

Spatial Analysis of Poverty and Food Insecurity in Rural Iran: Assessing Status and Food Insecurity Determinants

Mehdi Shabanzadeh-Khoshrody^{1*} 

1- Assistant Prof. in Agricultural Planning, Economics and Rural Development Research Institute (APERDRI)

Abstract

Purpose- This study aims to analyze the spatial patterns of poverty and food insecurity in rural areas of Iran, focusing on their current status and the key determinants affecting household food security in 2023. The research seeks to provide an evidence-based foundation for designing targeted policies to reduce poverty and improve food security in rural regions.

Design/Methods/Approach- The study calculates household food security indicators for rural areas of Iran using the Aggregate Household Food Security Index (AHFSI) and a calorie-based criterion. Food poverty is assessed using the Foster–Greer–Thorbecke (FGT) index, which is then used to map the spatial distribution of rural food poverty. To identify determinants of food insecurity, a logistic regression model is applied, incorporating socio-economic and demographic household characteristics.

Findings- The AHFSI for rural areas in 2023 was 68.8, indicating a low level of food security compared to over 90 in the early 2000s. Food poverty has increased substantially, with the poverty rate reaching 50.3%, compared to about 40% in the early 2000s. The poverty gap and poverty severity were estimated at 14.2% and 5.8%, respectively. Spatial analysis revealed significant disparities, with provinces such as Gilan, Hormozgan, and West Azerbaijan experiencing the highest food poverty levels, while Ilam, Semnan, and Kermanshah showed relatively better conditions. The logistic model results indicated that factors such as household head's age, dietary diversity, employment, subsidies, and income significantly improve food security, whereas gender and education of the household head showed no significant effect. Larger household size was associated with higher food insecurity.

Practical implications- The findings highlight an alarming decline in rural food security over the past two decades, driven by reduced dietary diversity, rising poverty, and reliance on low-cost, low-nutrition foods. Policymakers should adopt region-specific strategies, focusing on job creation, income enhancement, dietary diversification, and reforming the subsidy system to improve rural food security.

Original/Value- This study provides one of the most recent and comprehensive spatial analyses of rural poverty and food insecurity in Iran, combining national and provincial-level indicators with econometric modeling. By integrating spatial mapping with socio-economic determinants, it offers valuable insights for evidence-based, targeted policy interventions in rural food security.

Keywords- Food poverty, Food security, Rural areas of Iran, Logit model.

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*Corresponding Author:

Shabanzadeh-Khoshrody, Mehdi, Ph.D.

Address: Department of Agricultural Planning, Economics and Rural Development Research Institute (APERDRI), Tehran, Iran.

Tel: +989120972611

E-Mail: shabanzadeh.mehdi@gmail.com

1. Introduction

Nutrition directly affects human health. The type, quality, and diversity of daily consumed foods significantly influence both health status and disease prevention. Dietary diversity, particularly in providing essential micronutrients, is a cornerstone of healthy diets. Studies indicate that diverse food consumption can reduce the risk of malnutrition-related diseases and infections (Wen et al., 2024). Globally, over 3.5 billion people lived in rural areas in 2024, highlighting the importance of rural food security. In Iran, over 24 million people live in rural regions, facing unique economic and structural challenges (Sheibani & Karbasi, 2020). Given the pivotal role of rural areas in food production, ensuring food security and adequate nutrition in these regions is critically important. Rural households in Iran constitute a substantial portion of the country's population, playing a key role in its economic, social, and cultural structure (Iran Statistical Center, 2024). Despite this importance, rural households face a range of structural and economic challenges, including limited access to stable income opportunities, public services, and diversified food markets. These constraints increase their vulnerability to poverty and food insecurity and reduce their resilience to economic shocks and food price fluctuations (Siddique et al., 2020). Several national and international reports indicate that a considerable share of the population experiencing food-related deprivation and nutritional vulnerability resides in rural areas, reflecting persistent spatial inequalities and livelihood constraints (UNICEF, 2024). Such conditions restrict access to sufficient, safe, and diverse foods and adversely affect dietary quality. Over time, these limitations can undermine the health, nutritional status, and labor productivity of the agricultural workforce, thereby reinforcing cycles of poverty and food insecurity in rural regions.

The continuous increase in food prices over the past decade, driven by both domestic and international factors, has raised the cost of healthy diets in Iran. A joint report by international organizations shows that the daily cost of a healthy diet in Iran increased from \$3.005 in 2017 to \$4.167 in 2021, while the proportion of people unable to afford such a diet rose from 14.4% to 30% (FAO et al., 2023). These economic changes have negatively impacted household consumption patterns, especially among

low-income deciles, resulting in reduced intake of nutritious foods (Ghahremanzadeh et al., 2016; Ghorbanian & Bakhshoodeh, 2016; Ashktorab & Nematollahi, 2019; Kiani Dehkiani et al., 2022; Ghasemi & Fa'al Jalali, 2023).

Although it is commonly assumed that farmers in rural areas can improve their families' diets by producing diverse crops, empirical evidence does not conclusively confirm a direct link between farm production diversity and dietary diversity (Snapp & Fisher, 2015; Hirvonen & Hoddinott, 2017; Zanello et al., 2019). Moreover, many smallholder farmers sell their products and purchase food items from markets, and increases in productivity of main crops have had limited impact on improving food security (Webb & Kennedy, 2014; Ruel et al., 2017; Usman & Callo-Concha, 2021).

Previous studies in Iran regarding food consumption, poverty, and food security have generally been sporadic and limited in scope (e.g., Ahmadi Javid et al., 2014; Rostami et al., 2015; Abdi et al., 2015; Farshidi et al., 2020; Shahraki & Ghaderi, 2021; Shabanzadeh-Khoshrody et al., 2022; Azmayesh Asiabasri et al., 2023). Limited research has addressed the spatial distribution of poverty and food insecurity in rural Iran, often focusing on specific aspects and based on outdated data (Mehrabi Bushrabadi & Mousavi Mohammadi, 2009; Pakravan et al., 2015; Nosratabadi et al., 2015; Rezaeifar et al., 2022). Given that food security is a critical necessity for independent countries like Iran, it is essential for policymakers to manage this issue systematically and with informed approaches. Accordingly, understanding the current situation is not only vital for designing future programs but also necessary for monitoring and evaluating the outcomes of implemented interventions.

Therefore, this study aims to analyze the spatial patterns of food poverty and food insecurity in rural Iran using up-to-date and comprehensive data. Initially, food security and food poverty indices will be calculated and analyzed, followed by identifying the determinants of food security in rural areas across the country. Furthermore, the results will be compared with previous studies to elucidate trends and changes over time.

2. Research Theoretical Literature

2.1. Food Poverty

Food poverty, often conceptualized as food insecurity, refers to the inability of individuals or households to secure adequate, safe, and nutritious

food for a healthy and active life due to financial constraints or inadequate physical access (Jandaghian Bidgoli et al., 2024). Unlike transient hunger, food poverty reflects structural and persistent deprivation with significant physical, psychological, and social consequences (Seligman & Berkowitz, 2021). In 2021, over 2.3 billion people worldwide experienced moderate to severe food insecurity, including nearly 20% of the population in high-income countries (WHO, 2025). The health impacts of food poverty are wide-ranging: in adults, it is associated with anemia, type 2 diabetes, hypertension, cardiovascular disease, and multimorbidity; among older adults, it leads to reduced physical function and increased depression; in children, particularly during early life, it is linked to obesity, cognitive delays, poor educational performance, anxiety, and depression (Fram et al., 2024). Climate change, food price volatility, and intra-household inequalities in food allocation further exacerbate the problem (Seligman & Berkowitz, 2021).

2.2. Food Security

The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) define food security as a condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life (FAO, 2015). Food security encompasses four interrelated dimensions:

1. Availability: The presence of adequate food supply through domestic production, imports, or food aid.
2. Access: The economic, physical, and social means to obtain food.
3. Utilization: Proper use of food supported by dietary diversity, safe water, sanitation, and health care.
4. Stability: Reliable access to food over time, without risks from economic, political, or environmental shocks.

Food insecurity can be transitory, seasonal, or chronic. Chronic food insecurity, in which households consistently lack access to adequate and nutritious food, is particularly damaging due to its long-term health and development consequences (World Bank, 2024).

2.3. Determinants of Food Security

Food security in rural households is shaped by a complex interaction of socio-economic and

demographic characteristics, each influencing the ability to obtain and utilize adequate, safe, and nutritious food. Based on the variables examined in the present study, key determinants include:

- Age of the head of household – Age can affect food security in two contrasting ways. Greater age often brings farming experience, social capital, and accumulated assets that may improve household resilience; however, in later life, reduced physical capacity and income-generating potential may increase vulnerability to food insecurity (Mango et al., 2014; Chinnakali et al., 2014).
- Gender of the head of household – Gender plays an important role in access to resources, employment opportunities, and decision-making power. In many rural contexts, female-headed households may face structural disadvantages such as limited access to land, credit, and formal employment, which heighten food insecurity risks (Quisumbing et al., 2014; Nowak et al., 2020).
- Literacy of the household head – Literacy improves access to information, enhances nutritional knowledge, and facilitates better financial and agricultural management, thereby contributing to more diversified and nutritious diets (Smith & Subandoro, 2007; Bashir & Schilizzi, 2013).
- Household size – Larger households typically face higher food requirements, potentially increasing the strain on available resources. When income and food production do not grow proportionally, household size can become a significant predictor of food insecurity (Olayemi, 2012; Mango et al., 2014).
- Food diversity – Dietary diversity is a direct indicator of food utilization and nutritional adequacy. Households with greater dietary diversity generally have better micronutrient intake and improved health outcomes, reflecting higher food security status (Ruel, 2003; FAO, 2011).
- Household subsidy – In rural Iran, targeted government subsidies can play an important role in mitigating food insecurity by reducing the effective cost of basic goods and freeing household resources for diversified food purchases (Safarpour et al., 2014; Ghobadi et al., 2018).

- Employment status of the head of household – Stable employment, particularly in sectors with regular wages, is positively associated with household food security. Unemployment or reliance on seasonal and informal work increases income volatility and the risk of inadequate food access (Mango et al., 2014; Babatunde et al., 2007).
- Household income – Income remains the most critical determinant, influencing both the quantity and quality of food consumed. Higher income levels enable households to afford diverse diets, invest in food storage and preparation, and cope with price fluctuations (Smith & Subandoro, 2007; Babatunde et al., 2007).

This set of determinants forms the analytical foundation for examining spatial variations in food insecurity across rural Iran, allowing the study to assess both structural and household-level factors that shape food access and utilization.

3. Research Methodology

3.1. Data Collection and Estimation of Caloric Intake

This study adopts a quantitative analytical approach to investigate food security and food poverty in rural Iran for the year 2023. The spatial coverage encompasses rural areas across all 31 provinces of the country. A total of 18,321 rural households were included in the analysis, based on data from the Household Income and Expenditure Survey (HIES) conducted by the Statistical Center of Iran (SCI). The research design combines a comprehensive literature review and secondary data analysis. The literature review draws upon scholarly books, peer-reviewed journal articles, and academic theses related to food security, food poverty, and rural livelihoods. The quantitative dataset contains detailed household-level information on food consumption, demographic characteristics, and socioeconomic conditions.

The minimum dietary energy requirement was set at 2,400 kilocalories per capita per day, as established by the Ministry of Health and Medical Education of the Islamic Republic of Iran. This threshold reflects the dietary standards recommended for the average adult in the Iranian context, taking into account typical activity levels and body composition. The same value has been adopted in previous studies on food consumption and food security in Iran, including Pakravan et al. (2020), Rafati et al. (2021) and Shabanzadeh-Khoshrody et al. (2024),

providing consistency with national research practices. This threshold served as the benchmark for classifying households into food-secure and food-insecure categories.

To estimate the caloric content of rural households' food baskets, a nutritional performance matrix was constructed using consumption data for 222 distinct food items. This matrix was obtained by multiplying two component matrices:

1. Food Consumption Matrix – rows represent individual food items, and columns correspond to the quantities of each item consumed by rural households.
2. Nutrient Content Matrix – rows contain caloric values, and columns indicate the amount of energy (in kilocalories) per 100 grams of each corresponding food item.

Multiplication of these matrices yields the nutritional performance matrix for rural households, representing total caloric intake from all consumed food items. Assuming a linear functional form, the caloric content model is expressed as follows (Smed et al., 2005; Akerele, 2011; Shabanzadeh-Khoshrody et al., 2022):

$$L_h^* = \sum_{j=1}^{n=k} \beta_j X_{hj} + \varepsilon_h \quad (1)$$

Where:

L_h^* : total caloric intake of household h

X_{hj} : quantity of food item j consumed by household h

β_j : energy content (kcal) of food item j per unit of measurement

ε_h : random error term

To obtain per capita monthly caloric intake, the total household caloric intake matrix was divided by the average household size. Subsequently, dividing each element by 30 provided the average daily per capita caloric intake across different food items.

3.2. Aggregate Household Food Security Index (AHFSI)

To assess food security at the macro level, the Aggregate Household Food Security Index (AHFSI), developed by the Food and Agriculture Organization (FAO) and grounded in the works of Sen (1976) and Bigman (1993), was applied. The AHFSI is defined as:

$$AHFSI = 100 - [H\{G + (1 - G)I^P\} + 0.5\Omega\{1 - H[G - (1 - G)I^P]\}]100 \quad (2)$$

Where:

$H = \frac{P_U}{P_T}$: Headcount ratio, proportion of individuals consuming less than the energy requirement.

$G = \frac{C_S - C_{AU}}{C_{SH}}$: Severity of food poverty, where C_S is the standard energy requirement (kcal/day) and C_{AU} is the average energy intake of those below the standard.

$\Omega = \frac{S}{\bar{X}}$: Temporal variation in energy supply, where S is the standard deviation and $\bar{X}$ is the mean energy supply over time.

I^P : Inequality in the distribution of food gaps among the food-insecure population, measured using the Gini coefficient derived from the Lorenz curve.

The AHFSI ranges from 0 to 100, where values below 65% indicate critical food insecurity, 65%-75% denote low food security, and above 75% represent high food security (Mehrabani Bushrabadi & Mousavi Mohammadi, 2009; Amirzadeh Moradabadi et al., 2020).

In addition, this study employed a calorie-based criterion to classify households as food-secure or food-insecure. Following the World Food Programme (WFP) guidelines, households with per capita daily calorie intake exceeding the minimum requirement are considered food secure. Households with calorie intake at least 30% below this threshold are categorized as food insecure, while those with intake levels falling between these two ranges are classified as being on the borderline of food insecurity (Huang et al., 2015).

3.3. Foster–Greer–Thorbecke (FGT) Index

Food poverty was measured using the Foster–Greer–Thorbecke (FGT) index, widely used in poverty and food insecurity analysis (Foster et al., 2010). The general formula is:

$$FGT = P(a) = \frac{1}{n} \sum_{i=1}^q \left(\frac{Z - T_h^*}{Z} \right)^a \quad (3)$$

Where:

n : Total population size.

q : Number of food-insecure individuals.

Z : Calorie threshold for food security (2,400 kcal/day per capita).

T_h^* : Calorie intake of individual h .

a : Parameter defining the index type:

$a = 0$: Headcount ratio (incidence of food poverty)

$a = 1$: Poverty gap (depth of food poverty)

$a = 2$: Poverty severity (distribution-sensitive measure)

3.4. Logit model

To identify socioeconomic determinants of household food security, a binary logistic regression (logit) model was estimated. The dependent variable is defined as:

$$y_i = \begin{cases} 0 & \text{if household is food - secure (per capita calorie} > 2,400 \text{ kcal)} \\ 1 & \text{if household is food - insecure (per capita calorie} < 2,400 \text{ kcal)} \end{cases} \quad (4)$$

The probability model is given by:

$$\Pr(y_i = 1) = \frac{e^{\beta X_i}}{1 + e^{\beta X_i}} = \psi(\beta X_i) \quad (5)$$

Where:

X_i : Vector of explanatory variables (age, gender, education of household head, household size, employment status, subsidy receipt, income, dietary diversity).

β : Vector of coefficients to be estimated.

ψ : Logistic cumulative distribution function.

Marginal effects were calculated as:

$$ME_L = \frac{\partial P_i}{\partial X_i} = \frac{e^{\beta X}}{(1 + e^{\beta X})^2} \beta_i \quad (6)$$

The model's goodness-of-fit was evaluated using the Likelihood Ratio (LR) test:

$$LR = 2[LL_{UR} - LL_R] \quad (7)$$

where LL_{UR} and LL_R represent the log-likelihood values of the unrestricted and restricted models, respectively. The LR statistic follows a chi-square distribution and tests the overall significance of the regression (Agresti, 2003).

4. Research Findings

4.1. AHFSI and Food Security Status in Rural Iran

The components of the Aggregate Household Food Security Index (AHFSI) for rural areas of Iran in 2023 were first calculated as follows: the Headcount ratio (H), the Severity of food poverty (G), and the Temporal variation in energy supply (Ω). Based on these components, the AHFSI for rural areas was estimated at 68.8 (Table 1). According to the FAO classification, this value falls within the 65–75 range, indicating a low level of food security in rural regions. Historical comparisons show a marked decline over the past two decades, with Mehrabani Bushrabadi and Mousavi Mohammadi (2009) reporting an AHFSI of approximately 92 in the early 2000s, and Heidary (2018) estimating around 82 in the early 2010s. These results suggest a transition from high to low food security in rural Iran during this period.

The downward trend appears to be associated with persistent economic challenges, including high

inflation and income stagnation. In particular, the escalation of sanctions in 2018 led to reduced foreign exchange revenues, currency depreciation, and rising food prices. Meanwhile, wage growth did

not keep pace with inflation, reducing purchasing power, especially among rural households with lower income levels.

Table 1. AHFSI Index for Rural Areas of Iran in 2023

Headcount Ratio (H)	Severity of Food Poverty (G)	Temporal Variation (Ω)	Aggregate Household Food Security Index Index (%) (AHFSI)
0.445	0.634	0.017	68.8

It should be noted that while [Table 1](#) reports the aggregate AHFSI for rural areas (68.8%), [Figure 1](#) depicts the proportion of individuals classified as food secure, borderline, or food insecure based on the 2400 kcal per capita threshold. Therefore, the values presented in [Figure 1](#) are not directly comparable to the AHFSI, as they reflect individual-level classification rather than a population-level aggregate index.

In addition to AHFSI, the proportion of food-secure households was calculated ([Figure 1](#)). The results indicate that in 2023, only about 45% of rural residents were food secure, while more than 55% experienced either food insecurity or were on the borderline. In contrast, [Akbari et al. \(2016\)](#) reported that approximately 76% of rural households were food secure in the early 2010s, underscoring a substantial decline in rural food security over the past decade.

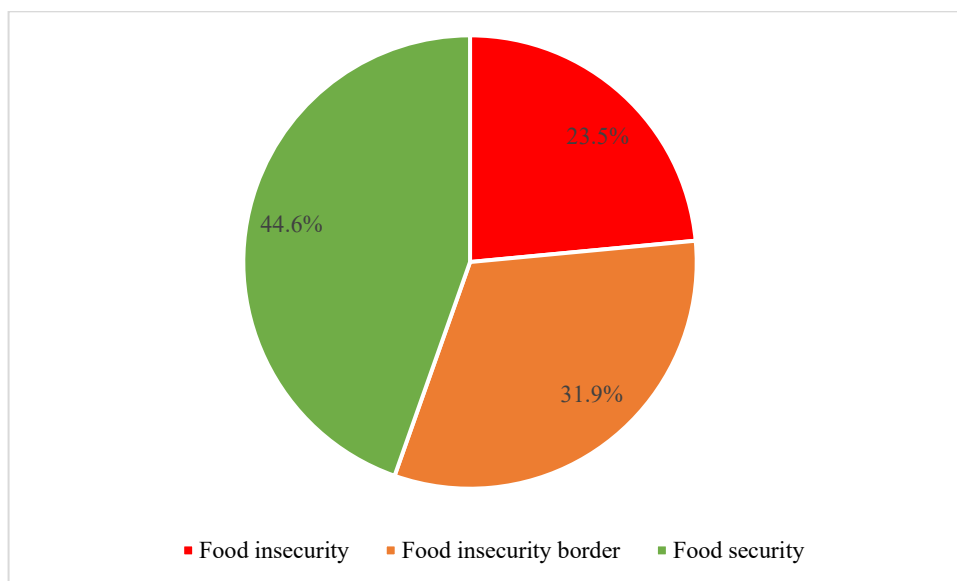


Figure 1. Percentage of Food Secure Individuals in Rural Areas of Iran in 2023

4.2. Daily Calorie Intake by Province

[Figure 2](#) presents the average daily calorie intake per adult in rural areas of different provinces of Iran in 2023, based on data from the Statistical Center of Iran. It should be noted that [Figure 2](#) presents average daily calorie intake per adult in rural areas of each province. These values reflect individual-level caloric consumption and are not directly comparable to the aggregate AHFSI index (68.8%),

which is calculated at the population level using headcount ratio, severity, and temporal variation. In line with national nutritional guidelines, a daily energy intake of 2,400 kcal per capita is considered the minimum requirement for maintaining adequate metabolic function. The results indicate that-with the exception of ten provinces: Hamadan, Kohgiluyeh and Boyer-Ahmad, Qazvin, Tehran, Golestan, Sistan and Baluchestan, Alborz, Gilan,

Hormozgan, and West Azerbaijan-all other provinces met or exceeded this threshold. This suggests that most rural residents during the study period achieved at least the basic caloric requirement for food security. However, a noteworthy pattern is observed in provinces such as South Khorasan and Ilam, which, despite being classified as economically deprived, exhibited relatively high average calorie intakes. Further

analysis suggests that in these cases, elevated calorie levels are largely attributable to the consumption of energy-dense but nutrient-poor foods, increasing total caloric intake without ensuring adequate micronutrient consumption. This underscores the limitation of calorie-based measures in fully capturing the nutritional dimension of food security, indicating that caloric adequacy does not necessarily equate to nutritional adequacy.

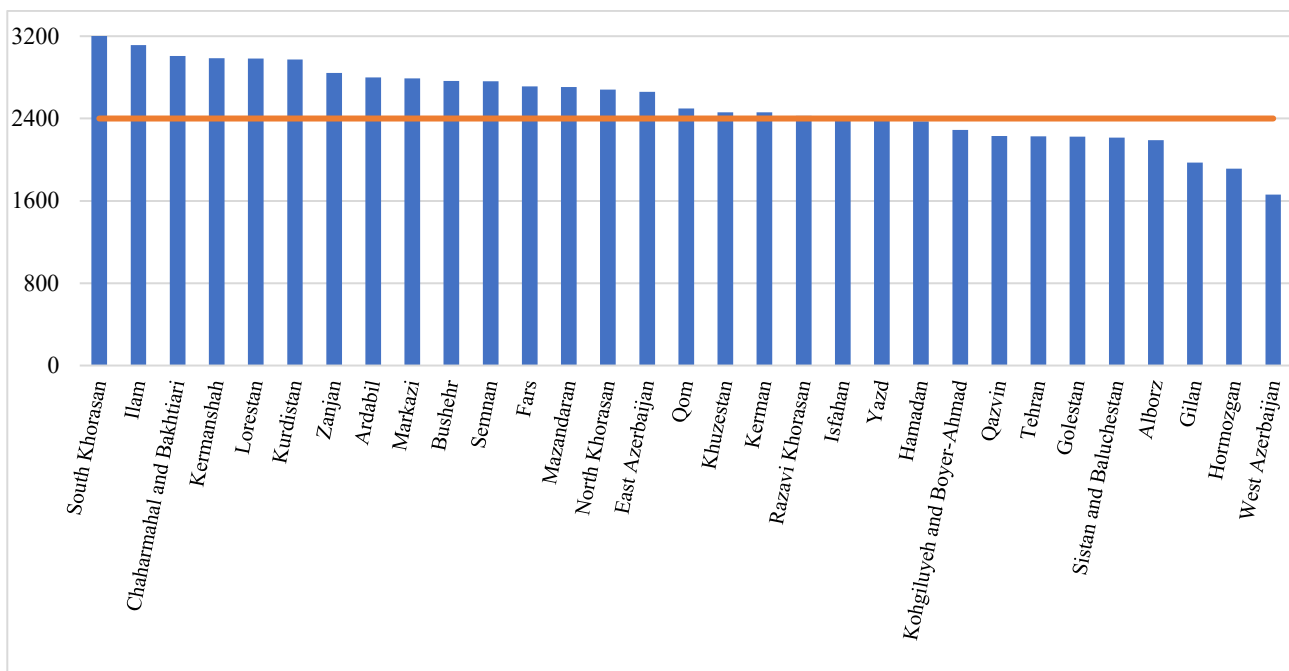


Figure 2. Calorie intake in rural areas of Iran in 2023 (kcal/day per capita)

4.3. Food Poverty Indicators

Table 2 presents key food poverty indicators for rural Iran in 2023. The average food poverty rate was calculated at 50.3%, indicating that approximately half of the rural population faced food poverty during this period. Comparisons with earlier studies by Nosratabadi et al. (2015), who reported rates of 40% and 46% in 2004 and 2012 respectively, suggest a significant worsening trend over the past two decades. The poverty gap was estimated at 14.2%, meaning that on average, calorie intake among food-poor households falls 14.2% below the minimum required level. To eradicate food poverty entirely, calorie intake for these households must increase by this proportion. The severity of food poverty, measured by the squared poverty gap index, stood at 5.8%, reflecting

the distribution of calorie deprivation among the poorest households and placing greater emphasis on those furthest below the threshold. A positive correlation exists between the poverty gap and severity indices, with provinces exhibiting higher poverty gaps generally also experiencing higher severity. Among provinces, Hormozgan, Gilan, and West Azerbaijan showed the highest food poverty rates, whereas Kermanshah, Semnan, and Ilam had the lowest. Spatial analysis highlights considerable heterogeneity across provinces, with poverty rates ranging from 19.6% to 79.4%, poverty gaps from 3% to 29.7%, and severity indices from 0.7% to 14%. Earlier studies (Jafari Sani & Bakhshodeh, 2008; Rezaeefar et al., 2022) reported narrower ranges, indicating a deterioration in food poverty conditions in rural Iran over time.

Table 2. Food poverty indicators in rural areas of Iran in 2023

Povince	Poverty Rate	Poverty Gap	Squared Poverty Gap
Hormozgan	79.4	29.7	14.0
Gilan	70.1	21.4	9.0
West Azerbaijan	68.1	24.6	11.3
Golestan	64.3	20.3	8.9
Tehran	64.0	15.3	5.1
Kerman	62.6	17.2	6.1
Qazvin	61.3	15.8	5.5
Alborz	60.9	21.9	10.7
Isfahan	60.1	16.7	6.4
Kohgiluyeh and Boyer-Ahmad	57.2	17.2	7.8
Qom	55.9	13.0	4.2
Yazd	54.0	17.7	8.1
East Azerbaijan	53.4	15.1	6.2
Khuzestan	53.1	10.4	3.2
Sistan and Baluchestan	53.0	17.9	8.9
Mazandaran	52.9	11.9	3.8
Hamadan	52.0	17.4	8.0
Ardabil	51.4	10.9	3.5
Razavi Khorasan	50.0	13.2	5.0
Kurdistan	48.1	15.7	7.2
Bushehr	45.0	12.2	5.0
Fars	43.0	12.8	5.7
Markazi	42.4	12.9	5.5
North Khorasan	40.6	10.3	3.9
Chaharmahal and Bakhtiari	37.2	7.8	2.6
Zanjan	36.9	9.3	3.4
Lorestan	35.1	7.8	2.6
South Khorasan	34.9	8.9	3.5
Ilam	28.5	4.8	1.2
Semnan	27.2	6.0	1.9
Kermanshah	19.6	3.0	0.7
Average	50.3	14.2	5.8

Figure 3 illustrates the food poverty map of rural Iran in 2023, highlighting that West Azerbaijan, Hormozgan, and Gilan have the highest poverty rates, whereas Kermanshah, Ilam, Semnan, and South Khorasan display relatively lower rates.

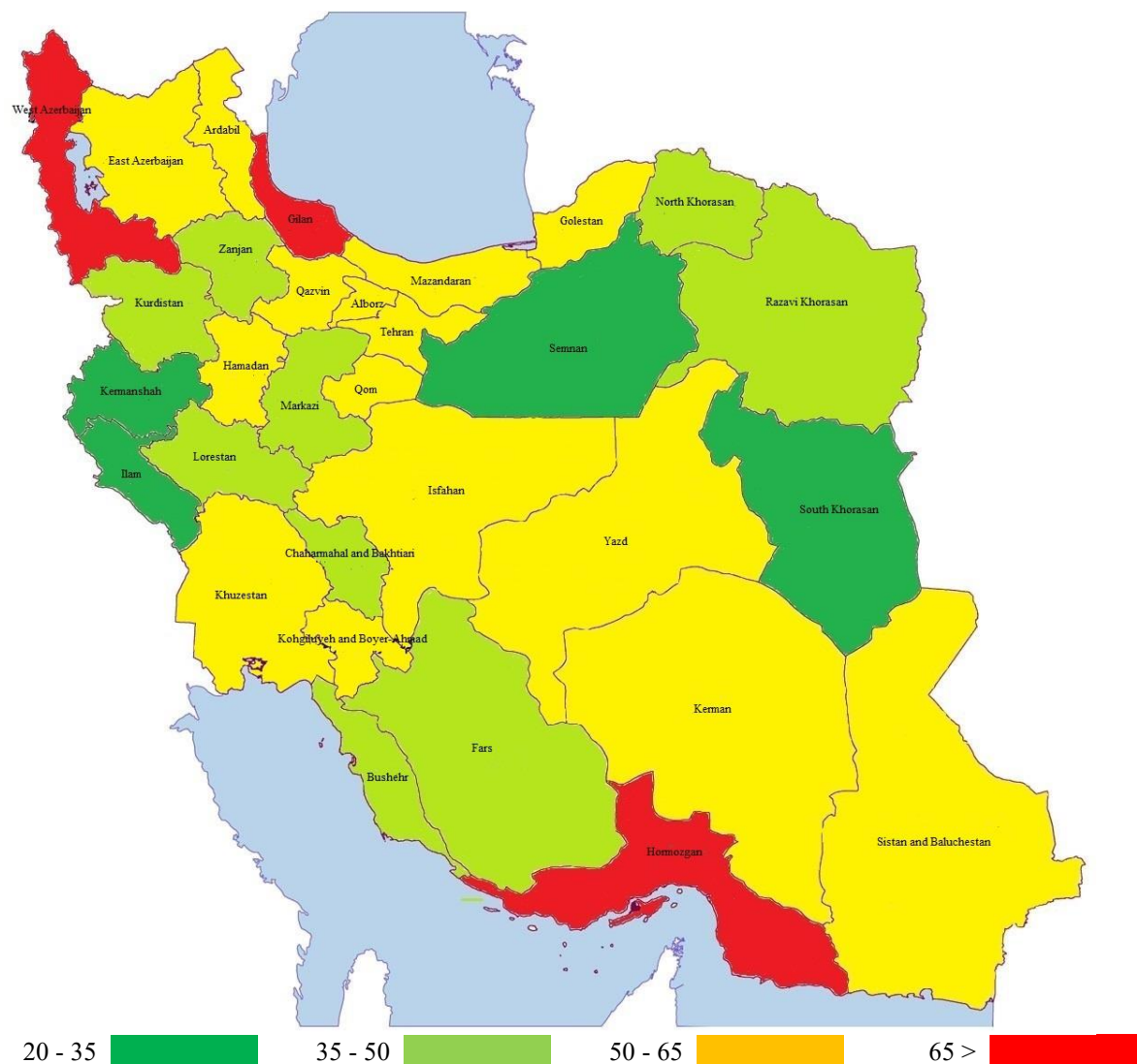


Figure 3. Food Poverty Map of Rural Areas of Iran in 2023

4.4. Determinants of Household Food Security

To identify the factors affecting household food security in rural Iran, a logistic regression model was estimated, with results summarized in [Table 3](#). Goodness-of-fit measures-including pseudo R-squared, classification accuracy, deviance, and Pearson chi-square tests-indicate a good model fit, confirming the robustness of the estimates.

Economic, demographic, and social variables collectively shape food security status. In rural settings, where livelihoods depend largely on agriculture, livestock, or seasonal work, disruptions in income or household composition directly impact food access and purchasing power.

Key findings include:

- Age of household head is negatively associated with food insecurity, consistent with [Akbari et al. \(2016\)](#) and [Hashemitabar et al. \(2018\)](#). Older

heads often have greater economic stability, land ownership, social networks, and livelihood experience, which reduce vulnerability. Unlike urban areas where aging might reduce income, in rural Iran it tends to increase social capital and stability.

- Gender of household head shows no statistically significant effect on food security in this model, possibly reflecting rural social norms and support systems that moderate gender disparities. While female-headed households often face vulnerability, gender effects may be mediated through income or employment status.
- Literacy of household head is not significant, perhaps due to the narrow definition of literacy (basic reading and writing). In rural areas, practical skills and informal knowledge may

- have a greater influence on livelihoods than formal education alone.
- Household size significantly increases the likelihood of food insecurity, echoing previous research (Akbari et al., 2016; Hashemitabar et al., 2018; Razmavar et al., 2023). Larger households demand more food and resources, and limited job opportunities can increase dependency ratios, lowering per capita availability.
 - Dietary diversity strongly reduces food insecurity risk. Households with varied diets-rich in fruits, vegetables, protein, and dairy-tend to have more stable nutrition and better economic conditions. In contrast, monotonous diets signal chronic poverty and vulnerability to shocks.
 - Receipt of government subsidies significantly improves food security, supporting findings by Okati et al. (2020). Subsidies provide stable income for many rural families with irregular earnings, helping meet basic nutritional needs and reduce vulnerability.

- Employment status of the household head is a strong determinant. Employed heads, even if informally or seasonally, secure essential income for food purchase. Unemployment raises food insecurity risks due to unstable income and limited access to social support (Pakravan et al., 2020).
 - Household income level is among the most critical factors. Higher and stable incomes enable better food access, while low or volatile income exposes households to insecurity amid economic crises or environmental shocks. This aligns with prior studies (Hashemitabar et al., 2018; Okati et al., 2020).
- In summary, rural food security in Iran depends heavily on economic stability, household demographics, social support, and effective resource management. Policies aimed at enhancing food security should focus on job creation, income stabilization, dietary diversification, and targeted social assistance.

Table 3. The results of the logit model

Variable	Coefficient	Z-statistic	p-value	Marginal Effect
Age of the head of household	-0.029	-14.894	0.000	-0.010
Gender of the head of household (male=1, female=2)	-0.134	-1.052	0.292	-0.048
Literacy of the household head (literate=1, illiterate=2)	0.063	0.967	0.333	0.023
Household size	0.398	11.542	0.000	0.144
Food diversity	-1.755	-10.466	0.000	-0.635
Logarithm of household subsidy	-1.141	-5.281	0.000	-0.413
Employment status of the head of household (employed=1, unemployed=2)	0.215	2.264	0.023	0.078
Logarithm of household income	-0.244	-3.741	0.000	-0.088
Pseudo R-squared	0.60	Deviance	0.95	
AN R-squared	0.76	Pearson	0.82	
Percentage of correct predictions	74.3%	Likelihood Ratio (LR)	4.845 (0.04)	

5. Discussion and Conclusion

As discussed in Section 4, our results have been compared with previous studies in Iran, highlighting temporal trends and differences in rural food security and poverty levels. These comparisons provide context for interpreting the current findings and reinforce the evidence-based insights presented in this study. Overall, the findings answer the

research question by highlighting spatial disparities in food insecurity across rural Iran and identifying key household-level determinants of food security. Food security, defined as universal access to a healthy, balanced, and sufficient diet, holds particular importance in Iran due to the country's unique political and economic challenges. The critical significance of food security extends beyond

its intrinsic connection to various dimensions of sustainable development; it also arises from the severe adverse impacts that food insecurity can have on public health, social cohesion, and even national security. In this context, adopting a data-driven and evidence-based approach to managing and improving food security becomes an unavoidable necessity.

This study calculated household food security indicators for rural areas of Iran using the Aggregate Household Food Security Index (AHFSI) and a calorie-based criterion. Food poverty was assessed using the Foster–Greer–Thorbecke (FGT) index, which facilitated mapping the spatial distribution of rural food poverty. Finally, a logistic regression model was applied, incorporating socio-economic and demographic household characteristics, to identify key determinants influencing rural household food security status.

The results of this study clearly demonstrate that rural food security in Iran depends heavily on several critical factors: economic stability, household demographics, social support mechanisms, and effective management of food resources. Economic conditions-especially stable income and employment-play a foundational role in ensuring access to adequate and diverse diets. Demographic factors such as household size and age of the household head influence vulnerability to food insecurity, while social supports, including government subsidies, substantially mitigate risks. Effective resource management, exemplified by dietary diversity, further reduces food insecurity risk by improving nutritional quality.

The concerning deterioration observed-marked by declining dietary diversity, rising food poverty rates, and reliance on low-cost, nutrient-poor foods-underscores the urgency of policy action. Enhancing rural food security requires a multifaceted approach focused on:

1. Job creation and income stabilization to ensure households have the means to access adequate food.
2. Promoting dietary diversification to improve nutrition and reduce dependence on calorie-dense but nutrient-poor foods.
3. Expanding targeted social assistance programs, including subsidies and support for vulnerable groups.

Based on these findings, we propose the following practical policy recommendations:

1. *Reforming the Subsidy System with a Focus on Food Security:* Transition from general subsidies toward targeted nutrition subsidies that directly assist low-income groups in purchasing nutrient-rich foods such as dairy, white meat, eggs, fruits, and vegetables. The introduction of a “Rural Healthy Nutrition Card” could facilitate access to quality foods for vulnerable households. Additionally, conditional subsidies rewarding dietary diversity could incentivize healthier eating habits.
2. *Developing Short Supply Chains for Food in Rural Areas:* Establishment of local producer-to-consumer markets and agricultural cooperatives can reduce intermediary costs and improve access to fresh foods. Supporting small-scale and home gardening, poultry, and livestock farming enhances micronutrient availability and diversifies food sources.
3. *Nutrition Education and Promotion of Healthy Consumption Patterns:* Implement educational programs in rural schools and community centers focusing on dietary diversity and affordable, nutrient-rich food preparation methods. Utilizing local media and agricultural extension services to disseminate practical cooking and food preservation techniques is crucial.
4. *Supporting Income Generation and Employment in Rural Communities:* Promote sustainable rural employment by developing small-scale agricultural industries, especially those empowering women, such as home-based dairy production and processing of herbal products. Access to low-interest microloans conditioned on healthy food production can encourage investment in productive activities like greenhouse farming and poultry rearing. Agricultural tourism can be another complementary income source.
5. *Continuous Monitoring and Surveillance of Food Security and Poverty:* Establish a national food security monitoring system that regularly collects and analyzes household data on consumption, income, and health, leveraging local health centers and rural administrations. Annual publication of detailed food poverty atlases at the provincial and village levels will guide resource allocation and intervention targeting.
6. *Focused Interventions in High-Risk Regions:* Special support programs for provinces

identified as critical, including free or subsidized nutritional packages for vulnerable groups such as children and the elderly, micronutrient supplementation in schools and health homes, and infrastructure improvements to facilitate market access.

7. *Attention to Large and Female-Headed Households*: Enhance social safety nets by increasing food aid quotas and subsidies for larger families and designing specific programs supporting female-headed households through training, home-based employment opportunities, and nutritional assistance.
8. *Multi-sectoral and Coordinated Actions*: Formation of provincial and district food security council's involving agricultural, health, welfare, local governance, and academic stakeholders is essential. Such coordination ensures synergy between poverty alleviation programs and public health initiatives, such as integrating poverty

reduction with maternal and child nutrition supplementation.

In conclusion, this study highlights the complex and multifactorial nature of food security challenges in rural Iran. By emphasizing the central role of economic and demographic factors alongside social support and nutrition education, our findings stress the need for data-driven, context-specific, and integrated policy responses. Addressing these dimensions holistically will foster sustainable improvements in rural nutrition and wellbeing, ultimately advancing national development and social stability.

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Authors' contributions

The authors equally contributed to the preparation of this article.

Conflict of interest

The author declares no conflict of interest.

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تحلیل فضایی فقر و ناامنی غذایی در مناطق روستایی ایران: ارزیابی وضعیت و عوامل مؤثر بر ناامنی غذایی

مهدی شعبانزاده خورشیدی

۱- استادیار موسسه پژوهش‌های برنامه‌ریزی کشاورزی، اقتصاد و توسعه روستایی، تهران، ایران.

چکیده مبسوط

۱. مقدمه

مناطق روستایی در ایران با جمعیتی بالغ بر ۲۴ میلیون نفر، نقش حیاتی در ساختار اجتماعی، اقتصادی و فرهنگی کشور ایفا می‌کنند. در ایران، اگرچه به صورت دیرینه مناطق روستایی از نظر دسترسی به منابع غذایی، عادات غذایی و فرهنگ‌های محلی، دارای الگوهای خاص خود بوده‌اند، اما با نفوذ تغییرات اقتصادی و اجتماعی، عادات غذایی در این مناطق نیز دستخوش تحولات قابل توجهی شده است. اگرچه دولت در ایران همواره سعی کرده است تا سیاست‌های حمایتی را به خصوص در مناطق روستایی، در جهت بهبود وضعیت معیشت خانوارها اتخاذ کند، اما کارشناسان معتقدند به دلیل شرایط تورمی و به دنبال آن تأثیرپذیری درآمد واقعی و قدرت خرید مصرف‌کنندگان، این برنامه‌ها در خصوص کاهش فقر و ناامنی غذایی اثرگذاری لازم را نداشته‌اند. این در حالی است که کاهش فقر و افزایش ضریب امنیت غذایی یک الزام برای کشورهای مستقل نظیر ایران به شمار می‌رود. از این رو، اتخاذ رویکردی علمی، مبتنی بر شواهد و داده‌محور در مدیریت این حوزه، ضرورتی انکارناپذیر دارد. گام نخست در این مسیر، شناخت دقیق وضعیت کنونی است تا بتوان سیاست‌های کارآمد و هدفمندی را طراحی و اجرا کرد. پژوهش حاضر با همین هدف، به بررسی و تحلیل فقر و ناامنی غذایی در مناطق روستایی ایران در سال ۱۴۰۲ پرداخته است.

۲. مبانی نظری تحقیق

مبانی نظری این پژوهش بر بررسی ارتباط میان فقر غذایی و ناامنی غذایی با رویکرد فضایی استوار است. فقر غذایی، به‌عنوان ناتوانی پایدار خانوارها در تأمین غذای کافی، سالم و متنوع برای حفظ زندگی سالم و فعال، یکی از مهم‌ترین ابعاد محرومیت در مناطق روستایی به شمار می‌آید. بر اساس تعریف سازمان خواربار و کشاورزی ملل متحد (FAO)، ناامنی غذایی زمانی رخ می‌دهد که افراد همواره به غذای کافی و مغذی، با دسترسی فیزیکی، اقتصادی و اجتماعی مناسب، دسترسی نداشته باشند. این وضعیت تحت تأثیر مجموعه‌ای از عوامل جمعیتی،

* نویسنده مسئول:

دکتر مهدی شعبانزاده خورشیدی

آدرس: موسسه پژوهش‌های برنامه‌ریزی کشاورزی، اقتصاد و توسعه روستایی، تهران، ایران.

پست الکترونیکی: shabanzadeh.mehdi@gmail.com

اقتصادی و اجتماعی نظیر سن، جنس، سطح سواد سرپرست، اندازه خانوار، تنوع غذایی، میزان یارانه دریافتی، وضعیت اشتغال و درآمد خانوار شکل می‌گیرد. تحلیل فضایی با شناسایی الگوهای مکانی و مناطق دارای بیشترین آسیب‌پذیری، زمینه‌ساز تدوین سیاست‌های هدفمند برای کاهش فقر غذایی و ارتقای امنیت غذایی در جوامع روستایی می‌شود.

۳. روش تحقیق

در این مطالعه، ابتدا شاخص‌های امنیت غذایی و فقر غذایی برای مناطق روستایی ایران محاسبه و سپس عوامل مؤثر بر ناامنی غذایی خانوار بررسی شد. برای سنجش امنیت غذایی، از شاخص کلی امنیت غذایی خانوار (AHFSI) و معیار کالری استفاده شد. همچنین، فقر غذایی با استفاده از شاخص فوستر، گریر و توربک (FGT) مورد ارزیابی قرار گرفت و بر مبنای آن، اطلس فقر غذایی مناطق روستایی ایران ترسیم گردید. در نهایت، به‌منظور شناسایی عوامل مؤثر بر ناامنی غذایی، مدل اقتصادسنجی لاجیت مورد استفاده قرار گرفت.

۴. یافته‌های تحقیق

بررسی شاخص AHFSI نشان می‌دهد که امنیت غذایی در سطح ملی برای مناطق روستایی ایران در سال ۱۴۰۲ معادل ۶۸.۸ بوده که بیانگر سطح پایین امنیت غذایی است. این رقم در مقایسه با مقادیر بالای دهه ۸۰ (بیش از ۹۰)، کاهش چشمگیری را نشان می‌دهد. از سوی دیگر، بررسی شاخص‌های فقر غذایی نشان‌دهنده افزایش چشمگیر فقر در مناطق روستایی در دو دهه گذشته است. نرخ فقر غذایی در سال ۱۴۰۲ به ۵۰.۳ درصد رسیده که در مقایسه با حدود ۴۰ درصد در اوایل دهه ۱۳۸۰، افزایش قابل‌توجهی دارد. شکاف فقر ۱۴.۲ درصد و شدت فقر نیز ۵.۸ درصد برآورد شده که به‌روشنی گویای عمیق‌تر شدن فقر در میان اقشار آسیب‌پذیر است. توزیع مکانی فقر نیز ناهمگونی زیادی را نشان می‌دهد؛ استان‌هایی مانند گیلان، هرمزگان و آذربایجان غربی در بدترین وضعیت قرار دارند، در حالی که ایلام، سمنان و کرمانشاه از نرخ فقر پایین‌تری برخوردارند. در نهایت نیز تحلیل مدل

نگران کننده داشته است. کاهش تنوع غذایی، گسترش فقر و تکیه بر مواد غذایی ارزان قیمت با ارزش تغذیه‌ای پایین، از چالش‌های اصلی خانوارهای روستایی به‌شمار می‌روند. از این‌رو، پیشنهاد می‌شود سیاست‌گذاران با رویکردی منطقه‌محور، اقدام به طراحی برنامه‌هایی در زمینه اشتغال‌زایی، افزایش درآمد، ارتقای تنوع غذایی و بازنگری در نظام یارانه‌ای کنند تا به بهبود امنیت غذایی در این مناطق دست یابند.

کلید واژه‌ها: فقر غذایی، امنیت غذایی، مناطق روستایی ایران، مدل لاجیت.

تشکر و قدردانی

مطالعه حاضر حامی مالی نداشته و حاصل فعالیت علمی نویسنده است.

لاجیت نشان داد که عواملی همچون سن سرپرست خانوار، تنوع غذایی، اشتغال، دریافت یارانه و سطح درآمد تأثیر معناداری در بهبود وضعیت امنیت غذایی دارند. در مقابل، جنسیت و سطح سواد سرپرست خانوار تأثیر معناداری نداشته‌اند. همچنین افزایش بعد خانوار افزایش ناامنی غذایی را به همراه دارد. در مجموع، نتایج پژوهش حاکی از آن است که وضعیت اقتصادی خانوار مهم‌ترین عامل تعیین‌کننده سطح امنیت غذایی در مناطق روستایی ایران است.

۵. بحث و نتیجه‌گیری

با توجه به یافته‌های پژوهش، می‌توان نتیجه گرفت که وضعیت امنیت غذایی در مناطق روستایی ایران طی دو دهه گذشته روندی

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