Empowering Farmers for Sustainable Food Security: Insights from Rural Iran

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Naser SHAFIEISABET[1] and Neginsadat MIRVAHEDI[1]

Abstract

This study investigates the role of structural empowerment in promoting sustainable food security in rural south-eastern Tehran, Iran. Despite its agricultural potential, the region faces persistent challenges due to weak empowerment structures. While most previous studies have focused on psychological or gender-based empowerment, this research applies Kanter's structural empowerment theory—initially developed for formal organisations—to rural agriculture. It examines how access to information, resources, power, and support influences food security across environmental-ecological, socio-economic, political-cultural, and infrastructural dimensions. Data from 400 farmers across 37 villages were analysed using multiple linear regression and structural equation modelling (SEM). The findings reveal significant positive impacts of structural empowerment on sustainable food security. These impacts arise from awareness, knowledge, and skills, along with training, association, and both formal and informal power. In contrast, institutionalism exhibited no statistically significant effect, highlighting the region's formal structures' inefficiency. These results underscore the importance of social networks, informal institutions, and collective agency in enhancing farmers' resilience and decision-making capacity. The study advocates shifting from top-down, technocratic policies to participatory, bottom-up empowerment strategies and recommends institutional reform, education and strengthening of local associations as key steps toward improving food system sustainability. This research offers a novel contribution by localising structural empowerment theory within an underexplored rural setting, providing valuable insights for policymakers, practitioners, and scholars in agricultural development. It calls for multidimensional policy interventions that address both individual and structural factors. Future studies should investigate gender disparities, conduct cross-regional comparisons, and refine empowerment metrics to enhance the applicability and relevance of findings across contexts.

[1] Department of Human Geography and Spatial Planning, Faculty of Earth Sciences, Shahid Beheshti University, Tehran, Iran. Post Code: 1983969411.

Corresponding author: Naser Shafieisabet, n_shafiei@sbu.ac.ir

Biographical notes

Naser Shafieisabet is an Associate Professor in the Department of Human Geography and Spatial Planning, Faculty of Earth Sciences at the Shahid Beheshti University, Tehran, Iran

Neginsadat Mirvahedi is a graduate of Geography and Rural Planning from the Department of Human Geography and Spatial Planning, Faculty of Earth Sciences at Shahid Beheshti University, Tehran, Iran.

Introduction

Sustainable food security is a critical and expanding global concern, particularly in developing countries where agriculture is integral to community livelihoods (Fanzo et al., 2024; Galeana-Pizaña et al., 2021; Yahaya et al., 2018). These countries face multifaceted challenges that hinder their capacity to achieve food security, including climate change, resource depletion, soil erosion, water scarcity, poverty, economic inequality, rapid population growth, limited access to technology, institutional barriers, and price volatility (Aziz et al., 2020; Balasundram et al., 2023; Onyeaka et al., 2024; Sekaran et al., 2021). These challenges are often interrelated and undermine the ability to provide sufficient, nutritious, and accessible food for all in the long term (Habiba et al., 2015). In this context, farmers play a crucial role in agricultural production and ensuring food security. Their responsibilities span several dimensions of sustainable food security, including environmental, socio-economic, political, and infrastructural aspects in rural and agricultural areas (Sibhatu and Qaim, 2017). Consequently, empowering farmers, particularly within the second Sustainable Development Goal framework, has become a focal point in addressing these challenges (Pérez-Escamilla, 2017; Yahaya et al., 2018). Governments have increasingly adopted the farmer empowerment approach to address the complex and multifaceted goals of rural development and food security (Abdolmaleky, 2012; Pérez-Escamilla, 2017; Shafieisabet and Mirvahedi, 2021). Existing research on farmer empowerment, particularly for women in the context of food security, has primarily focused on individual, collective, and psychological empowerment (Aziz et al., 2020; Galiè et al., 2019; Sarker et al., 2024; Tamako et al., 2022). However, the structural empowerment of farmers remains underexplored despite its critical relevance to sustainable food security. Farmers often operate within unequal socio-economic structures that limit their access to resources, institutional support, education, information, power, and opportunities for decision-making (Kehinde et al., 2021; Tambi and Lum, 2020; Viana et al., 2022; Sehat Tan and Mailena, 2021). Structural empowerment, which facilitates equitable participation in decision-making, production, and distribution processes, is crucial in addressing these challenges (Orgambídez et al., 2024; Ozbozkurt et al., 2021).

Structural empowerment involves policies, practices, and frameworks that increase individual autonomy in decision-making and influence over personal and collective affairs, promoting a horizontal decentralisation of power from formal structures to subordinates (Monje-Amor et al., 2020; Ozbozkurt et al., 2021). Such empowerment is pivotal in creating an environment where farmers can make informed decisions, assume responsibility for their work, and actively address food security challenges (Shuhaimi et al., 2025). Empowered farmers leverage the opportunities available within their environment and gain the necessary power to pursue their professional objectives (Dan et al., 2018). Although Kanter's (1977) structural empowerment theory was initially developed for formal organisations, its core principles—access to information, resources, support, and power—are equally applicable to rural and agricultural contexts (van den Berg et al., 2022; Walters et al., 2021). Despite differences in formality, rural communities share characteristics such as local power dynamics, indigenous institutions, and inconsistent access to resources. Reinterpreting this theory within agricultural and rural contexts offers valuable insights into the structural conditions affecting farmers and their capacity to contribute to sustainable food security.

This study applies a structural empowerment approach to assess the influence of key empowerment indicators on sustainable food security in a rural region of Iran. The region under investigation comprises villages in the southern Tehran metropolitan area, which, despite possessing fertile soil, suitable agricultural land, and a strategic location vital for national food security, faces significant challenges in food production and supply. These challenges are primarily attributed to ineffective structures that govern the empowerment of farmers, which fail to create a supportive environment for their development and, in many cases, act as barriers to progress.

Empowerment initiatives in the region have historically been inconsistent, top-down, and poorly coordinated among the responsible institutions. Consequently, these efforts have had limited success in improving agricultural production and enhancing sustainable food security. Farmers in this area have been deprived

of effective empowerment structures providing educational opportunities, skills development, access to resources, formal and informal support, practical information, and active participation. As a result, many farmers exhibit "stuck behavior," characterised by reluctance to change, limited production, diminished engagement with food security organisations, and resistance to adopting new practices. This behavior poses a potential long-term threat to sustainable food security.

The primary objective of this study is to examine the impact of various structural empowerment indicators on key components of sustainable food security. By providing valuable insights for policymakers, planners, and institutions engaged in rural and agricultural development, the study aims to strengthen empowerment structures, improve resource access, and foster active farmer participation in promoting sustainable food security and enhancing social welfare in rural communities.

Theoretical Framework

Sustainable food security, a critical component of sustainable development, ensures that all individuals have consistent access to sufficient, safe, and nutritious food without compromising the ability of future generations to meet their food needs (Habiba et al., 2015; Nwachukwu et al., 2024). This concept extends beyond providing basic calories and nutrients, emphasising economic accessibility, environmental sustainability, and the optimal use of resources to foster sustainable employment and meaningful community participation. It also prioritises the long-term, sustainable provision of food, which prevents the degradation of natural and agricultural resources (Oghuvbu, 2024). In examining the classical dimensions of food security—availability, access, utilisation, and stability—a more comprehensive, forward-thinking framework is necessary. These dimensions must, without question, be integrated into sustainable food security (HLPE, 2020; Schling and Pazos, 2024). Sustainable food security encompasses environmental-ecological, socio-economic, political-cultural, and infrastructural dimensions, all of which are critical to food production, distribution, and consumption (Hasdiansyah et al., 2021; Pérez-Escamilla, 2017; Reinbott, 2019; Shafieisabet and Mirvahedi, 2021; Shafieisabet and Mirvahedi, 2022). As a result, the classical food security indicators must be reconsidered about their interconnections with the broader dimensions of sustainable development (Berry et al., 2015; Clapp et al., 2022; Pérez-Escamilla, 2017).

A key element of this framework is the structural empowerment of farmers, who are central to sustainable food production, distribution, and consumption. Without addressing the institutional and social barriers that farmers face and enhancing their structural position, the overarching goals of sustainable food security will remain unattainable (Blesh et al., 2023; Touch et al., 2024). Structural empowerment is a focused effort to dismantle unjust and oppressive social, economic, and political systems that often restrict equitable access to resources and opportunities (Aziz et al., 2022; Kanter, 2008). This process offers marginalised groups, such as farmers, crucial to agricultural production and sustainable food security the chance to drive changes that enable more equitable access to resources (Lecoutere et al., 2024). The objective is to empower farmers to influence social and economic decision-making processes, advocate for their rights, and ensure continuous, sufficient, and healthy access to nutritious food that meets community needs (Oghuvbu, 2024). As a process, the structural empowerment of farmers enhances their ability to make informed choices and influence collective decisions, ultimately achieving desired actions and outcomes (Abdolmaleky, 2012). The theoretical foundations of this concept are grounded in Kanter's structural empowerment theory, which posits that social structures, rather than individual predispositions, significantly shape attitudes and behaviors (Kanter, 2008). Kanter contends that structural empowerment occurs when individuals have access to "information, support, resources, learning and growth opportunities, and both formal and informal power," creating an environment where they can effectively confront challenges (Kanter, 1977; Ta'an, 2024). The benefits of structural empowerment manifest in improved attitudes and progress toward achieving broader objectives (Al-Hammouri et al., 2021). In the context of sustainable food security, structural empowerment is realised when farmers have access to the necessary "information, support, resources, opportunities for learning and

growth, skill development, challenging responsibilities, and both formal and informal power" to enhance the key indicators of food security (Moura et al., 2024).

Access to learning and training opportunities is a fundamental aspect of structural empowerment for farmers, enhancing productivity and improving production processes while offering significant potential for preserving natural resources, reducing environmental damage, and fostering the ecological sustainability of food systems. Education equips farmers to manage resources responsibly and to contribute effectively to the four key food security indicators—access, availability, utilisation, and stability—within the environmental-ecological dimension of sustainable food security (Essilfie et al., 2021; Lufuke et al., 2023; Reilly et al., 2022; Yahaya et al., 2018). Furthermore, well-designed educational programs can strengthen production and distribution infrastructure when structural empowerment is fully realised. Practical training can increase production and improve food access through improved knowledge of technology and machinery (Ruzzante et al., 2021; Wonde et al., 2022). Specialised training in storage, processing, distribution, and transportation can further reinforce food security's consumption and infrastructure components (Raidimi and Kabiti, 2019; Vogliano et al., 2021). Education is also essential for bridging the knowledge gap, particularly regarding the relationship between biodiversity and farm management practices. By fostering a more profound understanding, farmers are better positioned to make informed decisions that support sustainable production practices (Elisante et al., 2019; Ezzeddin et al., 2024). Research conducted in South Africa has shown that training smallholder farmers enhances their decision-making abilities, leading to more scientifically informed and effective practices that contribute to sustainable food security (Raidimi and Kabiti, 2019).

Another essential aspect of structural empowerment is developing knowledge, skills, assets, and capacities within the farming community. By addressing inequalities and creating opportunities for learning, networking, and organising, these initiatives can mobilise the necessary capacities to achieve sustainable food security goals (Sharaunga et al., 2015; Zikargae et al., 2022). Increasing farmers' awareness and skills—particularly through modern training on sustainable agricultural practices—empowers them to make informed decisions, exercise professional independence, and use natural resources like water and soil responsibly (Abdul-Majid et al., 2024; Asitik and Abu, 2020; Finger, 2023). This knowledge promotes adopting environmentally friendly practices but contributes to ecosystem preservation, production diversity, and optimal resource consumption (Heinze et al., 2022; O'Connor et al., 2025). Structural empowerment enables farmers to make informed choices and engage actively in food production management and environmental processes, thereby strengthening sustainable food security's ecological and environmental dimensions (Nyathi et al., 2022; Prain et al., 2020). From this perspective, awareness encompasses farmers' active access to information related to responsible institutions, agricultural policies, and decision-making processes, combining the ability to understand, analysed, and utilise informational resources (Forney, 2021; Wann et al., 2024). Enhancing farmers' awareness—through timely information about markets, new technologies, training schedules, and the sharing of successful practices—can play a significant role in transitioning from non-productive to sustainable and efficient agricultural systems (Lei and Yang, 2024; Rossi et al., 2023; Zscheischler et al., 2022). This increased awareness improves the stability of natural resource use, reduces environmental pollutants, enhances safety and health standards, and ensures the sustainable management of land, ultimately bolstering the environmental stability of sustainable food security (Bernini and Galli, 2024; Damanik et al., 2021; Dessart et al., 2019; Galiè et al., 2019). Moreover, increasing farmers' capacity to acquire specialised agricultural knowledge not only improves productivity and income but also plays a pivotal role in reducing poverty and strengthening food security within the socio-economic dimension (Abdul-Majid et al., 2024; Pawlak and Kołodziejczak, 2020). For instance, in Nigeria, timely and relevant information has been identified as crucial in increasing farmers' capacity to produce crops such as maize, contributing to sustainable food security (Adewale, 2012).

Access to resources is a fundamental component of structural empowerment for farmers. It is realised when farmers can equitably and sustainably access essential resources required for production activities, including natural resources such as water, soil, and suitable land, as well as financial resources (both formal

and informal), government and private sector support, local institutions, and marketing and transportation networks (Conceição et al., 2016; Sun et al., 2025; Wei et al., 2021). In practice, access to resources reflects institutional power structures—who controls access, how resources are accessed, and under what conditions. These factors directly influence farmers' ability to ensure food security, particularly regarding socio-economic factors. For example, access to credit and emergency support in times of crisis can facilitate investments in productive innovations and enhance farmers' resilience to economic and climatic shocks (Bain et al., 2020; Barak et al., 2024; Dwomoh et al., 2023; Tesafa et al., 2025). In Indonesia, strengthening farmers' access to production inputs and involving them in decision-making regarding equipment procurement have been recognised as strategies to improve food stability and reinforce structural empowerment (Azizah et al., 2014). Similarly, in sub-Saharan Africa, policies that improve access to input supply infrastructure, agricultural tools, and farm technologies are linked directly to advancing sustainable food security (Conceição et al., 2016). Access to financial resources and control over income further reduce food insecurity (Ashagidigbi et al., 2022; Mataka et al., 2023).

Institutional support is another critical dimension of structural empowerment, encompassing various forms of direct and indirect assistance from government institutions, rural development organisations, and other agricultural sector stakeholders (Murugani and and Thamaga-Chitja, 2019; Sarma et al., 2024; Sun et al., 2025). Such support includes providing accurate, timely information, facilitating access to markets, storage facilities, transportation systems, seed supply, feed, fertilisers, and credit, and familiarising farmers with government regulations and policies. These elements are essential for enhancing agricultural productivity and sustainability. However, many small-scale farmers face significant barriers to accessing such support, which disrupts resource utilisation, limits market entry, and undermines food security at both local and national levels (Finger, 2023; Galiè et al., 2019). This reflects structural exclusion and institutional inequality, marginalising farmers within the agricultural value chain. In this context, agricultural cooperatives, local networks, non-governmental organisations (NGOs), private companies, and the government are crucial support links in the supply chain. These entities can enhance farmers' capacity for action and their sense of empowerment by providing technical advice, facilitating access to resources, and offering support during financial and climatic crises (Christian et al., 2024; Kaya and Altınkurt, 2018; Manyise and Dentoni, 2021). Specifically, government policy support, through incentive programs for agricultural equipment upgrades, subsidy allocation, and infrastructure development, is essential to strengthening the "access" and "stability" dimensions within the political-cultural aspect of sustainable food security (Barbosa, 2024; Wu et al., 2025).

Formal and informal power are key elements of Kanter's structural empowerment theory, further expanded by Chandler and Laschinger, highlighting the importance of access to opportunities and power structures (Al-Hammouri et al., 2021). As previously discussed, the "opportunity structure" enables farmers to advance, develop their skills and knowledge, and engage in decision-making and problem-solving processes. Farmers with better access to resources, information, and institutional support tend to be more active, creative, and motivated in addressing agricultural challenges. In contrast, farmers who lack these opportunities often experience reduced productivity and diminished motivation (Doss et al., 2018; Kabeer, 1999). Power relations are also central to this discussion. The concept of "power over" refers to the dominance of certain actors within institutional systems, controlling resources, decision-making, and policy directions, which can result in the exclusion and marginalisation of resource-poor farmers. Conversely, "power with" promotes group participation, collaborative learning, and cooperative relationships among farmers, fostering a space to redistribute power at the local level (Eidt et al., 2020; Rowlands, 1995). From Kanter's perspective, structural power is an individual's ability to mobilise resources, information, and institutional support to complete tasks and achieve goals. This power is derived from three primary sources: access to resources, support, and information, all of which are facilitated through both formal and informal systems (Ramos et al., 2019; Zamiri and Esmaeili, 2024). Formal power is typically rooted in the farmer's social and institutional position within the rural structure and is closely linked to visibility, flexibility, adaptability, and creativity in decision-making (Dessart et al., 2019; Pang et al., 2025). Farmers encouraged and rewarded for innovation in areas such as

planting, cultivation, harvesting, animal husbandry, horticulture, or aquaculture are more likely to engage in educational programs, agricultural problem-solving groups, and collective decision-making processes (Eidt et al., 2020). Active participation strengthens their sense of autonomy and social agency, promotes the formation of "power with" at the local level, and expands experiences that enhance collective capacities to tackle food security challenges (Setyadiharja et al., 2020; Zerafati-Shoae et al., 2020).

Both formal and informal power play facilitative roles in achieving the political, social, and economic dimensions of sustainable food security (Dhal and Kar, 2024; Habtewold and Heshmati, 2023; Hiywotu, 2025; van den Berg et al., 2022). Informal power, within the context of structural empowerment, refers to the social relationships, local networks, and support systems that arise from informal interactions between farmers and other social actors, both within and outside the rural community (Davies et al., 2011; Kanter, 1977; Laschinger et al., 2004). Unlike formal power, which originates from institutional roles, informal power is based on social capital, horizontal communication, and trust between individuals and groups. It is crucial in enabling informal access to resources, information, and decision-making opportunities. The development and reinforcement of social networks and communication channels for the supply, exchange, and marketing of agricultural products—particularly through cooperatives, local organisations, village councils, and producer groups—play a critical role in facilitating market access and improving resource management (Clement et al., 2019; Hua and Brown, 2024; Liu et al., 2022; Valentinov and Iliopoulos, 2021). These local institutions promote the exchange of knowledge and experience among farmers and support the sustainability of production systems by establishing mechanisms for conflict resolution, enhancing crisis resilience, and increasing social participation (Finger, 2023; Uphoff, 1992). Collaboration among farmers, governmental bodies, and technical experts—especially in areas such as drought management, pest control, and climate change adaptation—is essential for maintaining the resilience of agricultural systems. Such collaboration helps prevent declines in production and income during crises (Hussein et al., 2024; Thompson et al., 2023). Active farmer participation in educational initiatives, the integration of Indigenous knowledge, and the combined use of traditional and modern technologies further enhance productivity, promote environmental sustainability, and strengthen food security at both local and national levels (Adefila et al., 2024; WFF, 2024).

Institutionalism, another key component of structural empowerment, recognises institutions—whether governmental, non-governmental, or community-based—not merely as policy implementers but as facilitators of the social, economic, and knowledge systems in which farmers operate (Farah and Amara, 2025; Jemaneh and Shibeshi, 2023; Putsenteil et al., 2020). By shaping formal and informal processes, institutions play a pivotal role in redistributing power, facilitating equitable access to resources, and supporting the generation and application of indigenous knowledge. Organisations such as farmers' associations, agricultural unions, and NGOs enhance both individual and collective capacities, enabling economic diversification and strengthening rural resilience to climatic, economic, and biological shocks (Aziz et al., 2021; Junquera et al., 2022; Tamako et al., 2022). Moreover, institutions contribute by investing in educational infrastructure, promoting nutritional awareness, and institutionalising social learning, creating the foundation for innovation adoption, sustainable resource management, and adaptation to evolving challenges (Hulland, 1999; Silva-Jean and Kneipp, 2024). Institutional support for smallholder farmers—through land reform, equitable resource allocation, and government-backed tenure security—enhances psychological stability, incentivises investment, and encourages responsible resource use. These institutional mechanisms not only promote coherent and sustainable food production but also contribute to social sustainability and structural cohesion in rural communities, aligning with the economic, social, and political dimensions of sustainable food security (Abab et al., 2023; Kehinde et al., 2021; Sun et al., 2025).

The primary objective of this research is to investigate the relationship between farmers' structural empowerment and the four dimensions of sustainable food security: availability, access, utilisation, and stability. This study addresses a critical theoretical and empirical gap by proposing a novel analytical framework grounded in structural empowerment. This area remains underexplored in the context of sustainable

food security, particularly within rural agricultural systems in developing countries. Previous research on farmer empowerment, especially among women, has predominantly drawn upon theories such as Kabeer's empowerment framework, Sen's capability approach, psychological empowerment theories (e.g., Spreitzer), feminist and power theories (e.g., Foucault), Freire's critical consciousness theory, and integrative models like those proposed by Malapit and Quisumbing. While these approaches offer valuable insights, they emphasise internal and individualistic dimensions of empowerment—such as agency, self-efficacy, and autonomy—while paying comparatively less attention to structural, institutional, and externally modifiable factors, especially in rural agricultural contexts. In contrast, this study is anchored in Kanter's (1977) structural empowerment theory, which uniquely conceptualises empowerment as a function of access to four core components: resources, information, support, and formal and informal power. This theory offers tangible, measurable, and intervenable indicators suitable for analyzing the structural dimensions of empowerment within agricultural systems. Despite its relevance, Kanter's framework has been largely overlooked in farmer empowerment and sustainable food security research. The Iranian farming sector—particularly in the selected study area—exemplifies the consequences of limited structural empowerment. Farmers face significant institutional constraints that hinder their resilience to crises and compromise the long-term realisation of sustainable food security. By applying Kanter's theoretical lens, this study aims to develop an integrated theoretical and empirical model to support analysis, intervention, and policy development in food security from the perspective of farmer empowerment.

Based on this theoretical foundation and the reviewed literature, the following hypotheses are proposed for empirical testing:

H1: Training of farmers has a positive impact on sustainable food security.
H2: The knowledge and skills of farmers have a positive impact on sustainable food security.
H3: Farmer awareness has a positive impact on sustainable food security.
H4: Access to resources by farmers has a positive impact on sustainable food security.
H5: Access to support for farmers positively impacts sustainable food security.
H6: The formal power of farmers has a positive impact on sustainable food security.
H7: The informal power of farmers positively impacts sustainable food security.
H8: Farmer in association has a positive impact on sustainable food security.
H9: Institutionalism for farmers has a positive impact on sustainable food security.

Figure 1. Conceptual model of the study

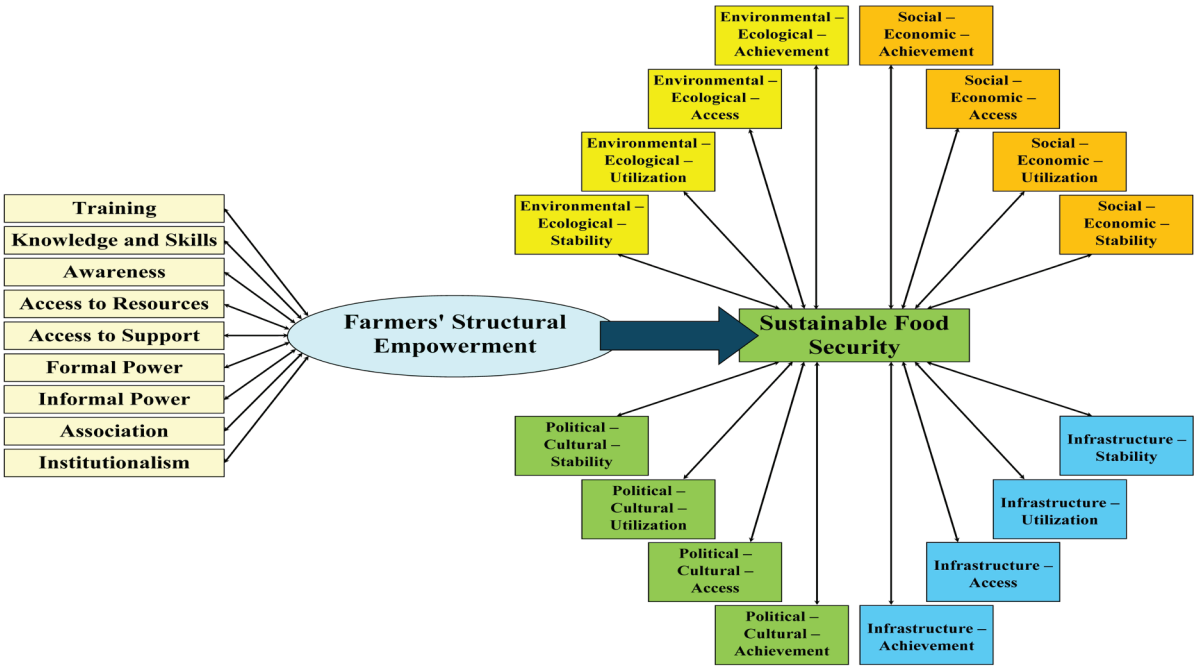


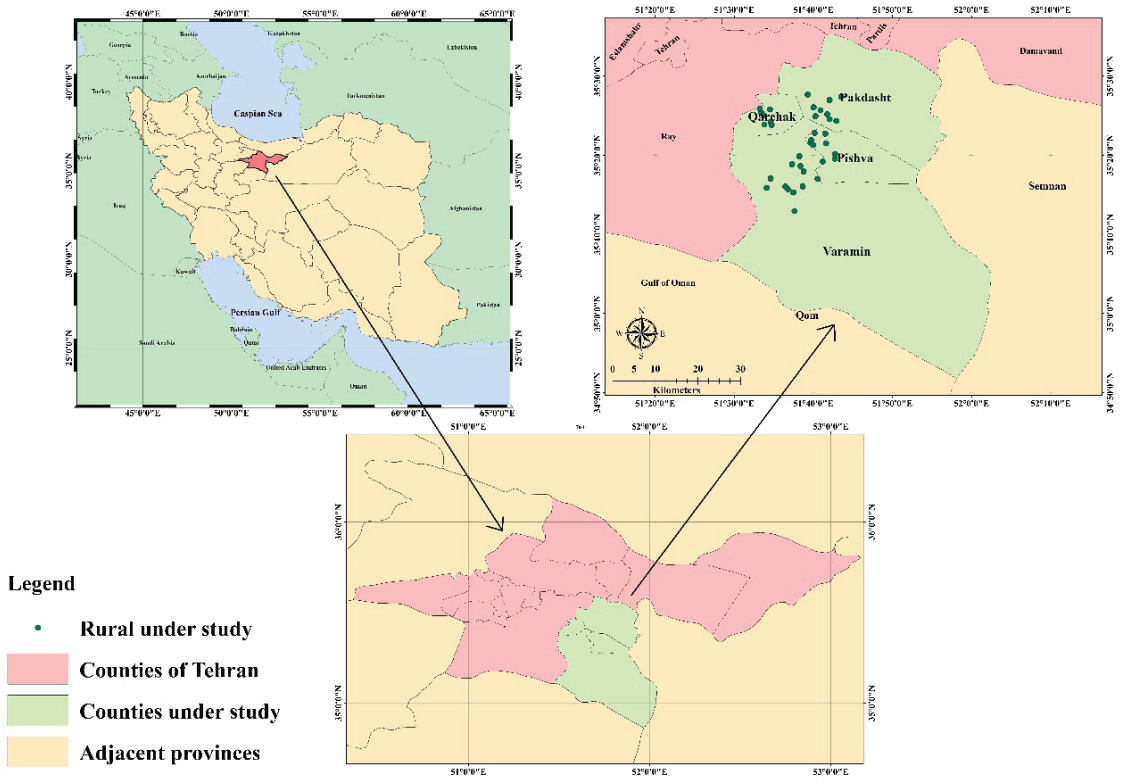
Figure 1 presents a comprehensive and systematic framework illustrating the relationships between the independent and dependent variables. The framework analyses the role of structural empowerment indicators in enabling farmers to achieve sustainable food security.

Methodology

Study Area

The study focuses on rural areas in south-eastern Tehran province, specifically the counties of Pakdasht, Qarchak, Pishva, and Varamin (Figure 2). These areas were chosen for their distinct environmental, economic, and social characteristics. South-eastern Tehran is a significant agricultural hub with fertile soil, adequate water resources, and considerable agricultural and livestock production potential. The region's flat terrain and extensive arable land further enhance its agricultural development prospects. As a key contributor to provincial and national food security, local farmers are central to food production. However, these farmers face considerable challenges, including limited access to resources, modern technologies, specialised training, financial services, and markets—factors essential for structural empowerment. Given the region's fragile climatic, infrastructural, and economic conditions, addressing these issues is critical to preventing further food production and nutritional crises. Examining these challenges will offer valuable insights into the relationship between structural empowerment and sustainable food security. Thus, this region provides a pertinent case for exploring agricultural development and policies to support south-eastern Tehran's rural areas.

Figure 2. Location of the study area



Data

The statistical population of this study comprises 163 active agricultural villages within the study area. Following the Central Limit Theorem and the requirement for a minimum sample size of 30, 37 villages were randomly selected. Based on data from 2016 and 2018, the selected villages included 3,127 farming households, forming the statistical sample. Using Cochran's formula, the required sample size for the survey was estimated at 342 individuals, assuming a 95% confidence level, a 5% margin of error, and an estimated variance of 0.25. In

order to improve precision and guarantee sufficient representation, especially in villages with fewer than 10 respondents, the final number of participants was changed to 400 individuals.

Indicators and Measurement Tools

A comprehensive review of the literature, including extensive screening of reputable databases with specialised keywords, revealed that most studies on empowerment in food security have primarily focused on women's empowerment. These studies predominantly rely on the Women's Empowerment in Agriculture Index (WEAI), which provides a set of dimensions and metrics for evaluating women's empowerment. In addition, other studies have explored various empowerment dimensions, including economic, social, agricultural, civil, and political aspects. The measurement tools used in the field of food security include the Household Food Insecurity Access Scale (HFIAS), Household Dietary Diversity Score (HDDS), Food Consumption Score (FCS), and the Food Insecurity Experience Scale (FIES), all of which are globally recognised in this domain.

This study introduces an innovative approach by examining the structural empowerment of farmers for sustainable food security in rural areas. We developed indicators of structural empowerment based on existing literature and prior research (see Table 1). Additionally, in line with the emphasis on sustainability in food security literature, we established sustainability dimensions—environmental-ecological, socio-economic, political-cultural, and infrastructural—aligned with the classical food security dimensions of access, availability, utilisation, and stability (see Table 2). This multidimensional approach integrates food security with sustainability, offering an innovative, interdisciplinary perspective that has gained traction in recent research on rural development, food policy, and resilience assessment.

To collect data, we designed a researcher-developed questionnaire based on the standard Conditions of Work Effectiveness Questionnaire (CWEQ), initially designed by Kanter (1977) and operationalised by Laschinger (1986). Chandler et al. later refined this tool into the CWEQ-I, with subsequent versions, including the CWEQ-II, further enhancing its scope. Although initially designed for formal work environments, the CWEQ was adapted for this study to better reflect farmers' occupational and environmental conditions, given the differences between these settings and formal work environments.

Since no fully standardised international tool exists for measuring sustainable food security, and existing instruments did not fully capture this study's specific characteristics, we developed our questionnaire based on theoretical foundations and relevant variables. We meticulously assessed its validity and reliability. Before administering the questionnaire in the study area, we evaluated its face and content validity. To assess face and content validity, we solicited feedback from experts in the field, including university faculty members and researchers from top Iranian institutions such as the University of Tehran, Kharazmi University, Shahid Beheshti University, and Tarbiat Modares University. Additionally, experts from the Ministry of Interior, municipalities, rural development offices, the Ministry of Jihad Agriculture, and the Office of Rural Development at the Presidency provided valuable insights. The lead author, with over 26 years of field research experience in rural areas around Tehran, also contributed to this review. The purpose of this phase was to ensure clarity, comprehensibility, logical coherence, and relevance of the questions.

Further, we sought feedback from a small group of farmers to assess the questions' clarity, conceptual accuracy, and relevance, ensuring alignment with the research topic. For content validity, specialists were asked to evaluate each question for accuracy and comprehensiveness, ensuring all essential dimensions of the research topic were addressed. The reliability of the questionnaire was confirmed through Cronbach's alpha, with results above 0.7 indicating acceptable internal consistency (see Table 7). After careful refinement based on expert feedback, the questionnaire's final draft was deemed reliable and valid.

Table 1. Latent and Observable Variables of Farmers' Structural Empowerment

Latent Variables	Observable Variables	References	
Training	Educational Programs for Enhancing Agricultural Product Production	Yahaya et al. (2018); Ruzzante et al. (2021); Reilly et al. (2022); Ezzeddin et al. (2024); Lufuke et al. (2023); Raidimi and Kabiti (2019); Elisante et al. (2019); Wonde et al. (2022); Vogliano et al. (2021)	AQ1
	High-Quality Specialised Training		AQ2
	Career Advancement Opportunities, Decision-Making Power, and Greater Independence for Farmers after Training		AQ3
Knowledge and Skills	Optimal Utilization of Knowledge and Skills in Agriculture	Abdul-Majid et al. (2024); Finger (2023); Zikargae et al. (2022); Heinze et al. (2022); Asitik and Abu (2020); O'Connor et al. (2025); Prain et al. (2020); Nyathi et al. (2022)	CQ1
	Opportunities for Learning New Agricultural Production Methods		CQ2
	Using Knowledge in Decision-Making, Innovation, and Problem-Solving		CQ3
Awareness	Information Dissemination by Relevant Agricultural Training Authorities	Forney (2021); Rossi et al. (2023); Lei and Yang (2024); Wann et al. (2024); Adewale (2012); Dessart et al. (2019); Damanik et al. (2021); Zscheischler et al. (2022); Bernini and Galli (2024)	BQ1
	Timely Receipt of Information for Awareness of Potential and Environmental Changes		BQ2
	Receiving Information from Other Farmers and Their Successful Activities		BQ3
Access to Resources	Accessibility to Agricultural Tools and Equipment	Azizah et al. (2014); Conceição et al. (2016); Galiè et al. (2019); Dwomoh et al. (2023); Sun et al. (2025); Ashagidigbi et al. (2022); Barak et al. (2024); Tesafa et al. (2025); Mataka et al. (2023); Haque et al. (2024)	DQ1
	Access to Formal and Informal Financial Resources, Such as Loans or Grants from the Public and Private Sectors		DQ2
	Farmers' Influence in Decision-Making Regarding the Procurement of Production-Related Supplies and Equipment		DQ3
Access to Support	Receiving Expert Feedback on Successful Agricultural and Non-Agricultural Activities	Kaya and Altınkurt (2018); Christian et al. (2024); Manyise and Dentoni (2021); Barbosa (2024); Wu et al. (2025); Finger (2023); Sun et al. (2025)	EQ1
	Receiving Specific Feedback for Improving Agricultural Practices		EQ2
	Providing Tips and Recommendations for Solving Production Problems and Challenges During Climatic or Economic Crises		EQ3
	Assisting in Securing Seeds, Inputs, and Production Tools to Enhance Agricultural Productivity and Sustainability		EQ4
Formal Power	Receiving Rewards for Innovation in Agricultural Activities to Increase Motivation and Improve Performance	Doss et al. (2018); Kabeer (1999); Zerafati-Shoae et al. (2020); Setyadiharja et al. (2020); Dessart et al. (2019); Pang et al. (2025); Zamiri and Esmaeili (2024); Zakaria et al. (2020); Adeyanju et al. (2021); Eidt et al. (2020)	HQ1
	Flexibility in Agricultural Work to Choose Production Methods Based on Needs and Environmental Conditions		HQ2
	Participation in Agricultural Training Programs		HQ3

Informal Power	Using social media for Product Marketing and Exchange	Clement et al. (2019); Hua and Brown (2024); Liu et al. (2022); Valentinov and Iliopoulos (2021); Finger (2023); Davies et al. (2011); Kanter (1977); Laschinger et al. (2000)	IQ1
	Membership in Local Associations and Institutions		IQ2
	Receiving Constructive Feedback from Farmers and Relevant Authorities to Improve Agricultural Performance		IQ3
Association	Internal Association Among Farmers to Solve Common Problems	Finger (2023); Hussein et al. (2024); Uphoff (1992); Thompson et al. (2023); Adefila et al. (2024); WFF (2024)	GQ1
	Association with Experts, Organisations, and Government Institutions in Agricultural Activities		GQ2
	Association with Associations and NGOs for Sharing Indigenous Knowledge		GQ3
Institutionalism	Strengthening Farmers' Capacity through Collaboration with Agricultural Unions and NGOs for Activity Diversification	Aziz et al. (2021); Farah and Amara (2025); Junquera et al. (2022); Tamako et al. (2022); Silva-Jean and Kneipp (2024); Jemaneh and Shibeshi (2023); Putsenteil et al. (2020); Abab et al. (2023); Kehinde et al. (2021); Sun et al. (2025)	FQ1
	Local Institutions Responsible for Strengthening Educational Infrastructure and Networking Among Farmers		FQ2
	Land Reforms and Resource Allocation by Government Institutions		FQ3

Table 2. Latent and Observable Variables of Sustainable Food Security

Latent Variables	Observable Variables	References	
Environmental – Ecological – Achievement	Improving Achievement to Food Through Sustainable and Optimal Utilisation of Natural Resources (Water, Soil, Energy, Biodiversity) with the Aim of Preserving and Conserving Them for Future Generations	Habiba et al. (2015); Nwachukwu et al. (2024); Pérez-Escamilla (2017); Reilly et al. (2022); Schling and Pazos (2024); Yahaya et al. (2018)	JQ1
Environmental – Ecological – Access	Improving Access to Nutritious and Healthy Food by Reducing Environmental Harm, Such as the Degradation of Natural Resources, Through the Implementation of Sustainable Agricultural Practices and Ecosystem Conservation	Elisante et al. (2019); Heinze et al. (2022); O'Connor et al. (2025); Oghuvbu (2024); Shafieisabet and Mirvahedi (2021); Shafieisabet and Mirvahedi (2022)	JQ2
Environmental – Ecological – Utilization	Improving the Utilization of Diverse Food Products by Enhancing the Quantity and Quality of Agricultural Land Through Modern Irrigation Methods, Optimised Fertilization, and Soil Management	Aziz et al. (2022); Raidimi and Kabiti (2019); Ruzzante et al. (2021); Wonde et al. (2022); Zikargae et al. (2022)	JQ3
Environmental – Ecological – Stability	Improving Stability in the Use of Natural Resources Through Sustainable and Responsible Management, particularly in the Production Process, Aimed at Preserving Renewable Resources for Future Generations	Abdul-Majid et al. (2024); Bernini and Galli (2024); Damanik et al. (2021); Dessart et al. (2019); Finger (2023); Nyathi et al. (2022); Prain et al. (2020)	JQ4

Social – Economic – Achievement	Improving Achievement to Food Through Fair Allocation of Financial Resources, Seeds, and Fertilisers to Farmers, Aimed at Enhancing Production Capacity and Reducing Economic Inequality	Azizah et al. (2014); Conceição et al. (2016); Dwomoh et al. (2023); Lecoutere et al. (2024); Sun et al. (2025); Tesafa et al. (2025); Walters et al. (2021)	KQ1
Social – Economic – Access	Improving Fair Access for Farmers to Agricultural Product Markets to Enhance Economic Conditions and Increase Sustainable Incomes	Christian et al. (2024); Finger (2023); Kaya and Altınkurt (2018); Manyise and Dentoni (2021); Sun et al. (2025)	KQ2
Social – Economic – Utilization	Improving the Purchasing Power of Food Through Increasing Consumers' Financial Strength and Reducing Food Price Volatility	Aziz et al. (2022); Berry et al. (2015); Clapp et al. (2022); Kanter (1977); Oghuvbu (2024); Pérez-Escamilla (2017)	KQ3
Social – Economic – Stability	Improving Stability in Food Supply and Access to Inputs (Seeds, Fertilisers, Machinery, etc.) Based on Farmers' Economic Capacity	Abab et al. (2023); Azizah et al. (2014); Barbosa (2024); Conceição et al. (2016); Galiè et al. (2019); Wu et al. (2025)	KQ3
Political – Cultural – Achievement	Improving Achievement to Food Through Government Policies and Agricultural Planning Aimed at Enhancing Production Levels and Promoting Sustainable Agricultural Practices	Azizah et al. (2014); Blesh et al. (2023); Conceição et al. (2016); Sun et al. (2025); Touch et al. (2024)	LQ1
Political – Cultural – Access	Improving Access to Food Through Providing Research Services and Extension Education to Farmers Aimed at Enhancing Productivity	Elisante et al. (2019); Raidimi and Kabiti (2019); Reilly et al. (2022); Ruzzante et al. (2021); Wonde et al. (2022); Yahaya et al. (2018)	LQ2
Political – Cultural – Utilization	Improving Food Utilsation Through Promoting Nutritional Culture and Raising Awareness of Proper Diet, Particularly Through Educational Programs	(HLPE, 2020); Pérez-Escamilla (2017); Shafieisabet and Mirvahedi (2021); Shafieisabet and Mirvahedi (2022); Silva-Jean and Kneipp (2024)	LQ3
Political – Cultural – Stability	Improving Stability in Food Supply Through Incentive Policies to Enhance Agricultural Machinery and Equipment Technologies	Barbosa (2024); Galiè et al. (2019); Sun et al. (2025); Tesafa et al. (2025); Wu et al. (2025)	LQ4
Infrastructure – Achievement	Improving Achievement to Food Through the Development and Enhancement of Appropriate Infrastructure for Agricultural Production, Transportation, and Distribution	Barbosa (2024); Conceição et al. (2016); Sun et al. (2025); Wu et al. (2025)	MQ1
Infrastructure – Access	Improving Access to Food Through the Use of Appropriate Machinery and Agricultural Mechanisation	Aziz et al. (2022); Ruzzante et al. (2021); Wonde et al. (2022); Wu et al. (2025)	MQ2
Infrastructure – Utilization	Improving Food Utilisation Through Optimising Storage, Processing, Distribution, and Transportation Processes of Products	Aziz et al. (2022); Elisante et al. (2019); Raidimi and Kabiti (2019)	MQ3
Infrastructure – Stability	Stability in Food Supply Through Strengthening and Expanding Food Supply Centres	Christian et al. (2024); Kaya and Altınkurt (2018); Manyise and Dentoni (2021); Sun et al. (2025)	MQ4

Analytical methods

The study adopts a quantitative, cross-sectional design with a descriptive-analytical approach. Data were analysed using multiple statistical methods, including Multiple Linear Regression (MLR) and Structural Equation Modelling (SEM) with the Partial Least Squares (PLS) method, facilitated by SPSS and Smart PLS 3 software, respectively. MLR was employed to examine the linear relationships between structural empowerment indices and sustainable food security. This method assumes linear relationships between dependent and independent variables and is typically used to analysed straightforward data and explore direct associations. SEM with PLS was applied to investigate causal relationships and the underlying structures among variables. SEM is particularly suited for modelling complex, nonlinear relationships, allowing the simultaneous analysis of multiple independent and dependent variables. This approach enables a deeper understanding of causal connections and intricate relationships between variables. Data were collected through field surveys, which provided information on farmers' structural empowerment indicators and the dimensions of sustainable food security in rural areas. These surveys facilitated the exploration of the association between these indicators and food security outcomes.

Results

Multiple Linear Regression Analysis

In the first step, we applied a multiple linear regression model to assess the impact of various dimensions of structural empowerment on changes in food security within rural communities. The results revealed that all variables included in the final model had a positive and statistically significant impact on sustainable food security ($p < 0.000$ for all dimensions) (Table 3). The dimension with the strongest standardised regression coefficient was "association" ($\beta = 0.602$), which encompasses elements such as internal association collaboration among farmers to solve everyday problems, external partnerships with experts, organisations, and government agencies, associations with NGOs to share Indigenous knowledge (Table 1). These findings underscore the importance of social capital and participatory networks in fostering food security.

The second most influential dimension was "Awareness" ($\beta = 0.456$), which includes timely dissemination of information about training programs, production potential, climate change, and knowledge sharing among farmers regarding successful agricultural practices (Table 3). This highlights the critical role of awareness and information accessibility in supporting informed decision-making regarding food production and consumption, especially in environmental instability. The "Knowledge and Skills" dimension ($\beta = 0.384$) also significantly contributed to food security, reflecting the importance of modern technology adoption, problem-solving abilities in production, and creative decision-making. These results suggest that empowerment and mastery over practical knowledge enhance individual agency within the food supply chain. It is noteworthy that three variables—"Access to Resources," "Institutionalism," and "Access to Support"—were excluded from the final model (Table 4). This exclusion may be attributed to the limited effectiveness of formal institutions, the inequitable distribution of resources, and insufficient structural support for farmers. In such contexts, informal networks and individual capacities often serve as compensatory mechanisms.

Table 3. Regression model to explain the effect of empowerment of farmers on sustainable food security

Model	Variables	Multiple correlation coefficient (R)	The coefficient of determination (R^2)	The adjusted coefficient	ANOVA (F)	Sig.
1	Association	0.602	0.362	0.361	226.052	0.000
2	Awareness	0.700	0.490	0.488	190.773	0.000
3	Knowledge and skills	0.739	0.547	0.543	159.274	0.000
4	Formal power	0.771	0.594	0.590	144.287	0.000
5	Informal power	0.792	0.627	0.622	132.467	0.000
6	Training	0.795	0.632	0.626	112.324	0.000

Table 4. Impact coefficients of the final model of independent variables on sustainable food security

	Variables	Non-standard coefficient		Standard coefficient	T	Sig.
		B	std	Beta		
The final model	Association	1.398	0.83	0.602	16.743	0.000
	Awareness	0.885	0.091	0.456	12.104	0.000
	Knowledge and skills	0.672	0.091	0.384	10.104	0.000
	Formal power	0.530	0.089	0.253	6.196	0.000
	Informal power	0.301	0.093	0.238	6.046	0.000
	Training	0.281	0.093	0.237	6.065	0.000

PLS-SEM Analysis

In the second step, we employed a two-stage partial least squares structural equation modelling (PLS-SEM) approach. The first stage involved evaluating the measurement model, which assesses the reliability and validity of the constructs by examining the relationships between latent variables and their indicators. The second stage focused on evaluating the structural model, which tests the hypothesised relationships between the latent variables. This was accomplished by estimating the paths between the variables and examining the model fit indices.

Measurement Model

The reliability and validity of the constructs in the measurement model were evaluated using Partial Least Squares Structural Equation Modelling (PLS-SEM) as the first step. Reliability was assessed using Cronbach's alpha and Composite Reliability (CR) according to Holland's theoretical framework (1999). As presented in Table 5, Cronbach's alpha values for all constructs exceeded the 0.70 threshold, indicating acceptable reliability. Likewise, the CR values exceeded the recommended threshold of 0.70, confirming good internal consistency and composite reliability across the variables.

Convergent validity was assessed using the Average Variance Extracted (AVE) index, following the guidelines of Fornell and Larcker (1981). An AVE value greater than 0.50 is considered indicative of adequate convergence. Table 5 shows that all constructs met this criterion, with the "Informal Power" variable achieving the highest AVE value of 0.816.

Discriminant validity was evaluated using the Fornell and Larcker criterion, which requires that the square root of the AVE for each construct (the diagonal value in the correlation matrix) exceeds its correlation with other constructs. As shown in Table 6, this condition was met for all constructs, confirming the discriminant validity of the measurement model. These results indicate that the latent variables are distinct and free from conceptual overlap.

Table 5. Convergent validity indicators and reliability of research variables

Variables	Cronbach's Alpha	Rho_A	Composite Reliability (CR)	AVE
Training	0.807	0.809	0.886	0.723
Awareness	0.766	0.769	0.865	0.681
Knowledge and skills	0.781	0.781	0.873	0.696
Access to resources	0.779	0.783	0.871	0.694
Access to support	0.717	0.815	0.836	0.589
Institutionalism	0.719	0.726	0.842	0.641
Association	0.775	0.775	0.869	0.689
Formal power	0.757	0.756	0.860	0.673
Informal power	0.887	0.887	0.930	0.816
Sustainable food security	0.876	0.911	0.899	0.680

Table 6. Correlation matrix of research variables (Discriminant validity)

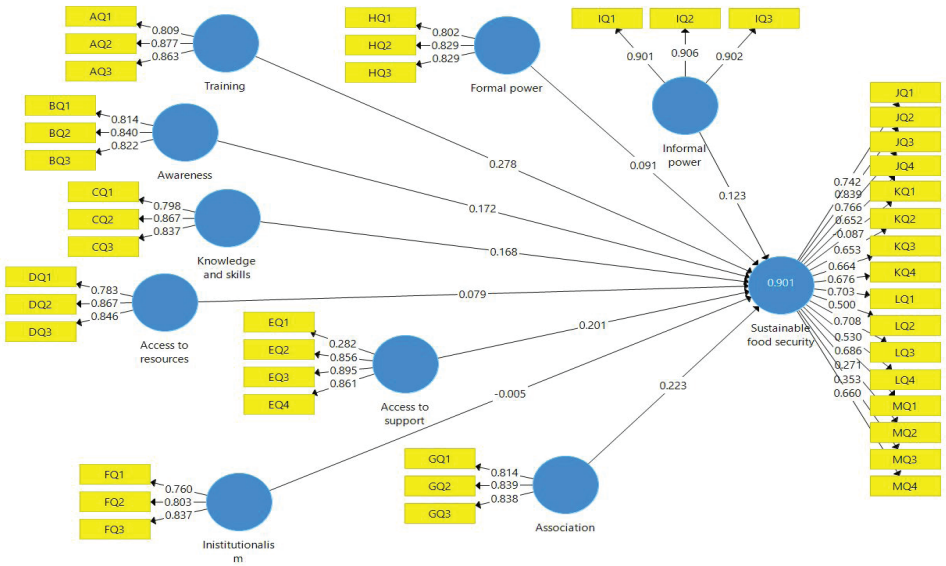
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
(a) Access to resources	0.737									
(b) Access to support	0.598	0.691								
(c)Association	0.464	0.653	0.730							
(d) Awareness	0.562	0.519	0.573	0.723						
(e) Formal power	0.468	0.599	0.655	0.766	0.713					
(f) Informal power	0.800	0.882	0.763	0.554	0.620	0.850				
(g) Institutionalism	0.926	0.552	0.655	0.673	0.861	0.466	0.681			
(h) Knowledge and skills	0.641	0.470	0.763	0.444	0.487	0.519	0.671	0.736		
(i) Sustainable food security	0.502	0.552	0.643	0.758	0.799	0.820	0.747	0.657	0.592	
(j) Training	0.641	0.880	0.852	0.540	0.503	0.670	0.461	0.407	0.821	0.764

Structural Model

In the second stage, the structural model was analysed to test the hypotheses and examine the relationships between the variables. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to assess the causal relationships among the latent constructs. This model focused on the relationship between the independent variable, the structural empowerment of farmers, and the dependent variable, the dimensions of sustainable food security, represented by causal paths. Figure 3 illustrates the model with standardised coefficients. In this model, circles represent latent variables, while rectangles denote observed variables. The path coefficients between latent variables indicate the strength and direction of the causal effects, and the values inside the circles (R^2) reflect the variance explained by the predictor variables. The results indicate that the structural empowerment of farmers significantly explains the four dimensions of sustainable food security: environmental-ecological, socio-economic, political-cultural, and infrastructural.

T-statistics were computed using the bootstrap resampling technique to assess the significance of the path coefficients. This method generates robust estimates of standard errors and confidence intervals, providing more reliable statistical inference in structural equation modelling. As shown in Figure 4, most paths were significant at the 95% confidence level (t-value > 1.96), except the path related to "Institutionalism," which did not achieve the required significance threshold. This suggests that institutionalism did not significantly contribute to explaining sustainable food security within the tested framework. In contrast, other components of empowerment, including awareness, cooperation, formal and informal power, and training, had significant positive effects on food security.

Figure 3. Model in standardized coefficient model



The results of the path analysis, summarised in Table 7, indicate that eight of the nine hypotheses were supported. Specifically, the variables "Training," "Knowledge and Skills," "Awareness," "Access to Resources," "Access to Support," "Formal Power," "Informal Power," and "Association" all had a positive and statistically significant effect on sustainable food security. The path coefficients ($p < 0.001$) and t-statistics (values greater than 2.76) confirm these findings. In contrast, the ninth hypothesis posited that "Institutionalism" influences sustainable food security was not supported. The t-statistic of 0.188 and a p-value of 0.851 indicated no significant relationship between these variables. This result aligns with the descriptive section of the study, which highlights the weak performance of formal institutions and the inefficiency of existing structures in supporting and organising farmers.

Figure 4. The absolute value of significant coefficients

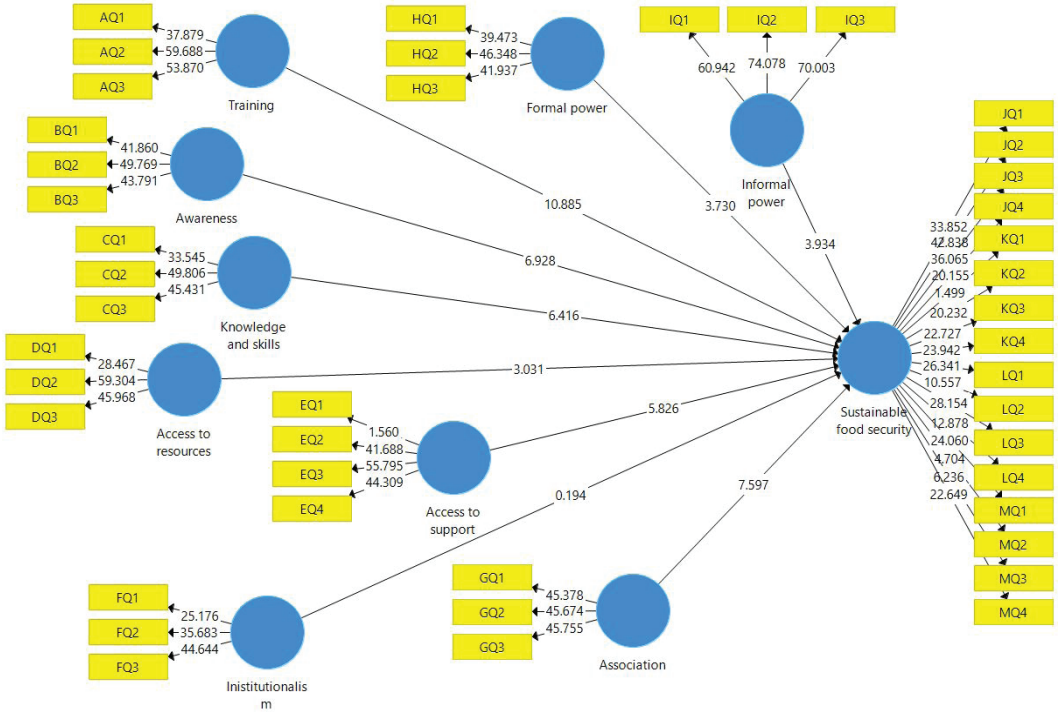


Table 7. Path coefficients (beta), t-statistic, coefficient of determination, and the result of research hypotheses

Path	T-value	P-value	Results
Training of farmers –› sustainable food security	10.762	0.000	Accepted
Knowledge and skills of farmers –› sustainable food security	6.361	0.000	Accepted
Awareness of farmers –› sustainable food security	6.771	0.000	Accepted
Access to resources by farmers –› sustainable food security	2.764	0.006	Accepted
Access to support by farmers –› sustainable food security	6.250	0.000	Accepted
Formal power of farmers –› sustainable food security	3.776	0.000	Accepted
Informal power of farmers –› sustainable food security	3.752	0.000	Accepted
Association of farmers –› sustainable food security	7.540	0.000	Accepted
Institutionalism for farmers –› sustainable food security	0.188	0.851	Rejected

Discussion

The present study examines the role of structural empowerment in enhancing sustainable food security among farmers in the south-eastern region of Tehran, Iran. The findings reveal a strong and significant relationship between the components of structural empowerment and various dimensions of sustainable food security. Analyses indicate that while farmers possess individual capacities such as awareness and association,

institutional and structural constraints limit fully realising the region's sustainable food security potential.

Hypothesis 1, which posits that farmer training positively impacts sustainable food security, aligns with findings by Wonde et al. (2022), who demonstrated that agricultural training in Ethiopia boosted productivity and farmer income, thereby enhancing food security. Similarly, Raidimi and Kabiti (2019) found that farmer training in South Africa directly improved production and food security. Furthermore, Essilfie et al. (2021) and Vogliano et al. (2021) emphasised the significance of farmer training and empowerment in improving food security, with agricultural knowledge and skills leading to better nutritional and food security outcomes. Hypothesis 2, which suggests a significant relationship between farmers' knowledge and skills and sustainable food security, is supported by research from Sharaunga et al. (2015) and Asitik and Abu (2020), who highlighted the positive impact of skill development on food security. Abdul-Majid et al. (2024) and Finger (2023) further corroborate this, stressing the importance of enhancing farmers' skills and knowledge to improve food security outcomes. Hypothesis 3, which indicates that farmers' awareness contributes to improved sustainable food security, is consistent with studies by Wann et al. (2024) and Lei and Yang (2024), which argue that increased awareness fosters better decision-making in production and consumption, thus promoting sustainable food security. Additionally, research by Dessart et al. (2019) and Bernini and Galli (2024) suggests that accurate, up-to-date information on sustainable practices aids decision-making and enhances food security. Hypothesis 4, which asserts that access to resources improves sustainable food security, is corroborated by studies by Conceição et al. (2016) in sub-Saharan Africa, Tesafa et al. (2025) in Ethiopia, and Galiè et al. (2019) in Tanzania. These studies emphasise the role of access to productive resources, agricultural infrastructure, and supportive services in bolstering resilience and food security sustainability. Path analysis in the current study further supports this, showing that farmers' access to institutional and policy support positively impacts sustainable food security. This is consistent with findings by Finger (2023) and Wu et al. (2025), who highlighted the importance of digital innovations and infrastructure support from governmental and non-governmental institutions in strengthening agricultural system resilience and sustainability.

Hypothesis 5 demonstrates farmers' access to institutional and policy support positively impacts sustainable food security. This is consistent with the findings of Finger (2023), Wu et al. (2025), and Barbosa (2024), all of whom highlight the importance of digital innovations and infrastructure support from both governmental and non-governmental institutions in strengthening agricultural system resilience and sustainability. Hypothesis 6, which posits that formal power positively influences sustainable food security, is consistent with findings by Setyadiharja et al. (2020), Doss et al. (2018), Dessart et al. (2019), Pang et al. (2025), and Zamiri and Esmaeili (2024). These studies highlight the effectiveness of formal and structural power in enhancing agency, motivation, and collective participation. Hypothesis 7, suggesting that informal power among farmers positively impacts sustainable food security, aligns with research by Valentinov and Iliopoulos (2021), Liu et al. (2022) in China, Hua and Brown (2024), and Clement et al. (2019). These studies underscore the importance of social networks, social capital, and local trust in fostering flexible resource management and enhancing food system sustainability. Hypothesis 8, which asserts that cooperation between farmers, associations, and institutions is crucial for sustainable food security, is supported by the literature of WFF (2024) and findings from Hussein et al. (2024) and Thompson et al. (2023). These studies emphasise the role of social capital, organisations, and group learning in strengthening resilience and cohesion within agricultural systems.

Hypothesis 9, which explores the role of institutionalism in sustainable food security, was not supported. This result aligns with the work of Ben Farah and Amara (2025) and Manyise and Dentoni (2021), who identified the weak performance of formal institutions and the ineffective linkage between institutions and farmers as contributing to structural inefficiency in developing countries. However, it contradicts the findings of Kehinde et al. (2021), Junquera et al. (2022), and Silva-Jean and Kneipp (2024), who observed a positive impact of institutions on agricultural sustainability. The divergence may stem from differences in institutional contexts, local participation, and the effectiveness of organisations. Institutions in the studied region are often perceived as bureaucratic entities, sometimes ineffective, not as development facilitators. The limited impact

of institutionalism in rural Iran, particularly in the study area, can be attributed to several factors, including the historical weakness of intermediary structures, low participation by formal institutions, and farmers' negative perceptions of institutional roles. Government institutions and cooperatives have traditionally taken a "commanding" approach characterised by top-down policymaking, which has replaced meaningful communication with local communities. As a result, farmers often view institutions as obstacles rather than supporters, contributing to the perception of bureaucracy. Moreover, many institutions in Iran are hindered by financial, administrative, and operational constraints, often prioritising implementing pre-determined policies over conducting needs assessments. Consequently, institutionalism has shown weaker practical effects than anticipated, as reflected in the data, which indicates a non-significant impact.

The results underscore the importance of fostering institutional and policy support, improving access to resources, and promoting cooperation among farmers to enhance food system resilience and sustainability. In conclusion, the study demonstrates that structural empowerment is most effective when pursued within a multidimensional and systematic framework that not only focuses on enhancing individual farmer capacities but also seeks to comprehensively reconstruct and redefine institutional structures and supportive environments. Therefore, achieving sustainable food security requires targeted policy interventions at three levels: training and awareness, supportive structures, and strengthening collective action at the local level. Only through these efforts can farmers effectively and flexibly address emerging environmental, economic, and social challenges. From a theoretical standpoint, the findings support the applicability of Kanter's structural empowerment theory to rural contexts. Initially developed for formal organisational settings, the study reveals that concepts such as "opportunity structure," "formal/informal power," and "access to resources" are also relevant in agricultural communities, especially where social relationships, local networks, and social capital are more significant than formal structures. Thus, this study not only tests the theory in a new context but also adapts it with a localised approach.

This research contributes to the international literature on sustainable food security by introducing the concept of structural empowerment, an aspect often overlooked in rural development studies. While previous research has focused on psychological, gender-based, or economic empowerment, this study applies and localises Kanter's structural empowerment theory in Iranian villages, revealing that collective agency, informal power, and knowledge-based cooperation are key factors in enhancing food security. The empirical evidence confirms the theory's applicability beyond formal organisations and highlights the inefficiency of existing institutional structures. These findings offer a new analytical framework for understanding the structural barriers to food sustainability and provide a foundation for comparative studies in regions with varying governance structures.

Conclusion

This study examined the impact of structural empowerment components on the four dimensions of sustainable food security in rural Iran. Data analysis revealed that farmer empowerment—especially regarding awareness, knowledge, skills, and association—is crucial in promoting food sustainability. However, the ineffective performance of formal institutions and inefficient organisational structures in resource distribution have diminished the impact of macro-level policies in this area. The findings highlight that top-down, technocratic approaches to farmer empowerment are insufficient for achieving long-term food security sustainability. Successful policies must address social, participatory, and institutional contexts. Specifically, fostering farmers' agency, supporting collective learning, restructuring institutional frameworks, and enhancing social capital is essential. Furthermore, the significant role of informal networks, local relationships, and social institutions in improving sustainable food security indicators is a key outcome of this study. The results support Kanter's structural empowerment theory's applicability in agricultural and rural settings. The theory's focus on access to resources, information, institutional support, and formal and informal power provides a robust framework for analyzing and advancing sustainable food security initiatives.

Based on the research findings, several recommendations for future studies are proposed to advance the understanding of structural empowerment and sustainable food security. Future research should explore gender disparities in structural empowerment, focusing on uncovering hidden inequalities and opportunities for female farmers. Additionally, employing mixed-methods approaches, combining qualitative and quantitative research, will offer deeper insights into informal mechanisms and local power networks. Comparative studies between Iran and other countries, such as Turkey, Egypt, India, and Morocco, could enhance regional policymaking capacity regarding sustainable food security. Moreover, examining the role of intermediary institutions like agricultural cooperatives and non-governmental organisations in facilitating access to resources, information, and support would provide a clearer picture of collective empowerment dynamics. These recommendations aim to deepen our understanding of structural empowerment in rural contexts and inform the development of more effective policies for food security.

Regarding practical and policy implications, the study suggests several actions for key stakeholders. Agricultural and rural development sector policymakers should prioritise revising empowerment policies by shifting from top-down approaches to bottom-up, context-specific capacity-building strategies. Investing in training systems that integrate practical, production-oriented skills and long-term institutional support is critical for ensuring that agricultural education aligns with farmers' needs. The study also highlights the need for restructuring ineffective institutions to enhance transparency, accountability, and inclusivity. For development organisations, NGOs, and intermediary institutions, the findings suggest creating and supporting local associations, such as cooperatives and collective learning spaces, to foster cooperation among farmers. These organisations should adopt a facilitative role, empowering farmers to become solution-oriented agents rather than executing projects directly. Furthermore, establishing horizontal networks among farmers can enhance the sharing of indigenous knowledge, successful practices, and social capital. Finally, for farmers and local stakeholders, the study emphasises the importance of self-organisation, participatory learning, and viewing themselves as active agents in driving change. Farmers can increase their bargaining power and problem-solving abilities by leveraging social networks and informal relationships. Empowering farmers with the knowledge, skills, and confidence to make independent decisions is essential for sustainable food security. These findings provide valuable insights for designing policies and interventions addressing the individual and structural factors critical for achieving long-term food security.

This study, while offering valuable insights, is subject to several limitations. First, the localisation of the Structural Empowerment Questionnaire presents a constraint. Although the questionnaire was adapted from Kanter's theoretical framework and standard CWEQ versions to fit the rural context of Iran, it is the first time this tool has been applied in the agricultural sector. As such, its items are not fully standardised across agricultural contexts but are tailored to the local setting. While the tool underwent rigorous validity checks (face and content validity) and demonstrated strong statistical reliability, future studies should validate it in diverse rural regions to improve its applicability and generalizability. Another limitation is the lack of a globally standardised tool for measuring sustainable food security. The questionnaire used in this study combines the classical dimensions of food security with sustainability factors (environmental, social, political, infrastructural). While this integrated model is innovative, the absence of an established global framework in this field limits direct comparisons with other studies. Furthermore, time and spatial limitations during data collection in southeastern Tehran's agricultural areas, including overlaps with farmers' working seasons and coordination challenges with local authorities, may have impacted the accuracy and diversity of the responses. Lastly, the regional focus of the study, confined to rural villages in southeastern Tehran, restricts the generalizability of the findings. Although the results may be relevant to regions with similar institutional and environmental structures, caution is advised when extending the conclusions to other parts of Iran or other countries. Therefore, future research should seek to validate these findings in diverse geographical and agricultural contexts and explore broader comparisons in the global literature on sustainable food security.

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