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## **Integrating Monetary Policy and Sustainable Land Use: A Longitudinal Analysis of Iran's Agricultural Sector Dynamics**

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### **Abstract**

Sustainable natural resource management and resilient land-use systems are critical to maintaining both agricultural productivity and planetary health. This study presents a comprehensive longitudinal analysis of Iran's agricultural sector over the period 1970–2024 to explore how temporary and permanent monetary policy shocks influence sustainable land-use dynamics. By focusing on key macroeconomic indicators—namely, sectoral growth, investment in sustainable practices, and labour market demand—we examine the multifaceted impacts of monetary fluctuations on the capacity of the agricultural sector to adapt to environmental and economic challenges. Using the Blanchard-COA technique, we extract distinct temporary and permanent monetary shocks and assess their implications through robust econometric methods. Guided by Solow's growth theory and Keynesian investment principles, we deploy Vector Error Correction Models (VECM) to capture long-run equilibrium relationships governing growth and investment. Additionally, the Autoregressive Distributed Lag (ARDL) approach is employed to analyse the responsiveness of labour market demand to monetary shocks. Our results reveal that while temporary monetary shocks induce a positive, short-term increase in labour demand, permanent shocks exert detrimental effects on long-term growth and investment—factors essential for advancing sustainable land use, soil conservation, and water management. Beyond quantifying these relationships, our findings emphasise that aligning monetary policy with supportive environmental and fiscal measures can catalyze investments in sustainable agricultural innovations and resource-efficient practices. This integrated framework not only promotes economic stability but also reinforces the ecological integrity of agroecosystems. Ultimately, this study provides policymakers with critical insights to formulate monetary strategies that balance immediate economic stimulus with the long-term objectives of sustainable land-use and natural resource management.

**Keywords:** Agricultural sustainable development, growth, investment, labour market demand, monetary policies, sustainable land use

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## Introduction

Iran's agricultural sector remains a cornerstone of the national economy, contributing approximately 12.8 % of GDP and employing nearly 17 % of the labor force (Farajzadeh, 2024). However, its development trajectory is not solely determined by production structures or factor endowments; it is also highly influenced by macroeconomic volatility and monetary instability, particularly in the form of monetary shocks and exchange rate fluctuations (Delangizān et al., 2011; Khodaparast Shirazi, 2015). Over the past five decades, the sector has experienced exposure to macroeconomic. recurrent episodes of monetary expansion, high inflation, and unstable credit markets have significantly altered investment behavior and labor absorption within agriculture (Bernanke & Blinder, 1992; Zibaei, 2004; Bonny & Ayunku, 2024).

Agriculture in Iran is not only a provider of food but also a regulator of ecological stability and a buffer against rural poverty. Thus, the interaction between monetary policy and land-use systems has wide-ranging implications for both economic performance and sustainability. In this context, the Central Bank of Iran applies a combination of temporary instruments (e.g., open market operations, interest rate changes) and permanent tools (e.g., base money expansion, credit rationing policies) that directly affect sectoral dynamics—especially through investment costs, real wages, and capital availability (Zahedi & Azadi, 2018).

Despite growing empirical literature on monetary transmission in Iran (Munir & Qayyum, 2014), the long-term structural impacts of monetary policy on sustainable agricultural development remain largely understudied. While Keynesian frameworks predict that expansionary policy may temporarily boost employment and investment (Delangizān et al., 2011), more recent FAVAR-based evidence suggests these effects may be reversed over time due to inflationary inertia and declining real investment (Khodaparast Shirazi, 2015).

This study investigates the dynamic effects of temporary and permanent monetary policy shocks on three key macroeconomic dimensions of Iran's agricultural sector: sectoral growth, investment, and labor market demand, covering the period 1970–2024. By employing a rigorous econometric framework—drawing on the Blanchard-Quah decomposition, ARDL, and VECM approaches—we identify distinct monetary transmission mechanisms and their implications for long-run sustainable land use.

Through this integrated lens, the paper contributes to the broader literature on development economics and environmental policy by offering empirically grounded recommendations to align Iran's monetary instruments with sustainable agro-ecological outcomes.

## Materials and Methods

**Shock Identification:** Blanchard-COA decomposition (Blanchard & Perotti, 2002) to isolate permanent vs. transitory monetary shocks.

**Econometric Strategy:**

- VECM (Johansen, 1991) for long-run cointegration among agricultural GDP, investment, labor productivity, and monetary variables.
- ARDL (Johansen, 1995) to model short- and long-run effects on labor demand.

**Theoretical Underpinnings:**

- Solow model frames the growth-channel analysis.
- Keynesian capital accumulation theory underlies investment responses.
- Labor market behavior informs ARDL model specification.

**Data Scope:** 1970–2024 annual series from the Central Bank of Iran, the Statistical Center of Iran, and the World Bank.

This methodological framework combines structural and time-series econometrics to disentangle the dynamic responses of agricultural variables to monetary shocks. The Blanchard-Quah decomposition allows for orthogonalization of structural innovations under the assumption of long-run neutrality of transitory shocks. The integration of VECM and ARDL enables both short-run adjustment analysis and identification of long-run equilibrium paths, capturing the interplay between real monetary effects and sector-specific fundamentals (Enders, 2015).

## Results and Discussion

### Labor Market Response

- Temporary monetary expansion yields a statistically significant 2–5 % short-term boost to agricultural employment.
- Permanent expansions (e.g., sustained liquidity growth) erode employment capacity by –3 % over 3–5 years.
- Wage adjustment lags suggest that initial job gains vanish as inflation expectations solidify.

### Growth Dynamics

- VECM reveals a stable long-run elasticity ( $\sim 0.4$ ) of agricultural output to productivity improvements.
- Temporary monetary shocks temporarily elevate output via liquidity, but dissipate within 5 years.
- Permanent monetary shocks significantly undermine long-term growth ( $-1.1\%$  effect), primarily through investment destabilization.

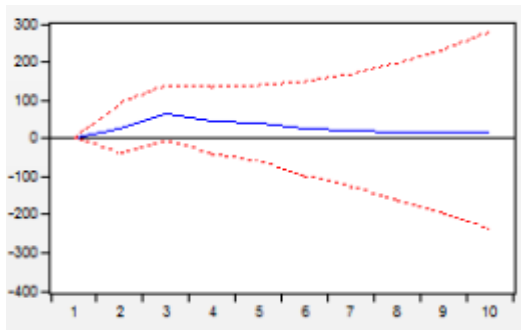


Figure 1: Impulse Response of Agricultural Growth to a One-Standard-Deviation Temporary Monetary Shock

Source: Research findings

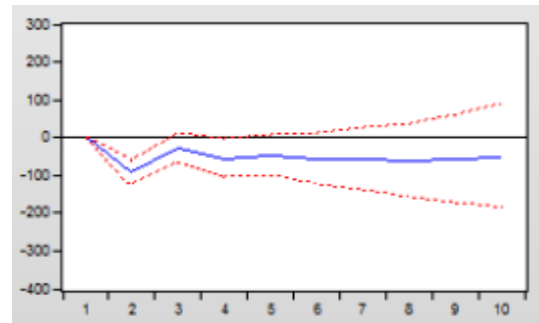


Figure 2: Impulse Response of Agricultural Growth to a One-Standard-Deviation Permanent Monetary Shock

Source: Research findings

### Investment Trajectory

- Both shock types depress real agriculture investment:
  - Permanent shocks:  $-2.3\%$  decline in gross fixed capital formation.
  - Temporary shocks: initial fall followed by recovery—investment remains 5–7 % below trend.
- Impulse Response Functions reveal investment disruption persists for 8–10 years post-shock.

The robustness of these findings is supported by stationarity diagnostics, cointegration tests (Johansen), and model stability checks (CUSUM, CUSUMSQ). The significance of estimated coefficients ( $p < 0.05$ ) in both VECM and ARDL frameworks confirms long-run equilibrium relationships and valid short-run dynamics. The impulse response analysis further reveals the temporal persistence of shocks, particularly in capital formation. These results underscore the asymmetric transmission of monetary policy, warranting differentiated treatment of temporary vs. permanent shocks in agricultural policy design.

## Conclusions and Outlook

This analysis highlights a critical policy dilemma: monetary expansions may stimulate short-term labor uptake but impair long-run investment and sustainable land use. To reconcile these effects, we strongly propose the following integrated policy portfolio:

### 1. Monetary Calibration via a Dual-Peak Rule:

Anchor monetary policy around projected inflation targets ( $\leq 8\%$ ), deploying temporary monetary easing only during agricultural planting/harvesting seasons, and withdrawing liquidity swiftly to prevent inflation entrenchment.

## 2. Monetary–Fiscal Coordination:

Channel central bank lending into green credit lines, subsidized via the National Development Fund, earmarking 20–30 % of agrarian credit to precision irrigation, organic inputs, and drought-resistant crops. These loans should be repayable over 10–15 years with interest rates below real inflation.

## 3. Institutional Innovation in Risk Mitigation:

Launch inflation-indexed agricultural bonds in local markets to hedge farmers and rural investors. Strengthen crop insurance systems, linking coverage to R&D investment outcomes.

## 4. R&D-Driven Productivity Surge:

Leverage the proven elasticity coefficient ( $\sim 0.35\text{--}0.45$ ) of agricultural R&D by allocating 1 % of agricultural GDP annually to extension services, water-saving technology, and climate-resilient crops.

## 5. Sustainable Water and Soil Governance:

Tax irrigation volumes and reallocate subsidies toward water-efficient infrastructure and soil conservation projects, financed via natural resource-based sovereign funds.

These measures, collectively, can transform monetary policy into a catalyst for resilient, sustainable agricultural growth, balancing short-run stabilization with long-run ecological integrity and food security. Thus, when monetary policy is designed in a targeted, time-bound, and agriculture-aligned manner, it can evolve from a purely stabilizing instrument into a strategic lever for resilient and sustainable agricultural growth under economic and environmental uncertainty.

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