income Support Programme (BISP) can considerably boost food security by addressing economic, social, and structural hurdles. For example, transfer from quarterly to monthly payments can increase household food consumption stability and payments should be adjust based on inflation rates to maintain real purchasing power. Due to ineffective targeting, many vulnerable households continue to be excluded from the safety net; increasing coverage assures that more families receive assistance, especially in marginalised, rural, and conflict-

affected regions. BISP should integrate with other social programs. Connect cash transfers to employment by providing job training and microloans to recipients to achieve self-sufficiency. Increase the availability of free school lunches to promote education and enhance child nutrition. We can say that the best results will come from scaling up BISP or other cash distribution programs in conjunction with more comprehensive interventions including job creation, agricultural investments, and nutrition education. The cycle of food poverty can be broken with a multi-sectoral strategy, guaranteeing long-term resilience for Pakistan's most vulnerable households. Further more the BISP allows spending freedom as it is unrestricted cash transfer programme. To properly ensure the access to food and tackle food insecurity, though, a conditional cash transfer programme is needed to be start in the country.

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ESSAY IV: REVIEW OF POLICIES

Pakistan, being an agricultural country, is capable of producing sufficient food to fulfill the dietary requirements of its population. However, the Earth's population is increasing at a rapid rate than our capacity to provide sustenance. In the face of rapidly fluctuating climatic conditions, we must find ways to feed people with limited water resources and diminishing agricultural land. As our resources dwindle, ensuring adequate food supply for the population will demand advanced and reliable structures of food production.

Fortunately, agriculture is an ancient and adaptable industry, holding immense potential. By examining some of humanity's oldest cultivation practices, we can gain valuable insights and ideas for shaping the future of our food system. With the need for sustainable and resilient approaches, exploring traditional agricultural methods may guide us towards effective solutions.

Limited resources are posing a number of issues. The National Nutrition Survey (NNS 2011) reports concurringly high undernutrition indices. Over 58% of households are affected by food insecurity. About two thirds of adult women are low in vitamin D, and half suffer from anaemia and calcium inadequacy.

One-third of children under five are underweight, and 15% of children under five have severe or moderately acute malnutrition that requires emergency medical intervention. In addition, stunting affects almost two-thirds of children is a common sign of chronic malnutrition.

Taking into account the aforementioned situation, we have structured this chapter to offer an understanding of the diverse policies and research initiatives carried out by specialists and interested parties from different ministries and esteemed establishments. Determining the nature of the action in the area of food and nutrition security is the primary objective.

4.1 Policies associated to Food and Nutrition Security

A few of the policy initiatives being implemented in Pakistan to ensure food security include the creation of the Ministry of National Food Security and Research (MoNFSR), the implementation of social safety nets and poverty reduction programs, the provision of agricultural subsidies, and the establishment of the Pakistan Agriculture and Research Council (PARC) to achieve sustainable agricultural production for food and nutrition security. The National Food Security Commission (NFSC), which is led by the Prime Minister, was established by the federal government in order to create a national strategy for the expansion of agriculture and the long-term resilience of food and nutrition security.

Pakistan became a member of the international Scaling Up Nutrition (SUN) program in 2013, and the Planning and Development Division formed a national SUN secretariat. A SUN secretariat has been established by each province government within its own Planning and Development Department. To improve food security in Pakistan's selected districts, MoNFSR is launching the Zero Hunger Program in collaboration with the World Food Program. Additionally, a national Infant and Young Child Feeding (IYCF) plan was created and adopted in 2015 with support from UNICEF.

In every province, there have been proposals for multi-sectoral nutritional protocols. Under the Punjab Food Support Scheme, the government of Punjab has been helping qualified households fulfil their food needs by giving them Rs. 1,000 per household. As of now, it has benefited one million people with low incomes. "Nutrition", the fourth module of the KP Health Incorporated Reforms Program, is being executed at a cost of Rs 20 million Out of the Rs 14.11 billion,. A "Mother and Child Nutrition Program" is introduced in seven districts of Baluchistan. At an

estimated cost of Rs. 582.00 million for three districts, the "Nutrition Support Program" and "Nutrition Sensitive Agriculture" programs were introduced in Sindh.

The salient characteristics of Public Sector Development Programs (PSDP) in the healthcare sector are as follows:

4.1.1 Sehat Sahulat Programme

The "Sehat Sahulat Programme," a major health initiative spearheaded by the Pakistani government, aims to provide the groundwork for Universal Health Coverage (UHC) in the country. In addition to being a social health security program that is helping to realise the "National Health Vision 2016-2025," the program is revolutionary because it gives the government the ability to offer medical care to the general population from private as well as public hospitals. Overall , it's a financial aid program that enables low-income individuals to quickly and affordably receive critical medical care.

Phases of the Sehat Sahulat Program are being implemented; the first phase, which ran from 2016 to 2018, involved 38 districts and 3.2 million people. In the second phase of the initiative (2019–2020), which is being carried out in 91 districts, 8.5 million households are receiving support, and the number of participants is increasing.

4.1.1.1 "Ehsaas" Family Planning and Primary Healthcare Programme (FP&PHC)

The Ehsaas Program has reinforced the FP&PHC initiative, which is working to curb population growth. According to PSLM, 2018–19, Pakistan has a 34.0% Contraceptive Prevalence Rate (CPR) and a 3.7% Total Fertility Rate (TFR). Pakistan has demonstrated its dedication to promoting family planning. Every province has created a unique family planning scheme. The government has trained mid-level clinicians in the public and commercial divisions to give IUDs and implantation, and it is making sure that a range of procedures are readily available across the

nation. In addition, the government is working with religious leaders and family elders as part of its social movements to promote family planning acceptability.

The governments of Khyber Pakhtunkhwa, Sindh, and Punjab have established health centres specifically for teenagers. In an effort to reach 6.7 million additional contraceptive users and raise CPR to 50%, the government is striving to boost regional harmonization in order to uphold a robust national commitment.

4.2 Policies related to Nutrition Security

It is believed that good nutrition is the cornerstone of human growth. It is an overarching subject with close ties to almost all of the SDGs. Undernourishment hinders development and has detrimental effects on the human body. One of the best strategies to end hunger, promote economic expansion, and provide prosperity to the populace and the nation is to concentrate on nutrition. Approximately one in nine people worldwide suffer from hunger, and one in three are overweight. Pakistan is not alone among most countries in having a double burden of malnutrition. A 2018 National Nutrition Survey (NNS) found that 29% of children under five are underweight, 18% are wasting, and 40% are stunted. Children under five who are overweight make up 9% of the total.

4.2.1 Nutrition Interventions/Activities

To tackle malnutrition and its effects, the following actions and measures are being carried out at the national and provincial levels.

4.2.1.1.1 National Initiatives/Programs

- The Food Fortification Program (Flour, Edible Oil, and Salt) covers about 1,006 wheat flour mills and 2,333 micro feeders nationwide.

• The Ministry of National Health Services, Regulations and Coordination (NHSR&C) has created a nutrition-specific PC-1 "Tackling Malnutrition Induced Stunting in Pakistan," which costs Rs. 312 billion to address stunted growth and malnutrition in children in 67 more malnutrition districts.

- An Urdu version of the updated "Pakistan Dietary Guidelines for Better Nutrition" has been released for public promotion and awareness across all demographic groups.

  The National Nutrition Thought Management Program (NNTMP) is being established with the intention of minimizing malnutrition, particularly among disadvantaged populations, by teaching and sensitizing all demographic groups about nutritional awareness and dietary choices.
- The Multi-Sectoral Nutrition Management Information System, or MNMIS, is being developed as a multi-sectoral collection of information that will quantify the economic and physical aspects of nutrition indices.
- The activities are carried out under the Scaling Up Nutrition (SUN) Networks: discussions of the National Steering Committee (NSC) on Early Childhood Development (ECD).
- The National Nutrition Forum (NNF) meets regularly, and measures have been taken to encourage nutrition through policy planning, teamwork, research and development. The NSC is a high-level interministerial alliance and decision-making body.

4.2.1.1.2 Provincial Initiatives

- Punjab is carrying out the Ehsaas Nashonuma Program, the Human Capital Investment Program, and the Stunting Reduction Program.

- Four districts (Bannu, D.I. Khan, Tank, and Nowshera) are participating in the KPK SPRING program, which is an Integrated Nutrition Gain initiative that promotes stunting prevention and rehabilitation in the region. The province is now implementing the "Integration of Health Services Delivery" plan, which is a new project valued at Rs 7.0 billion. The initiative's focus will be on nutrition, maternity, newborn, and child health.
- In seven Balochistan districts, the Balochistan Nutrition Programme for Women and infant has now been implemented.
- In 23 districts of Sindh where the prevalence of stunning exceeds 40%, an Accelerated Action Plan (AAP) worth Rs 5.6 billion is being launched to reduce stunting and malnutrition.

4.3 The Ministry of National Food Security and Research (MoNFSR)

The primary goal of this ministry's development in 2011 was to guarantee food security in rural areas. This ministry is renowned for creating regulations pertaining to food availability, access, utilization, and stability in order to guarantee food and nutrition security. Additionally, they guarantee the nation's contemporary, effective food production and delivery networks. Specific targets for creating food security policies are to decrease poverty, eradicate hunger, approve workable systems for food production, making agriculture more profitable, productive, viable and climate resilient. We conducted interviews with the ministry's wheat commissioner and food security based on these goals. The first pillar of food security, or food availability, is the ministry's primary concern. A ministry spokesman claims that guaranteeing the availability of food will inevitably guarantee the other pillars of

To increase productivity on the limited amount of cultivable land, provide food security, and generate income, the Ministry imports hybrid crop types' seeds from other countries with the assistance of the Pakistan Agricultural Research Council (PARC). The Ministry suggests a bio fortification technique for nutrition security, which comprises growing seeds with higher percentages of micro and macronutrients. In order to provide people with wholesome wheat, the ministry has started a program in collaboration with flour mills, whereby they grind wheat and mechanically add zinc and iodine to wheat flour. In line with ministry statistics obtained by PARC, the National Nutrition Survey (NNS), which was carried out in collaboration with the World Food Program (WFP), reports that 18.5 percent of people experienced food insecurity in 2014–15.

Additionally, the official said that although the ministry does not address gender from this angle, they do take into account the amount of food needed for Pakistan's whole population. Provinces pay PASSCO for wheat by presenting proof of their population and the quantity of wheat they need. Crop acreage and productivity targets were established by the Federal Committee on Agriculture (FCA). The question of how much of the aim the provinces could meet was then posed. It was emphasizing that wheat is a staple crop that every household needs and that they will have to import it if there is a scarcity. The spokesperson claims that the primary causes of the disparity are the scarcity of arable land and the exponential growth in population.

Pakistani agriculture is struggling to survive in the modern world. The speaker stated that production costs are one of the main causes of food poverty. Nonetheless, since these crops are more profitable than wheat and cotton, people will grow crops like sugarcane, maize, and rice. He added that perishable commodities have a greater rate of food losses and that food losses are a factor in the occurrence of food insecurity. The middleman is doing badly in this scenario; he takes

advantage of farmers and increases his supply chain commission. Controlling food losses, which lead to food insecurity, is critical.

4.4 Pakistan Multi-Sectoral Nutrition Strategy (PMNS) 2018-2025

The government and other stakeholders responded to the situation by developing the Pakistan Multi-sectoral Nutrition Strategy (PMNS), which reflects their determination to seize the chance to advance and implement evidence-based intervention strategies to lessen the economic, social, and human cost of malnutrition. Additionally, the PMNS aims to fulfil commitments made in Pakistan Vision 2025 and international agreements like the Global WFP. The National Strategy's primary goals are to: enable and encourage standardized national reporting in response to international commitments; integrate provincial activities with national goals and international duties.

It is now generally acknowledged that in order to lower the prevalence of malnutrition, a multi-sectoral response is required, one that enables each sector to capitalize on their unique roles and responsibilities to increase nutrition while simultaneously pursuing collaboration and links with other sectors. A multi-sectoral matrix of activities includes both "nutrition-specific" and "nutrition-sensitive" strategies, as seen in: The major objective of nutrition-specific interventions, which are mainly carried out through the health sector, is to address critical determinants of malnutrition by means of treatment and prevention strategies.

The sectors that implement nutrition-sensitive programs also have the potential to raise the nutritional intake of those they serve, particularly by concentrating on the main causes of malnourishment. The main treatments and topic areas that fall under this category are as follows:

Agriculture and Food Security*:* Family incomes can be increased, access to a wider variety of foods can be improved, and food security can be improved by implementing drought mitigation

and prevention strategies, adopting nutrient-dense crops, increasing agronomic output and distribution, and other initiatives.

Education*:* Education sector investments in nutrition and health facilities, coordinated with all relevant stakeholders and sectors, such as in-school meals, deworming, or micronutrient dietary supplements, as well as learning and development of skills, will lead to better children's health and nutrition, which will improve their performance and participation in school.

Gender Equality*:* Research indicates that keeping females in school longer causes a delay in marriage age and makes young women more capable, educated, and powerful mothers. Each of these components contributes to the better nutritional health of kids and teens. In order to increase women's opportunities at home, men must also be active.

Social Protection & Welfare*:* Social protection programs that establish clear objectives and incorporate precise and verified nutrition offerings improve the nutritional status of beneficiaries significantly and increase the likelihood of project welfare goals being attained. Health insurance policies and cash transfer programs are further strategies for managing hunger and poverty.

Food Safety and Quality*:* Governmental organizations and commercial food vendors can collaborate to enhance food safety, quality, and nutritional values by refining rules, tracking, and inspecting systems for hygienic food preparation and improved packaging; additionally, by offering a legislative framework and enforcing law enforcement to permit fortified salt oil, flour and other prepared and nutritious food.

4.5 Critical Evaluation

Pakistan's government has focused its efforts on implementing food security regulations, however there are still obstacles in the way of providing its people with complete food and nutritional security. A rigorous analysis highlights the obstacles still to be overcome.

4.5.1 Obstacles and Areas for Improvement

1. **Policy Fragmentation**: Although comprehensive policies exist, their execution frequently suffers from a lack of coordination between federal and provincial institutions, which results in overlaps and inefficiencies.
2. **Data Limitations**: For policymaking to be effective, accurate and current data on food security indicators is necessary. However, Pakistan has difficulties gathering and analyzing data, which makes focused initiatives difficult.
3. **Climate Vulnerability**: Floods and droughts brought on by climate change can seriously disrupt food production and supply systems in Pakistan's agriculture.
4. **Infrastructure Deficiencies**: Inadequate market access, transportation systems, and storage facilities, particularly in remote areas, make it difficult to distribute food efficiently, which impacts both availability and affordability.
5. **Nutrition-Focused Interventions**: To prevent malnutrition and associated health problems, programs that address food availability must also place more emphasis on nutritional diversity and quality.

4.5.2 Recommendations for Improved Implementation

1. **Integrated Policy Approach**: Strengthen collaboration across various governmental departments and agencies to enable cohesive policy execution.
2. **Data-Driven Decision Making**: Make investments in reliable systems for gathering and analyzing data to help guide the creation of programs and policies and enable focused, successful interventions.
3. **Encourage climate-resilient farming methods**, such as the creation and spread of crop types resistant to drought, that can be adjusted to the changing climate.
4. **Infrastructure Development**: To improve food distribution and minimize post-harvest losses, improve rural infrastructure to enable effective food storage, transportation, and market access.
5. **Nutrition Education and Programs**: Put into action community-based nutrition education programs and initiatives that address particular nutritional deficiencies and encourage dietary diversity.
6. To sum up, Pakistan has laid the groundwork for tackling food security through a number of laws and initiatives, but overcoming implementation obstacles would require coordinated efforts. To achieve sustainable food security for all populations, a comprehensive strategy that incorporates data utilization, infrastructure development, climate resilience, policy coordination, and nutrition-focused tactics is necessary.