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Impact of Agricultural Policies on Smallholders' Food insecurity Resilience in Iran: Evidence from Iran

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Abstract

One of the essential goals of societies, primarily developing and underdeveloped countries, is to eradicate poverty and achieve sustainable development. As vulnerable individuals in many communities' face growing economic, environmental, and political challenges, proactive crisis management by governments and policymakers—aimed at increasing the productivity of key economic sectors such as agriculture—has become essential. The efficiency of the farm sector is not only crucial for ensuring national food security, but it also significantly impacts the livelihoods, incomes, and resilience of rural smallholders. The purpose of this study is to investigate the impact of agricultural support policies on the resilience of rural farmers in the Fariman region. The study area is the Hossein Abad Rekhneh Gol village, Iran, and the data were collected through documentation and the use of questionnaires. The Resilience Index Measurement and Analysis (RIMA) introduced by the FAO has been used to determine the resilience of rural farmers. Additionally, the distribution of subsidized fertilizers to farmers as a common agricultural support policy in the country has been chosen. The impact of this agricultural support policy on the resilience of rural farmers has been estimated using the propensity score matching method in this study. The study results indicate that households eligible to receive subsidized fertilizers have higher resilience on average compared to households that are not eligible. Based on the research findings for the study area, it is recommended that rural smallholders be prioritized in the allocation of subsidized fertilizers, which is constrained by quantity and budget limitations imposed by the government, compared to large-scale farmers. Additionally, facilitating rural farmers' access to the available agricultural wells owned by non-private institutions can potentially improve farmers' resiliency.

Keywords: Agricultural support policies, Food insecurity, Propensity score matching, Resilience, Rural farmers

Introduction

The concept of resilience is considered as the capacity of a system, family, or individual to withstand various shocks and risks, which has been on the agenda of all countries as a new concept of development in the 2030 Sustainable Development Agenda (d'Errico *et al*., 2021; FAO, 2018). Achieving food security and combating poverty and hunger have become central to the agricultural policies of various countries, especially in developing and underdeveloped societies. Two major global paradigms, i.e., the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs), prioritized the

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eradication or reduction of global poverty and hunger. Accordingly, medium-term and short-term agendas have been outlined in different communities to achieve these overarching goals (United Nations 2015a, 2015b).

The agricultural sector plays a crucial and strategic role in ensuring food security and significantly contributes to broader economic development. In both underdeveloped and developing countries, agriculture drives growth by producing and supplying food, generating employment through the expansion of upstream and downstream industries, and increasing foreign exchange earnings via the growth of non-oil exports. Therefore, the development of the agricultural sector is considered one of the most effective tools for reducing poverty in communities. (Alam *et al*., 2023). Iran, as a developing country, is no exception to this trend and requires the development of its agricultural sector to stimulate sustainable and inclusive economic growth. Increasing the productivity of the agricultural sector, in addition to ensuring the country's food security, can significantly improve the livelihoods and employment status of Iran's rural population. The small-scale, peasant production system is the most prevalent mode of production, accounting for more than 85% of agricultural production units in the country.

In rural areas and among farmer households, food security and resilience are deeply intertwined. Food security not only ensures that families have consistent access to sufficient, safe, and nutritious food, but it also strengthens their resilience to economic and environmental shocks (Zarif Moradian *et al*., 2022). Resilient households are better able to adapt to challenges such as fluctuating market prices, natural disasters, and climate change, which are common in agricultural-dependent regions. Improving food security in these areas, through both enhanced agricultural productivity and sustainable farming practices, enables farmers to buffer against shocks, maintain stable incomes, and ensure the well-being of their families. As a result, strengthening food security directly contributes to the overall resilience of rural communities, fostering long-term stability and growth.

In general, supportive policies in Iran's agricultural sector can be introduced through three general frameworks. The first group includes tax exemptions, legal privileges, tariff barriers, and preferential rates for bank credits. The second group includes explicit and implicit subsidies for the production and consumption of agricultural commodities, including input subsidies and price support measures. Finally, the third group can be introduced as public services and infrastructure in the agricultural sector, which includes budget payments for the development of agricultural infrastructure, research and extension, and other civil activities in the agricultural sector (Mojtahed & Esfahani, 1989).

Granting production subsidies and setting guaranteed prices for strategic agricultural products are among the most common types of direct support for agricultural producers in Iran. The objective of the government and policymakers in adopting and implementing the policies mentioned above is not only to enhance the productivity of the farm sector but also to increase the income of farmers and improve their livelihood status, especially rural smallholders. Regarding the improvement of the livelihood status of rural smallholders, one can refer to ensuring their food security and income stability, as agricultural producers are constantly faced with technical, economic, and environmental challenges due to the nature of farming production. Therefore, identifying and implementing measures that will increase the resilience of rural smallholders is of great importance. Given that a significant percentage of agricultural producers in Iran are made up of rural smallholders and the importance of their resilience to food insecurity, considering measures and policies that lead to an increase in the resilience of rural farmers against various shocks is essential. Upon reviewing the existing literature, a significant gap becomes apparent. While many studies have focused on the impact of agricultural support policies on food insecurity, few have explored their effects on farmers' resilience to food insecurity. Table 1 shows the aforementioned studies.

Table 1- Summarized literature

Number	Surveyed study	Location	Policy measures / Programs (in Agriculture)	Affected factors
1	(Hunt *et al.*, 2011)	Australian villages	Agricultural extension; extension program in the Tasmanian sheep industry as a supporting case study	Improving the capacity-building and resilience in rural industries and communities
2	(Schouten *et al.*, 2012)	Netherlands	Rural development policies; Impact of Modulation from a Resilience Perspective	Increasing an average score of 79/156 on the criteria for developing resilience.
3	(Ambelu *et al.*, 2017)	Southern Ethiopia	The intervention measures on the livestock and infrastructure of resilience dimensions	Improving the resilience of rural communities.
4	(d'Errico *et al.*, 2020)	Lesotho	Cash transfer projects; Child Grant Program.	Positive and significant short-term impact on less resilient households.
5	(Buitenhuis *et al.*, 2020)	Netherlands	Common agricultural policies (CAP)	Strongly support the robustness of the resilience of farming system.
6	(Anantha *et al.*, 2021)	South Asia	Management practices on sustainable crop production	Improving climate resilience in smallholder farming systems
7	(Maia *et al.*, 2021)	Brazil	Climate resilience program; a set of climate-smart production practices and locally-adapted technologies.	Improving the production practices, land management, and the quality of life of the farmers.
8	(Baffour-Ata *et al.*, 2023)	Ghana, Bono east Region,	Climate smart agriculture (CSA) program.	Positive and significant effect on the resilience of smallholder farmers.
9	(Ali *et al.*, 2023)	Ethiopia	Climate smart agriculture (CSA) program.	Increasing smallholder farmers' resilience
10	(Temesgen Gelata *et al.*, 2024)	Ethiopia	Dairy contract farming adoption	Increasing households' resilience to food insecurity by 18%

This research intends to examine the effect of a common supportive policy in the Iranian agricultural sector on the resilience of rural smallholders against food insecurity. This study aims to examine the effect of a specific agricultural support policy-subsidized fertilizer distribution-on the resilience of rural smallholder farmers. It is believed that the proper implementation and adoption of each type of support policy in this sector not only provides the means to achieve the overarching goals, such as achieving sustainable food security, but also leads to an improvement in the livelihood status and resilience of farmers.

Materials and Methods

Study Area and Data

Fariman County, Iran, with an area of 3,356 square kilometers, is located the capital of Khorasan Razavi Province. The county has two districts, four cities, five townships, and 148 inhabited villages. The total population of Fariman County is 99,001, of which 85,966 live in cities and 40,035 (44.40%) live in villages (Iran Statistics Center, 2015). Fariman County is considered an important agricultural production hub in Khorasan-Razavi province due to its extensive irrigated and rainfed farmlands and high capacity for agricultural, horticultural, and livestock production. Considering the significance of agricultural production in Fariman County, examining the resilience capacity of farmers in this region and the impact of agricultural support policies on their resilience are of undeniable importance.

With the objective of studying the impact of agricultural support policies on the resilience of rural farmers, the following criteria have been considered for selecting the target village in Qalandarabad district: (i) The study village should have a sufficient number of farm households for whom agriculture is the main source of income for the household head; (ii)

The agriculture of the households under study should include both rain-fed and irrigated farming; and (iii) The farmers should reside in the same village.

According to the opinions of experts from the Agriculture organization and the Agricultural Support Services Organization, the village of Hosein Abad Rekhneh Gol has been selected for the study due to the impressive number of rural employment in the agricultural sector and the availability of diverse water resources in kinds of wells and qanats. The geographical coordinates of Hoseynabad-e Rekhneh Gol are approximately: Latitude: 35°32′38″ N and Longitude: 60°04′55″ E.

Data Collection and Parametrization

The resilience of the statistical population in facing food insecurity was estimated using the results of a previous study (Moradian *et al*., 2023) conducted in Hossein Abad Rekhneh Gol village. The households of rural farmers who were part of the study (Moradian *et al*., 2023) were surveyed about their receipt of agricultural support subsidies. The impact of farming subsidies on the resilience index against food insecurity was then calculated using the methods detailed in section 3 of this article. The statistical sample group comprised 149 farm households, selected through a random sampling method from a total of 214 farmers in the village.

Farmers who received subsidized fertilizers during the agricultural year are considered the treatment group, and farmers who did not receive subsidized fertilizers are in the control group. Table 2 shows the number and share of the treatment and control groups.

Table 2- The number and share of rural households in the treatment and control groups

Control group (Farmers who did not receive subsidized fertilizer)	Treatment group (Farmers who received subsidized fertilizer)	Description
76	73	Number (household)
51%	49%	Share of total (percentage)

Source: Research findings

Methods

The methodology employed in this research comprises two main parts. The first part estimates the resilience index of rural smallholders against food insecurity, and the second part examines the effect of the implemented support policies on this index.

Estimating the Resilience Index of Rural Smallholders against Food Insecurity: In this study, the resilience index of rural smallholders was estimated using the RIMA (Resilience Index Measurement Analysis), which was introduced by the FAO in 2008 and expanded in 2016. The RIMA resilience index consists of four pillars, namely access to public services, assets, social safety nets, and adaptive capacity. Each of these pillars is composed of a number of unobservable variables. To examine the resilience index (RIMA) against food insecurity, various food insecurity indicators can be utilized, including the Food Consumption Scale (FCI) and the Household Hunger Scale (HHS). Finally, after separately calculating the resilience index's pillars and the food insecurity indicators, the RIMA Resilience Index is obtained using methods such as structural equation models (MIMIC[1]). The RIMA resilience index can range from zero to one hundred, with lower values meaning less resilience to food insecurity and vice versa.

Estimating the Impact of Agricultural Support Policies on the Resilience of Rural Farmers: In general, the policies of purchasing agricultural products at guaranteed prices and providing subsidies for agrarian inputs are considered the most significant agricultural support policies implemented in various

1- Multiple Indexes and Multiple Causes

regions, including the area under investigation in this study. The guaranteed price policy, primarily applicable to wheat, involves the government announcing the purchase rate for wheat for the upcoming agricultural year, allowing farmers to supply their produce to the government.

The policy of granting agricultural input subsidies, a recent initiative, is a comprehensive support system for farmers. It includes granting credit and financial facilities, distributing agrarian inputs, and other facilities. Notably, among these, the allocation of subsidized fertilizers plays a crucial role. These fertilizers, distributed based on farmers' share of agricultural water ownership, directly enhance their productivity and income. Other required inputs are obtained by farmers in the free market. Given that some farmers in the study, due to low quantity or quality of harvested wheat or other factors, choose not to participate in the wheat guaranteed price policy and instead sell their product on the open market and that yield differences further complicate the assessment of this policy's impact on farmer resilience, this study focuses on evaluating the impact of the subsidized fertilizer distribution policy on the resilience of rural farmers. As mentioned, the main objective of this study is to examine the effects of subsidized fertilizer distribution on the RIMA resilience index, which is called the Resilience Capacity Index (RCI) of rural households. In this regard, the Matching Method is considered an effective tool for evaluating the effect of a specific treatment (for example, an agricultural policy) on a group of people in society. In empirical research, matching is defined as pairing and comparing treatment group units with control group units based on observable characteristics (Independent variables). This method was first used by Rosenbaum and Rubin (Rosenbaum & Rubin, 1985) and has since been extensively used in the field of market policy evaluation (Filsaraee, 2015).

Estimation Procedure

To estimate the propensity score, the probability of treatment participation is first calculated for all observations using observed variables as predictors. Subsequently, individuals from the control group are matched to those in the treatment group based on these scores. Logit or Probit models are commonly employed to estimate the probability of participation. In this study, the treatment is the use of agricultural support policies (subsidies fertilizer), and the independent variables include the pillars of the resilience RIMA index such as access to public services (ABS), assets (AST), social safety nets (SSN), and adaptive capacity (AC). The experimental model is as follows:

$$Y = \alpha + ABS_iX_i + AST_iX_i + SSN_iX_i + AC_iX_i \quad (1)$$

The Average Treatment Effect on the Treated (ATT) is considered the parameter of interest in the PSM analysis. In this study, ATT refers to the average effect of agricultural support policies (subsidies fertilizer) on the resilience of the rural households under study. ATT is calculated by using the matching of observations in the treatment group and the control group that are close in terms of propensity scores, as follows:

$$ATT\ (x) = E(Y_{1i}|T_i = 1) - E(Y_{0i}|T_i = 1) \quad (2)$$

Descriptively, the PSM estimate is simply a difference in means between the treatment group and the control group, where the means are weighted averages using the weights of the distribution of propensity scores to participate (Pishbahar Esmaeel, 2017).

In the research literature, various methods of propensity score matching are used to match two treatment and control groups with similar propensity scores to calculate ATT. Given that the choice of matching estimator depends heavily on the characteristics of the data under consideration and the structure of the study, the Radius estimator is used in this study.

Results

Based on the mentioned results, out of the 149 households examined, 33 households (22%) are highly resilient, 82 households (55%) are resilient, 26 households (18%) are relatively resilient, and finally, eight households (5%) are

vulnerable to food insecurity.

Table 3 shows the results of comparing the means of the two treatment and control groups for the independent variables of the model before matching.

Table 3- Comparison of the average resilience pillars in two control and treatment groups

Pvalue	T	Standard deviation		Mean		Independent variables
		Treatment group	Control group	Treatment group	Control group	
0.00	4.66	0.14	0.56	0.36	-0.35	Access to Basic Service (ABS)
0.00	-11.17	0.81	0.65	0.68	-0.66	Assets (AST)
0.38	0.86	1	1	0.17	0.17	Social Safety Nets (SSN)
0.00	-0.5	0.96	0.86	0.4	-0.39	Adaptive Capacity (AC)

Source: Research findings

As can be seen from the Table 3, before matching, the social safety net variable does not statistically differ between the control and treatment groups. However, there is a statistically significant difference between the control and treatment groups in terms of the variables of access to public services, assets, and adaptation capacity. These differences indicate that there is sample selection bias, and therefore, matching of households from the two groups is necessary before examining and evaluating the effect of the subsidized fertilizer distribution on household resilience capacity.

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Table 4- Propensity Score Matching calculations - The Probit model results

P-value	T	Coefficients	Variables
0.03	2.10	0.39	Access to Basic Service (ABS)
0.00	6.05	1.49	Assets (AST)
0.26	-1.11	-0.14	Social Safety Nets (SSN)
0.14	1.47	0.24	Adaptive Capacity (AC)
0.97	0.03	0.005	Intercept
Log likelihood: 50.42	LR Chi2: 105.66		Prob 0.00

Source: Research finding

Table 5 explains the estimated propensity score. Once the propensity score has been calculated for each observation, it is necessary to ensure that there is an overlap in the propensity score range between the control and treatment groups. This range is called the region of common support and is used to determine the optimal number of blocks.

Table 5- Descriptive statistics of the estimated Propensity Score Matching

Mean	Smallest	Percentiles	Thresholds
0.686	0.134	0.137	1%
	0.137	0.167	5%
Std. Dev	0.145	0.197	10%
0.289	0.145	0.473	25%
	(Largest)	0.758	50%
Variance.	0.999	0.932	75%
0.082	0.999	0.990	90%
	0.999	0.999	95%
Observations 103	1	0.999	99%

Source: Research findings

Based on Table 5, the region of common support ranges from 0.134 to 1. The optimal number of blocks was determined to be five, ensuring that within each block, the average propensity score is statistically similar between the treatment and control groups. This stratification helps satisfy the balancing property required for unbiased treatment effect estimation.

Table 6 shows the results of the test of the propensity score's balancing property. Based on Table 6, which indicates the number of treatments and controls in each block, the balance of the blocks has been achieved.

Table 6- The balance test of the estimated propensity score

Sum	Receiving and not receiving subsidized fertilizer		Propensity score blocks
	1	0	
12	3	9	0.134
9	5	4	0.2
12	5	7	0.4
23	16	7	0.6
47	44	3	0.8
103	73	30	Sum

Source: Research findings

Table 7 shows the effect of the subsidized fertilizer distribution support policy on the resilience index of rural farmers in Hossein Abad Rekhneh Gol village. Table 7 shows the results of using the propensity scores obtained from the probit model and matching the propensity scores using the radius method. The radius method was chosen from among the other available algorithms for calculating the ATT (Average Treatment Effect on the Treated).

Table 7- The effect of the support policy of subsidized fertilizer distribution on the RCI of rural farmers

Standard Deviation	t	Numbers of Control Group	Numbers of Treatment	Average Treatment effect on the Treated	Treatment	Dependent Variable
1.55	4.08	73	30	6.33	Receiving subsidized fertilizer	Resilience Capacity Index

Source: Research findings

The t-statistic between the control and treatment groups is significant (Table 7) meaningthat the distribution of subsidized fertilizers, as an agricultural support policy, has a significant effect on the resilience index of rural farmers in Hossein Abad Rakhneh Gol village. The mean resilience of the treatment group (the group that received subsidized fertilizers) is higher in the face of food insecurity than the control group (the group that did not receive subsidized fertilizers).

Conclusion and Discussion

In general, unpredictable crises in the political, economic, and environmental fields are considered to be significant factors in food insecurity in developing countries. Iran, as a developing country, has always been and continues to face various shocks, such as climate change, drought, and political and economic sanctions. These challenges and problems have had a significant impact on different economic sectors, especially agriculture and industry, in recent years.

Since resilience is considered the capacity for absorption, adaptation, and transition of an individual or household in the face of shock (Béné *et al*., 2012), increasing resilience requires long-term measures that cannot be achieved without the support of policymakers. These measures include a wide range of actions,

including the creation and improvement of infrastructure and agriculture, especially in rural areas. Accordingly, the objective of this study is to assess how the subsidized fertilizer distribution support policy influences the resilience of rural farmers in Hossein Abad Rakhneh Gol village. In this regard, the propensity score matching approach has been used. Based on the results obtained from the mentioned method, it was found that the average resilience of households that received subsidized fertilizers is higher than the group of households that did not benefit from this policy.

Based on the results of the study of (Moradian *et al.*, 2023), among the variables that create the asset pillar in the resilience index, the wheat yield variable plays a significant role. Therefore, factors that lead to an increase in the yield of agricultural products can also increase their resilience in the face of food insecurity. One of the factors that have a significant impact on improving the yield of agricultural products, including wheat, is the use of chemical fertilizers, including nitrogen, phosphorus, and potassium. In the cultivation year 2022-2023, in which the data was collected, these fertilizers were the only subsidized input distributed by the government to farmers. Due to the difference between subsidized and market prices, majority of the farmers who were unable to receive this subsidy due to lack of agricultural water were unable to buy it in the market in cash, too. This can have a significant impact on reducing the yield of their products and consequently affect their resilience.

Creating an understanding and awareness of rural farmers' resilience and identifying the factors and policies that affect their resilience will lead to directing the policy path in the form of improving the weaknesses of different regions and will result in significant savings in budget and time. These two factors are among the important and limiting factors in various policy-making.

Finally, based on the study results, it is recommended that:

≠ The number of available agricultural rental wells for rural farmers should be increased. Additionally, extending the contract duration with rural farmers could lead to an increase in the productivity of agricultural production in rural areas.

Necessary changes in the resolution related to fertilizer distribution laws should be made in a way that small rural landowners (including rain-fed farmers and irrigated farmers) receive subsidized fertilizers based on the area under cultivation in each agricultural year. In the allocation of subsidized fertilizers, which are limited by quantity and budget constraints from the government, rural farmers should be prioritized over large landowners.

Limitations

Policies supporting agricultural producers in Iran mainly involve providing subsidies for production inputs and purchasing essential products, particularly wheat, at guaranteed prices by the government. Considering the approach taken in this study regarding the impact of agricultural support policies on the resilience of rural farmers, it may not be possible to assess the effectiveness of the policy of purchasing agricultural products at guaranteed prices in improving the livelihoods and resilience of rural farmers due to differences in eligible conditions.

Since no study has been done on the impact of the policy of purchasing agricultural products at guaranteed prices on the resilience of farmers in Iran, this could be an area of interest for researchers in the future.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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تأثیر سیاست‌های کشاورزی بر تاب‌آوری کشاورزان خرده مالک در برابر ناامنی غذایی در ایران

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چکیده

یکی از اهداف اساسی جوامع، به‌ویژه در کشورهای در حال توسعه و کمتر توسعه‌یافته، ریشه‌کن کردن فقر و دستیابی به توسعه پایدار است. با توجه به اینکه افراد آسیب‌پذیر در بسیاری از جوامع با چالش‌های اقتصادی، زیست‌محیطی و سیاسی روزافزون مواجه هستند، مدیریت پیشگیرانه بحران‌ها توسط دولت‌ها و سیاست‌گذاران، به‌ویژه در راستای افزایش بهره‌وری بخش‌های کلیدی اقتصادی مانند کشاورزی، به امری ضروری تبدیل شده است. کارآیی بخش کشاورزی نه تنها برای تضمین امنیت غذایی ملی از اهمیت بالایی برخوردار است، بلکه تأثیر عمده‌ای بر معیشت، درآمدها و تاب‌آوری کشاورزان روستایی کوچک دارد. هدف این مطالعه، بررسی تأثیر سیاست‌های حمایتی کشاورزی بر تاب‌آوری کشاورزان روستایی در منطقه فریمان است. این مطالعه بر روستای حسین‌آباد رخنه‌گل در ایران متمرکز بوده و داده‌ها از طریق مصاحبه و با استفاده از پرسشنامه‌ها جمع‌آوری شده است. برای اندازه‌گیری میزان تاب‌آوری کشاورزان روستایی از شاخص اندازه‌گیری و تحلیل تاب‌آوری (RIMA) که توسط سازمان خواربار و کشاورزی ملل متحد (FAO) معرفی شده است، استفاده گردیده است. همچنین، توزیع کودهای یارانه‌ای به کشاورزان، به‌عنوان یک سیاست حمایتی رایج کشاورزی در کشور، به‌عنوان متغیر مورد بررسی انتخاب شده است. تأثیر این سیاست حمایتی بر تاب‌آوری کشاورزان روستایی از طریق روش همسان‌سازی امتیاز تمایل (Propensity Score Matching) برآورد شده است. نتایج مطالعه نشان می‌دهد که خانوارهای واجد شرایط برای دریافت کود یارانه‌ای، به‌طور متوسط تاب‌آوری بالاتری نسبت به خانوارهایی که واجد شرایط دریافت این کود نبوده‌اند، دارند. بر اساس نتایج این تحقیق در منطقه مورد مطالعه، پیشنهاد می‌شود که کشاورزان روستایی کوچک در تخصیص کود یارانه‌ای، که با محدودیت‌های مقداری و بودجه‌ای دولت مواجه است، نسبت به کشاورزان بزرگ‌مقیاس در اولویت قرار گیرند. علاوه بر این، تسهیل دسترسی کشاورزان روستایی به چاه‌های کشاورزی موجود که تحت مالکیت مؤسسات غیرخصوصی هستند، می‌تواند به‌طور بالقوه تاب‌آوری کشاورزان را افزایش دهد.

واژه‌های کلیدی: تاب‌آوری، روش جورسازی، سیاست‌های حمایتی کشاورزی، کشاورزان روستایی، ناامنی غذایی

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