



Food politics in China: How strengthened accountability enhances food security

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ABSTRACT

As the locus of political power, state is widely acknowledged to play an important role in achieving Sustainable Development Goals, particularly in food security. However, the means through which states can harness their power to enhance food security, particularly in developing countries, has yet to be thoroughly explored. This paper addresses this gap by examining the effects of enhanced accountability on food security, and investigating how it can operationalize food security goals into enforceable directives for lower-tier officials, with a focus on China. Utilizing the implementation of the “provincial governor responsibility system for farmland protection and grain production” as a natural experiment and employing a difference-in-difference strategy, we demonstrate that main grain-producing areas (MGPA), whose governors’ promotion is more tightly linked to food producing, experience a more significant increase in grain sowing areas when compared to other provinces. The results are robust facing a series of robustness checks. Additionally, by considering the dispatch of central inspection team, political cycle, and governor’s tenure as the sources of variations in accountability, we confirm that the key mechanism at play is the accountability inherent in China’s nomenklatura system, rather than alternative economic incentives. The back-of-the-envelope calculation demonstrates the increased grain production caused by strengthened accountability could meet the basic food needs of at least 8.76 million people annually. Our findings highlight that crafting tailored policies based on different political systems to strengthen official accountability is of great significance for better governance of food security.

1. Introduction

Despite extensive efforts, global hunger and malnutrition continue to pose a significant challenge, with food insecurity remaining a pressing issue (FAO, 2017). While the trade-driven global food system mitigates food supply challenges in nations with scarce farmland, its primary focus on profit generation precipitates detrimental environmental outcomes, including land degradation, deforestation, and water pollution—exacerbated by unsustainable agricultural methods (Chappell, 2018; Gerber et al., 2013; Hertel and Baldos, 2016; Krausmann and Langthaler, 2019). Furthermore, disruptions stemming from trade disputes, pandemics, and conflicts like the Russo-Ukrainian war have intensified the strain on the food system (Fan et al., 2021). The world is nearing a pivotal juncture, where the longstanding paradigms of the food regime are showing increasing signs of dysfunction. In response, the FAO (2021) advocates for a transition towards food autonomy and localized systems. Localization entails re-establishing connections between producers and consumers via short supply chains and direct

marketing (Zhong et al., 2023). Initiatives such as The New Urban Agenda and The Milan Urban Food Policy Pact highlight the significance of local food provision and sustainable land use for agriculture to bolster food security (MUFPP (Milan Urban Food Policy Pact), 2015; UN-Habitat, 2017).

Nations globally have adopted diverse strategies to safeguard farmland and enhance food security through the localization of food provision. Western countries typically employ a neoliberal framework supported by regulatory and legal instruments to manage these issues (Baritau et al., 2016; Leach et al., 2020). In contrast, China has cultivated a distinct approach within its unique politico-economic context, focusing on administrative accountability to govern food security. This strategy represents a marked departure from Western methodologies, highlighting the diversity in global approaches to food system governance.

In Western nations, public policy interventions frequently employ a combination of legislative and planning instruments to manage farmland use and food security (Bengston et al., 2004; Daniels and Lapping,

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2005; Devaney, 2016; Perrina and Nougaredes, 2022). For example, France has enacted legislation aimed at the long-term preservation of agricultural land, establishing protected zones through official decrees that render alterations difficult (Perrina et al., 2018). Similarly, the provincial government of British Columbia has implemented the Agricultural Land Reserve (ALR), which restricts development on agriculturally viable land using a zoning-based approach (Newman et al., 2015). Economists and planners advocate for government intervention in land use through zoning as an effective means to minimize externalities. Local governments employ farmland protection plans to evaluate and safeguard crucial agricultural areas, establishing objectives and crafting tailored implementation strategies. These include agricultural zoning, buffers, right-to-farm ordinances, and the transfer or purchase of development rights, alongside mitigation requirements and cluster or conservation development rules (Ngqangashe et al., 2022). Additionally, agricultural subsidies and market-oriented policies are extensively utilized to enhance grain production (Rada, 2015). Governments provide substantial financial incentives to farmers, supporting the acquisition of necessary inputs, equipment, and machinery, and integrating crop insurance programs to mitigate risks. Concurrently, policies aimed at improving market access and fostering international trade are implemented. These involve reducing trade barriers, promoting fair competition, and offering comprehensive market information and support to farmers (Brown et al., 2020; Alston et al., 2009).

In China, the localization of the food system is intimately connected to administrative boundaries spanning multiple levels of governance (Zhong et al., 2020). The government has enacted specific administrative measures, assigning the responsibility for implementing central government initiatives that promote food system localization to provincial and municipal authorities. This approach has been focused on ensuring food self-sufficiency, marked by stringent policies on farmland preservation and food security. Provincial authorities are tasked with distributing quotas for farmland conservation and grain production to municipal levels. Nonetheless, this framework initially lacked a defined system for assessment or monitoring. In terms of farmland protection, a significant stride was made in 2005 when the State Council issued the Number One Document, which introduced a provincial-level government accountability system emphasizing reforms to enhance farmland management and quality control. Subsequently, in 2015, the General Office of the State Council released the Assessment Measures for the Performance Evaluation of Provincial Governors on the Food Security Responsibility System, mandating annual evaluations of the adherence to this system by provincial governors. The integrated approach of these initiatives demonstrates the proactive stance of the Chinese government in addressing both farmland protection and food security, emphasizing the necessity for ongoing assessment, accountability, and reform to maintain critical farmland resources and ensure a stable food supply.

Accountability, a crucial political tool in China's authoritarian regime, is measured by officials' performance in farmland protection and grain production. This metric is intimately linked to their chances for promotion, operating within the complex dynamics that govern promotional mechanisms in hierarchical structures (Bo, 1996; Fang et al., 2023). Administrative leaders from lower-level departments vie for promotion by excelling in quantifiable metrics (Gong, 2010; Wang, 2019). Efforts are intensifying to reinforce the primary responsibility of local authorities for food security, enhance grain production assessments, and prioritize grain production in local work plans and performance evaluations (Zhong, 2023). This approach raises critical questions about the effectiveness of accountability frameworks in governance. Despite extensive research, significant gaps remain in understanding how accountability specifically contributes to food security in transitional countries. Exploring how accountability impacts farmland protection and boosts grain production is crucial for improving food security outcomes. Moreover, given the prevalence of de facto one-party rule in many regions, it is vital to understand how accountability affects these outcomes, highlighting the importance of examining its

impact in such governance contexts.

This paper examines the intricate relationship between accountability and its effects on farmland preservation and grain production within China, essential components for ensuring food security. Employing the provincial governor responsibility system for farmland protection and food security as a natural experiment, our difference-in-differences analysis demonstrates a significant increase in grain sowing areas in main grain-producing areas (MGPA)—regions where governors' career progression is closely tied to grain production—compared to other provinces. Our findings are robust, substantiated by various tests including the use of alternative dependent variables, data from multiple levels, special samples, political connections, and a matching approach. Further analysis incorporating the influence of central inspection teams, political cycles, and governors' tenure as variables for accountability variation confirms that the primary mechanism influencing outcomes is the accountability inherent in China's nomenklatura system, rather than alternative economic incentives. Collectively, our results indicate that local cadres, tasked with land and grain management, significantly enhance food security through the structured accountability present within the Chinese nomenklatura system.

Our study makes several contributions to the scholarly discourse on accountability. First, it diverges from the prevailing research that predominantly emphasizes accountability's role in achieving visible political gains that spur economic growth (Su et al., 2012). Instead, our focus shifts to the often-overlooked area of food security. Second, employing a political economy framework, we examine the logic underlying farmland preservation and grain production, thus broadening the scope of accountability theory's application. This not only addresses the limitations found in Western models that rely on market mechanisms to secure food safety but also introduces new interpretive perspectives and substantiated evidence concerning the motivations of officials in transitional regimes. Third, we elucidate how top-down accountability fosters food localization in a transitional state, enhancing our comprehension of anti-neoliberal food governance frameworks. By exploiting the temporal depth of our dataset, we conduct a comparative analysis of two key implementations of the responsibility system in China, occurring in 2005 and 2015, periods marked by significant shifts in China's personnel and governance structures. Furthermore, our analysis explores how accountability objectives are transmitted across different government tiers, from provincial to prefectural and county levels, providing a multi-scalar assessment. Methodologically, we utilize a principal identification strategy, supported by three auxiliary approaches, to verify the mechanisms through which accountability operates.

2. Institutional background and hypothesis development

2.1. Governing food security through responsibility system

The governance of food security in China is primarily manifested in the aspects of farmland quantity and grain cultivation. The quantity of farmland serves as the foundation for grain production; however, it is essential to ensure the proportion of grain within the crop planting structure to effectively guarantee grain yield. Firstly, a stringent responsibility system of farmland protection was established to ensure the quantity of farmland in 2005. However, despite this safeguarding, the phenomenon of non-grain use of farmland has become increasingly prominent. The implementation of the responsibility system of grain production in 2015 then encompasses a crucial aspect, namely the assurance of the farmland area for grain crops. These two initiatives constitute significant components of the responsibility for food localization in China, whereby provincial governments are entrusted with the implementation of these major initiatives from the central government.

2.1.1. Responsibility system for farmland protection

China's top-down land planning system serves as a robust

mechanism for the protection of farmland and control of non-agricultural land growth. Under this system, the central government establishes targets and guidelines for farmland protection, which are then cascaded down to local governments for implementation. This top-down approach ensures a unified and coordinated effort to preserve farmland throughout the country.

Since the emergence of the 1990 s, the implementation of land finance strategies has generated substantial fiscal revenues, both budgetary and extra-budgetary, which not only mitigated local financial crises from 1994 onwards but also served as a driving force behind accelerated economic growth. However, these strategies have also given rise to a significant challenge, characterized by extensive land conversion projects leading to the loss of valuable farmland. Between 1996 and 2003, over 6 million square kilometers of farmland were converted for industrial and housing use, precipitating a decline in food production from 512 million tons to 430 million tons. In response to these dual crises, the State Council enacted new policies aimed at safeguarding farmland and promoting agricultural and rural development. Subsequent to the year 2000, several significant policy shifts witnessed a greater concentration of power in the central government through the intensification of centralized supervision over land use. As part of this process, the first step involved the introduction of a policy in 2005 to assess provincial governments' performance in relation to farmland protection. Following this, a dedicated agency, known as the Supervisor of State Land, was established in 2006, comprising nine regional offices, with the primary responsibility of overseeing and evaluating provincial-level governments' efforts in protecting farmland.

The issuance of the Number One Document by the State Council in 2005 further emphasized the need for reform in managing and enhancing the quality control practices surrounding farmland. At that time, official data estimated the nationwide stock of farmland to be approximately 1.83 billion mu. It is noteworthy that the '1.8 billion mu farmland preservation' policy marked the initial attempt to adopt a farmland preservation quota as a pivotal evaluation criterion for cadre performance in China. This quota-oriented territorial management within the framework of cadre evaluation illustrates the authoritative operations of the Chinese Communist Party (CCP). Local cadres exercise considerable authority over land-use decisions within their jurisdictions, under the pressure of upward accountability and performance-driven cadre management, facilitated through mechanisms including hierarchical operation, inter-jurisdictional competition, and territorial management tied to cadre performance evaluation (Chien, 2015): (1) Through a hierarchical operational approach, performance accountability is subcontracted vertically, cascading down one administrative level, which allows for streamlined decision-making and implementation processes. (2) Inter-jurisdictional competition, operating horizontally, serves as a potent motivator for local leaders to not only fulfill but surpass their designated responsibilities, driving innovation and effectiveness in achieving targets. (3) The utilization of quota-oriented territorial management, known as "zhi biao shu di hua guan li," is intrinsically linked to the evaluation of cadres' performance, ensuring a structured and results-driven approach to land-use governance.

2.1.2. Responsibility system for grain production

Since the 1990 s, the overall grain output in China has experienced fluctuations and ceased to increase. Consequently, in the Government Work Report of March 1995, the government proposed the intention of implementing a provincial governor responsibility system to ensure food security. The key components of this system include assigning provinces as regional areas, with provincial governors responsible for the entire system. The objective is to achieve a balance between grain demand and supply, maintain stability in the grain market, and focus on stable production by increasing total grain output, ensuring stability in grain resources through proper procurement, establishing a gradual grain

storage system for stability, and maintaining price stability through interregional grain adjustments.

Although this system has led to short-term improvements in grain production and positively impacted the balance between supply and demand, it relies on administrative measures rather than market-driven approaches. This conflict with the ongoing development of a market economy has resulted in issues of hoarding by various government levels and hindered grain circulation. Consequently, the "rice bag" provincial governor responsibility system has gradually been abandoned.

The grain security provincial governor responsibility system, implemented in 2015, is a continuation of the previous "rice bag" provincial governor responsibility system. It further clarifies the authority and responsibility of provincial-level governments in areas such as grain production, distribution, and consumption. A notable feature of this system is the introduction of a quantitative assessment mechanism that specifies the responsibilities, scope, and evaluation criteria for the responsible entities.

With regards to grain production, the emphasis is placed on ensuring the stability of farmland area, regulating the balance between converting agricultural land to non-agricultural use, and avoiding non-grain use of farmland. At the provincial level, due to variations in resource endowments and industrial development among provinces, the assessment of the grain security provincial governor responsibility system assigns different values to each province based on their production targets. It is noticeable that all provinces in China are divided into main grain-producing areas (MGPA) and non-main grain-producing areas (NMGPA). MGPA are designated by the government as key zones for producing staple grains, while NMGPAs might have less favorable conditions for large-scale grain farming. Accordingly, there are significant differences between MGPA and NMGPAs in the quantitative assessment system. For instance, the maintenance of farmland is given a score of 7 for MGPA and 6 for NMGPAs. The fulfillment of grain planting acreage and production targets earns a score of 5 for MGPA and 3 for NMGPAs, respectively. The assessment results are categorized into four levels: excellent, good, qualified, and unqualified. Provinces that perform well are commended while those deemed unqualified are required to rectify their shortcomings, with the main responsible individuals subject to discussions if rectification is incomplete. Rewards and punishments are determined based on the ranking, and assessment results serve as important criteria for the selection and appointment of leadership positions.

2.2. Unlocking the power of accountability for food security within nomenklatura system

The nomenklatura system is a crucial starting point to understand the accountability and governance in China. This system, drawing inspiration from the Soviet model, serves not only as a mechanism for appointment but also as a tool for ideological alignment and policy implementation across various levels of government (Burns, 2019). At its core, the Nomenklatura system is a hierarchical network of positions and the individuals who fill them, controlled by the CPC. It encompasses a wide array of positions, ranging from high-ranking government officials to managers in key state-owned enterprises and institutions (Chan, 2004). The central feature of this system is the control exercised by higher levels of the party over appointments to these positions. This control extends beyond mere appointment; it involves close monitoring and evaluation of performance, adherence to party policies, and political loyalty (Landry et al., 2018). This interconnectedness ensures a top-down approach in governance, where adherence to the CPC's policy goals is a prerequisite for career advancement, thus fostering a governance culture deeply entrenched in accountability and performance. Superiors oversee and evaluate task outcomes, implementing rewards or penalties accordingly. This hierarchical monitoring system is

exemplified by reported cases, such as that of former Deputy Governor of Yunnan Province, Cui Maohu, investigated for unauthorized land use for performance projects, underscoring the repercussions for inadequate farmland protection efforts.¹ At the time when Zhao Zhengyong, then Secretary of the Shaanxi Provincial Party Committee, was removed from his post, the leaders of the Shaanxi Provincial Department of Natural Resources convened a meeting to deploy measures to strengthen the prohibition of the occupation of farmland, strictly enforce the farmland protection system, and use the former Secretary Zhao Zhengyong as a negative example to promote reform through case study.

Within the Nomenklatura system, the principle of accountability is characterized by a top-down approach, where officials are accountable primarily to their superiors within the party hierarchy (Mei and Pearson, 2014). To fulfill objectives pertaining to food security, provincial administrations typically implement a tiered responsibility system for farmland protection and grain production. This system, resonating with national assessment protocols, tailors a precise set of indicators for prefecture-level cities to evaluate and enhance farmland conservation and grain output. Concomitantly, prefecture cities cascade this evaluative framework to the county level, ensuring accountability permeates through the administrative hierarchy. Contemporary reports indicate a surge in instances where local officials face censure for dereliction of duty regarding the safeguarding of farmland and the restriction of its non-grain use. For instance, in Hunan Province of China, supervisory bodies such as the Discipline Inspection and Supervisory Authorities have intensified oversight and have investigated multiple instances of illegal occupation and the unauthorized non-grain use of basic protected farmland. Consequently, pertinent leading officials have been held accountable for these infractions.² Such trends underscore the rigorous enforcement measures and punitive mechanisms enacted by superior governmental tiers. This form of accountability is distinct in its focus on political and ideological alignment with the CPC's objectives. Furthermore, the accountability is also deeply embedded in performance-based evaluation system. Economic development, implementation of reforms, and maintenance of social order are typical benchmarks for evaluating an official's performance. For example, plenty of scholars have found that the promotion of local officials is tightly associated with the economic development in their jurisdictions (Li and Zhou, 2005; Landry et al., 2018). While policies like environmental protection are found to have a "one-vote veto" power in the promotion of officials in the recent decade (Tang et al., 2021). This has led to a governance culture where quantitative metrics often dominate over qualitative assessments, incentivizing officials to focus on visible achievements.

In response to the growing prominence of food security issues, the Chinese central government has begun to reassess its traditional emphasis on economic development as the primary criterion for performance evaluations (Wang, 2019). Within the realm of food security, the nomenklatura system provides a distinctive framework for enforcing accountability. This system mandates that provincial governors, particularly in Major Grain Producing Areas (MGPA), align their actions with central directives that focus on farmland protection and grain output. The responsibility imposed on provincial governors acts as a form of performance-based governance, where success in farmland protection and grain production serves as key performance indicators. Consequently, we posit that the responsibility system fosters a more targeted and outcome-oriented approach to food security. This is especially relevant in MGPA, where the connection between grain production and the career progression of governors is most pronounced.

Therefore, we posit the following hypothesis and the whole theoretical and empirical framework is shown in Fig. 1.

Hypothesis: The establishment of accountability mechanisms can

effectively safeguard food security through the augmentation of farmland protection and grain production. Empirically, MGPA are supposed to have more significant increase on the grain sowing areas after the implementation of responsibility system.

3. Data and methods

3.1. Data

The data used in this paper comes from multiple sources. First, we obtained data on grain sowing area, education level, urban per capita disposable income, rural per capita net income, fertilizer usage, agricultural machinery input and other variables for each province between 2002–2020 through China Statistical Yearbooks. Secondly, in terms of grain output data, we calculated the grain output using data from CropWatch bulletin, which is based mainly on remotely sensed data (<https://cloud.cropwatch.com.cn/>). The data on grain sowing area for prefecture-level cities and counties were sourced from the dataset "ChinaCropArea1km" (Luo et al., 2020). Third, the data of MGPA is from National Food and Strategic Reserves Administration. Specifically, there are 13 MGPA among 31 provinces. Figure A1 from Appendix presents the geographical distribution of these MGPA provinces. Fourth, the detailed information of provincial governors comes from websites. Specifically, we first determine the names of provincial governors according to the almanac of a province. Then we search the name in Google and Baidu to find their curriculum vitae, according to which we code the features of a leader.

Before conducting a rigorous regression analysis, we present some preliminary evidence to support the claim that strengthening accountability has a significant impact on food security. In Fig. 2, we divide provinces into two groups based on whether they are MGPA or not and plot the average grain sowing areas in each group from 2002 to 2020. Two key findings emerge from Fig. 2. Firstly, it is unsurprising that grain sowing areas are more substantial in the MGPA group than in the NMGPA group. Secondly, we observe that the gap between the grain sowing areas in these two groups becomes more pronounced after two-fold implementation of the responsibility system. For instance, while trends were similar before the responsibility system of grain production initiated in 2015, divergence occurred once provincial governors' assessments became linked to grain output. That is, while the grain sowing areas decrease in NMGPA group after 2015, the grain sowing areas significantly increased in MGPA group. To sum up, Fig. 2 provides an intuitive and compelling indication that accountability plays an essential role in maintaining food security.

3.2. Methods

To identify the effect of strengthening accountability, we utilize the following difference-in-difference (DID) model:

$$\text{GrainSowingArea}_{it} = \alpha_0 + \beta_1 \text{MGPA}_i * \text{Year}_{2005-2015} + \beta_2 \text{MGPA}_i * \text{Year}_{2015-2020} + \Theta X_{it} + \xi_i + \theta_t + \mu_{it}$$

In this specification, the subscript i , t refers to province i in year t , respectively. The dependent variable, $\text{GrainSowingArea}_{it}$, is the natural logarithm of the grain sowing area in province. MGPA_i equals 1 if province i is the main grain production area and 0 otherwise. $\text{Year}_{2005-2015}$ and $\text{Year}_{2015-2020}$ are two dummy variables which are assigned a value of 1 if the observation is within the time period of 2005–2015 or 2015–2020, respectively. X_{it} represents a set of control variables, including production costs of food, fertilizer usage, level of mechanization in grain production, cultivated land area per capita, education level of peasants, and urban-rural income gap. We control province and year fixed effects through ξ_i and θ_t respectively. This generalized DID setting ensures that β_1 and β_2 accurately capture the effects of the farmland protection and grain production responsibility

¹ https://www.ccdi.gov.cn/yaowenn/202308/t20230830_289553.html.

² https://www.sxfj.gov.cn/jing_cai_zhuan_ti/620523/43694d/222261617.shtml.

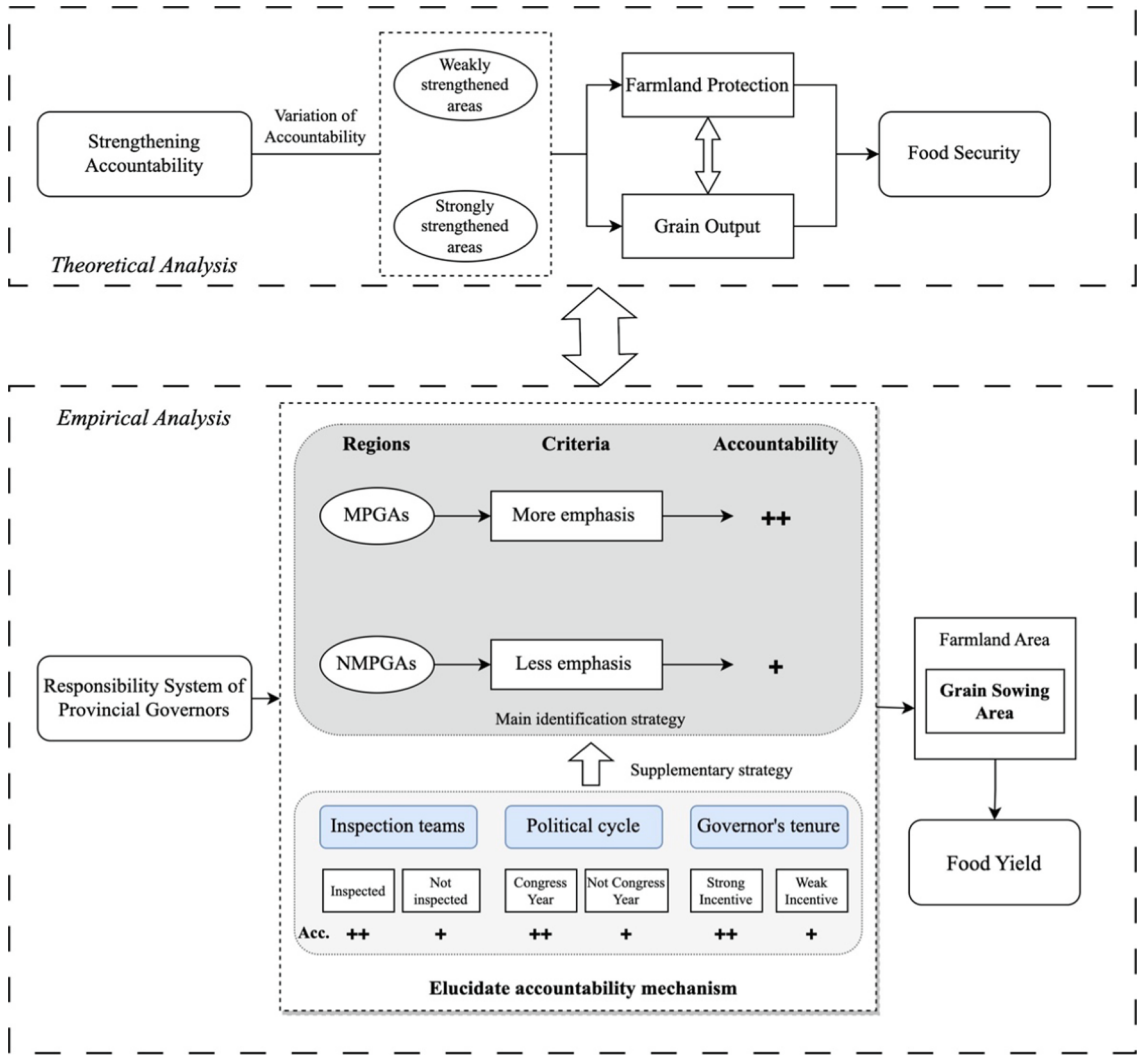


Fig. 1. Theoretical and empirical framework.

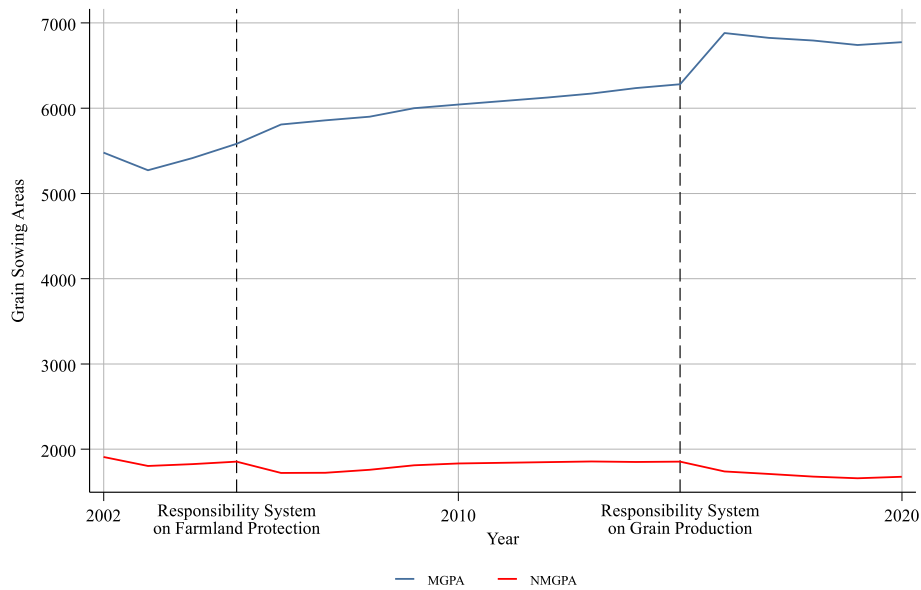


Fig. 2. Grain sowing area in MGPA and NMGPA group.

system. If the strengthening of accountability contributes to food security, we expect both β_1 and β_2 to be positive. μ_{it} is the standard error which is clustered at province level.

4. Empirical results

4.1. Baseline results

Table 1 presents the estimated impact of strengthened accountability on grain sowing area. To ensure the reliability of our findings, we utilized stepwise regression analysis. Initially, we regressed the logarithm of grain sowing area on an interactive term between MGPA and a dummy variable indicating post-strengthening accountability while controlling for year and province fixed effects only. In subsequent analyses, from column (2) through column (6), we incrementally incorporated additional control variables pertinent to each province. Notwithstanding minor fluctuations, the coefficients for both the $MGPA * Year_{2005-2015}$ and $MGPA * Year_{2015-2020}$ interaction terms stabilized, consistently manifesting significant positivity at a minimum threshold of 5 %. This indicates that linking farmland protection and food security to provincial governors' assessments is highly effective in increasing grain sowing area. Additionally, our analysis discerns a more pronounced impact stemming from the 2015 emphasis on grain production compared to the 2005 focus on farmland protection. For instance, as evidenced in column (6), the coefficients of 0.123 and 0.396 respectively indicate that stringent assessment standards for provincial governors correlate with a 12.3 % and 39.6 % increase in grain sowing areas within MGPA provinces. Overall, Table 1 compellingly demonstrates the efficacy of both policy measures, while concurrently highlighting the 2015 policy — with its direct focus on grain production — as particularly effective.

4.2. Event study

In addition to the static specification, we use the following dynamic specification to show whether the parallel trend assumption holds in our analysis. The dynamic specification is shown as follows:

$$GrainSowingArea_{it} = \alpha + \sum_{k=-3}^{k=15} \gamma_k MGPA_i * Year_k + \Theta X_{it} + \xi_i + \vartheta_t + \mu_{it}$$

where the outcome variable and fixed effects are the same as the baseline specification. We replace the traditional difference-in-difference term with $\sum_{k=-3}^{k=15} \gamma_k MGPA_i * Year_k$, a set of dummy variables that indicate the policy was or will take effect from 2002 to 2020. Using the year 2004 as the baseline, k spans from -3 to 15 , excluding -1 .

The results of the dynamic effect analysis are shown in Fig. 3, where we plot the point estimates and 95 % confidence intervals of γ_k . Consistent with the parallel trend assumption, we find that none of the coefficients are positively and statistically significant before the initiation of the responsibility system. This observation suggests that our baseline estimates are not confounded by pre-existing differences between MGPA and NMGPAs. Notably, following the implementation of the farmland protection responsibility system in 2005, a significant increase in grain sowing area is observed in MGPA compared to NMGPAs. This trend remains statistically significant throughout the 2005–2015 period. The introduction of the grain production responsibility system in 2015 further amplified this effect, with MGPA exhibiting continued progress in increasing grain sowing area. Overall, Fig. 3 reinforces our baseline findings.

4.3. Robustness checks

To validate the robustness of our baseline findings, we implemented

several additional tests. First, we explored alternative metrics for measuring grain sowing area, including the absolute value of grain sowing area, its proportion relative to the total cropped area (encompassing cash crops, tea, cotton, etc.), and the logarithm of this proportion. These variations are systematically analyzed and their results are consolidated in Table 2. Across these alternative dependent variables, our analysis consistently reveals a significantly positive impact of the farmland protection and grain production responsibility systems. This uniformity in outcomes across diverse measures reinforces the robustness of our baseline results, indicating that our conclusions are not dependent on the specific choice of dependent variables.

Secondly, we excluded certain special samples from our analysis, which are categorized into two distinct groups. The first part includes autonomous regions of ethnic minorities (AREM) and municipalities that are directly administered under the central government (DAM). Previous studies have highlighted that the political economy environment in these provinces differs significantly from other provinces. For instance, officials in AREMs are evaluated mainly based on criteria such as ethnic unity and social stability, while top leaders from DAMs are considered rising stars in the political arena (Wu, 2014). After excluding these areas, as shown in the first three columns in Table 3, we observed only slight modifications in the coefficients of our difference-in-difference terms. Importantly, the significance of these terms persisted regardless of the exclusion of DAM or minority regions. The second part of special samples comprises provinces that receive abundant grain planting subsidies from central government. Due to the appealing subsidies, there is a possibility that farmers may be encouraged to cultivate grains on their land, leading to potential bias in our findings. For instance, Li and Lin (2022) documented that Inner Mongolia, Heilongjiang, Liaoning and Jilin received considerable subsidies for producing grains between 2016 and 2019. To address this issue, we have excluded these four provinces in the last columns in Table 3. Despite this exclusion, the coefficients continue to closely mirror our baseline results, suggesting that our findings are not unduly influenced by these subsidies.

Our third set of robustness checks employs both prefecture- and county-level datasets to examine the impact of the introduction of the responsibility system on grain sowing areas, acknowledging that policy implementation permeates multiple layers of China's administrative structure. We utilize the ChinaCropArea1km dataset, which gleams information from long-term phenological records observed at agricultural meteorological stations, underpinned by the GLASS LAI remote sensing product (Luo et al., 2020). This data enables us to construct prefecture- and county-level panel data. The Difference-in-Differences (DID) results are presented in Table 4. We find that the patterns discerned from both the prefecture- and county-level data align closely with the baseline results. This consistency underscores the significant impact of the enhanced accountability mechanisms, which were introduced in tandem with the responsibility system, on the area devoted to grain sowing.

Fourth, we consider the political connections in provincial leader's reactions to the strengthening of accountability. Previous studies have pointed out that political connections are more important after one moves up to the provincial level (Landry et al., 2018). Therefore, if politically connected cadres tend to be appointed in grain producing provinces and are more incentivized to promote food security, then it would confound the estimated effect of accountability on the increase of grain sowing areas. To address this concern, we conduct two parts of analysis. The first is to examine whether the baseline results change after controlling the effect of political connections. To accomplish this work, we follow the method proposed by Jiang (2018) and construct a dummy variable indicating whether the provincial leader is politically connected. Specifically, a provincial leader is identified as political connected if she/he was first promoted to a provincial leadership position (as party secretary or governor) when the General Secretary is in power.

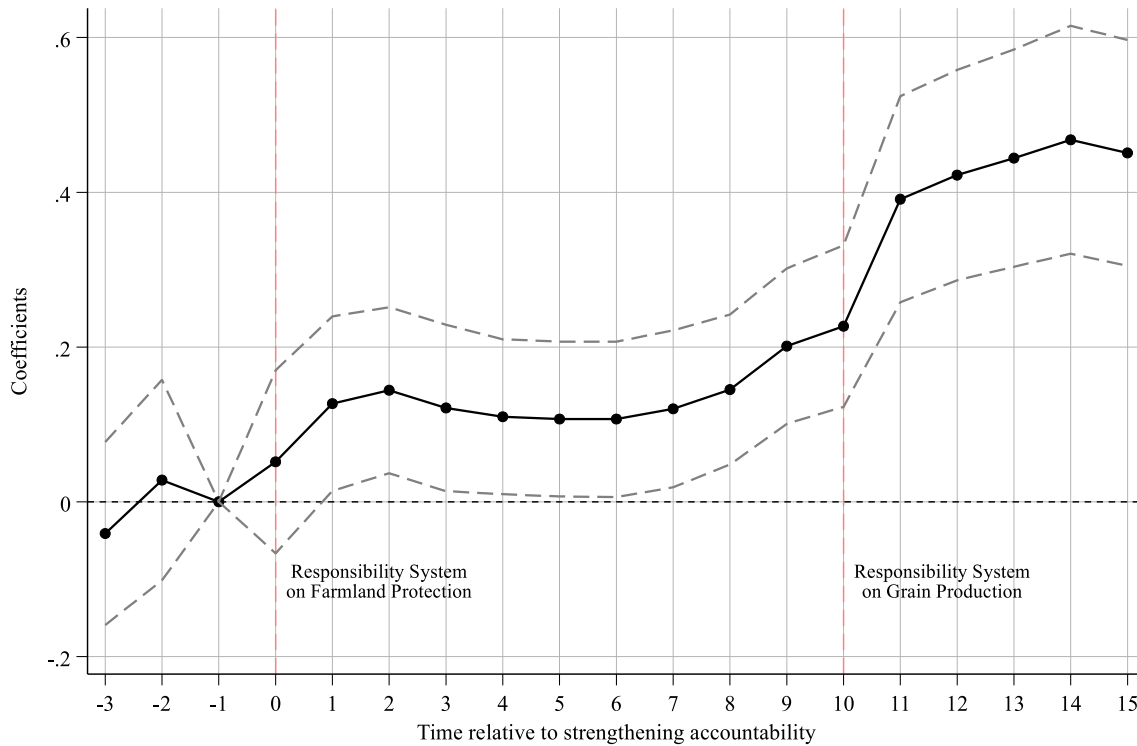
Table 1

Baseline results.

Dependent Variable	Grain sowing area (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.102** (0.040)	0.082 (0.067)	0.082 (0.067)	0.116** (0.047)	0.126** (0.048)	0.123** (0.049)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.349*** (0.088)	0.320*** (0.083)	0.316*** (0.083)	0.391*** (0.089)	0.402*** (0.088)	0.396*** (0.086)
Production costs		0.203 (0.368)	0.196 (0.378)	0.082 (0.267)	0.111 (0.266)	0.094 (0.250)
Education			−0.050 (0.074)	−0.066 (0.054)	−0.057 (0.050)	−0.059 (0.048)
Urban-rural income gap				−0.988* (0.507)	−0.936* (0.503)	−0.890* (0.468)
Fertilizer					0.112 (0.104)	0.149 (0.117)
Machinery					−0.066 (0.072)	−0.061 (0.075)
Cultivated land area per capita						0.052 (0.076)
Constant	7.663*** (0.019)	6.652*** (1.833)	6.794*** (1.997)	8.399*** (1.122)	8.183*** (1.203)	7.865*** (1.459)
Year Fixed Effect	YES	YES	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Observations	570	570	570	570	570	570
R-squared	0.989	0.989	0.989	0.991	0.991	0.991

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Fig. 3.** Event Study.

The results after controlling political connections are reported in Table 5. We can find that the coefficients of DID terms are only slightly changed before and after controlling political connections of party secretaries and governors. To exclude the potential selection bias caused by political connections, our second part of work is to test whether political connections do have impact on the appointment to MGPA. The results

using Logit and Probit model are reported in Table A1, which suggests that political connections have no significant impact on the appointment results of officials to MGPA or NMGPAs. Taking together, these two analyses confirm the baseline results are unlikely biased by political connections.

Fifth, we use a subsample of provinces with different statuses of

Table 2

Robustness checks: change dependent variable.

Dependent Variable	Grain sowing area		Proportion of grain sowing area		Log(proportion)	
	(1)	(2)	(3)	(4)	(5)	(6)
MGPA*Year ₂₀₀₅₋₂₀₁₅	628.794*** (201.416)	691.217*** (145.883)	0.034** (0.015)	0.035** (0.013)	0.089 (0.059)	0.101 (0.061)
MGPA*Year ₂₀₁₅₋₂₀₂₀	1,453.874*** (414.759)	1,474.807*** (306.598)	0.085*** (0.026)	0.085*** (0.022)	0.332*** (0.101)	0.348*** (0.109)
Constant	3,322.434*** (102.206)	3,564.963 (2,842.626)	0.262*** (0.007)	0.462 (0.425)	-1.684*** (0.023)	-1.027 (1.583)
Control Variables	NO	YES	NO	YES	NO	YES
Year Fixed Effect	YES	YES	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Observations	570	570	570	570	570	570
R-squared	0.982	0.984	0.958	0.959	0.960	0.961

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 3**

Robustness checks: drop special samples.

Dependent Variable	Grain sowing area (logged)			
	DAMs	AREMs	DAMs + AREMs	Four subsidizing provinces
	(1)	(2)	(3)	(4)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.153*** (0.039)	0.083 (0.056)	0.137*** (0.039)	0.101* (0.050)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.359*** (0.089)	0.372*** (0.084)	0.363*** (0.093)	0.324*** (0.082)
Constant	11.220*** (1.573)	7.782*** (1.461)	9.238*** (1.499)	8.151*** (1.418)
Control Variables	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES
Observations	494	494	418	494
R-squared	0.992	0.993	0.993	0.991

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 4**

Robustness checks: using city- and county-level dataset.

Analysis Level Dependent Variable	Prefecture-level Grain sowing area (logged)		County-level	
	(1)	(2)	(1)	(2)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.201*** (0.035)	0.255*** (0.044)	0.178*** (0.019)	0.156*** (0.022)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.197*** (0.056)	0.270*** (0.068)	0.230*** (0.029)	0.248*** (0.034)
Constant	6.660*** (0.015)	8.208*** (1.047)	4.309*** (0.008)	4.224*** (0.451)
Control Variables	N	Y	N	Y
Jurisdiction FEs	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	7,420	5,327	57,980	40,347
R-squared	0.955	0.942	0.928	0.905

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

MGPA and NMGPAs but are similar as possible in other dimensions. To achieve this, we have employed a propensity score matching approach to minimize the systematic differences in firm characteristics apart from whether a province is an MGPA or not. We have used the same covariates as control variables in the baseline regressions to obtain the

Table 5

Robustness checks: control political connections.

Dependent Variable	Grain sowing area (logged)		
	(1)	(2)	(3)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.122** (0.050)	0.123** (0.049)	0.121** (0.050)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.395*** (0.086)	0.395*** (0.086)	0.393*** (0.087)
Party Sec. Connected	0.016 (0.024)		0.017 (0.025)
Governor Connected		-0.006 (0.017)	-0.009 (0.019)
Constant	7.827*** (1.439)	7.856*** (1.456)	7.812*** (1.435)
Control Variables	Y	Y	Y
Province FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	570	570	570
R-squared	0.991	0.991	0.991

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 6**

Balance table before and after matching.

Variable	Matched	Treated	Control	%bias	t-test	t
Production costs	U	5.09	4.97	43.8	5.16	0.000***
Education	M	5.03	5.05	-6.1	-0.56	0.577
	U	2.10	2.16	-13.9	-1.61	0.109
Urban-rural income gap	M	2.15	2.12	5.4	0.53	0.596
	U	3.59	3.92	-16.4	-1.94	0.053*
Fertilizer	M	3.82	3.77	2.3	0.21	0.835
	U	4.10	3.55	26.2	3.11	0.002***
Machinery	M	3.79	3.82	-1.7	-0.16	0.876
	U	6.39	6.65	-12.8	-1.52	0.129
Cultivated land area per capita	M	6.60	6.54	3	0.27	0.785
	U	0.96	1.08	-71.1	-8.12	0.000***
	M	1.00	1.01	-3.3	-0.34	0.737

matched sample. The balancing test results after matching are presented in Table 6. Our findings indicate that there are no significant differences between the two groups (MGPA and NMGPAs) regarding covariates after matching, which confirms the effectiveness of matching. The regression results based on the matched samples can be found in Table 7. Similar to our baseline results, we discovered that linking farmland protection and grain production with provincial governors' assessment has a

Table 7

Robustness checks: matched sample.

Dependent Variable	Grain sowing area (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.128*** (0.045)	0.181*** (0.064)	0.171** (0.064)	0.171** (0.065)	0.187*** (0.064)	0.189*** (0.064)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.315*** (0.088)	0.374*** (0.094)	0.358*** (0.097)	0.362*** (0.101)	0.392*** (0.099)	0.400*** (0.101)
Constant	7.712*** (0.022)	9.591*** (1.138)	9.688*** (1.124)	9.779*** (1.124)	9.791*** (0.934)	10.656*** (1.278)
Year Fixed Effect	YES	YES	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Observations	332	332	332	332	332	332
R-squared	0.994	0.994	0.994	0.994	0.995	0.995

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.significantly positive effect on grain sowing area.³

In our final robustness check, we conducted placebo tests by randomly assigning MGPA status among the sample provinces. The objective of this test was to ascertain whether the observed increase in grain sowing area can be attributed specifically to the responsibility system imposed on provincial governors. If the responsibility system is indeed the causal factor, the randomly assigned 'treatment' group should not exhibit a significant effect on grain sowing areas. For this test, provinces were randomly designated as MGPA, ensuring a rigorous evaluation. To bolster the reliability of our findings, this random sampling process was replicated 500 times, and the Difference-in-Differences (DID) model was applied to each of these samples. The results of this extensive placebo testing are illustrated in Fig. 4. The figure clearly shows that the distribution of coefficients for the responsibility system on farmland protection and grain production is predominantly centered around zero. This lack of significant impact from the random assignment of MGPA status strongly indicates that the actual driver of increased grain sowing area is the specific modification in the assessment criteria for provincial governors, lending further credence to our hypothesis.

5. Mechanisms

5.1. Verification of accountability mechanisms

After discovering that incorporating farmland protection and grain production into the assessment system for provincial governors has a significant impact on grain sowing area, we adopt three supplementary strategies to further affirm the increase in grain sowing area in MGPA is due to strengthened accountability (Fig. 1). The first strategy leverages the natural experiment stemming from the deployment of inspection teams by the Central Commission for Discipline Inspection (CCDI). These teams, dispatched without prior notice, aim to uncover and address not only corruption at the local level but also non-compliance with central directives. Previous studies have indicated that local leaders tend to more stringently adhere to central government directives when subjected to these inspections, given their influence on career advancements (Tian and Tsai, 2023). Therefore, if the increase of grain sowing area is a reaction to the strengthening of accountability, we suppose provincial governors would more aggressively increase the grain sowing area to meet the policy intentions of the central government.

To accomplish this empirical examination, we first verify the link between the dispatch of inspection teams and food security prior to

2015. If the underlying mechanism is accountability, we anticipate that the strengthening accountability accompanied by inspection teams, even without the introduction of responsibility system on food production in 2015, will also lead to the disparity of the grain sowing area between MGPA and NMGPAs.⁴ Considering that the timing of inspections varies across provinces, we adopt the method proposed by De Chaisemartin and d'Haultfoeuille (2020) which considers the heterogeneous treatment effects on the estimation results. The results are detailed in Table 8. Consistent with our hypothesis, we find that compared with NMGPAs, MGPA see significant increase of grain sowing area if there is inspection team stationing at the province. The placebo estimators DID_M^{pl} and $DID_M^{pl,2}$, which verify the parallel trends assumption following the placebo test methodology proposed by De Chaisemartin and d'Haultfoeuille (2020), is not significantly different from zero. This indicates that the parallel trend hypothesis also holds in the framework of De Chaisemartin and d'Haultfoeuille (2020).

Next, we further add the introduction of responsibility system on food production on the basis of inspection teams by focusing on the full sample spanning from 2002 to 2020. The reasonability of this design is that the dispatch of inspection teams could be viewed as an external shock of strengthening accountability, and the introduction of responsibility system on food production further strengthens accountability, which allow us to more convincingly elucidate the underlying mechanism. Therefore, a triple-difference framework is adopted.⁵ The details of triple-difference method are presented in Appendix B. Table 9 presents the results of triple-difference estimation. In columns (1) and (2), we examined the interaction of inspection teams with the respective responsibility systems for farmland protection and grain production. Columns (3) and (4) amalgamate these two policies, focusing solely on the interaction with inspection teams. Our findings reveal that the deployment of inspection teams correlates with an increase in grain sowing area. Specifically, provinces hosting inspection teams exhibited a 5 % increase in grain sowing area compared to those without such teams. This observation supports the hypothesis that direct oversight from the central government incentivizes local authorities to prioritize food security, thereby affirming the role of accountability in this context.

The second supplementary strategy in our analysis examines the influence of the political cycle inherent in Chinese Communist Party.

³ Before conducting the DID with the matched sample, we also tests the parallel trend assumption using the event study framework. The results are reported in Figure A2 in the Appendix.

⁴ In the practice, inspection teams had included the farmland protection and food production as key focuses of their supervision. For example, during the central inspection in Inner Mongolia in 2014, it was pointed out that there were problems with inadequate protection of farmland in the region. As a result, 38 cases were investigated and 32 individuals were dealt with.

⁵ Before conducting triple-difference estimation, we have confirmed the parallel trend assumption based on the framework proposed by Olden and Møen (2022).

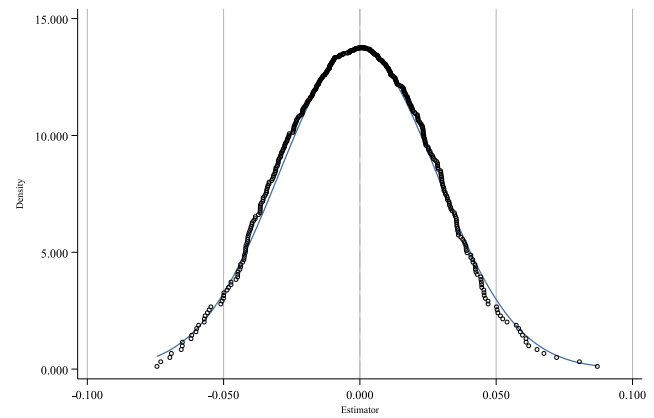
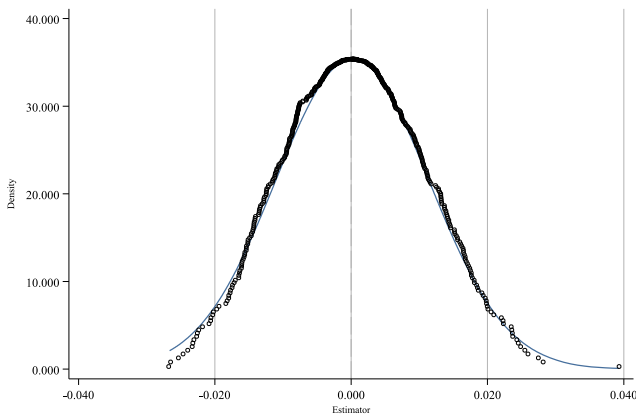


Fig. 4. Placebo test.

Table 8

Effect of inspection teams on grain sowing area.

	Estimate	Standard error	LB (95 % CI)	UB (95 % CI)
DID_m	0.036	0.018	0.002	0.071
DID_M^1	0.016	0.009	-0.002	0.034
$DID_M^{1,2}$	0.012	0.007	-0.002	0.025

Notes: The results are estimated based on de Chaisemartin and D'Haultfoeuille (2020) method and data prior 2015.

Table 9

Mechanism: inspection teams.

Dependent Variable	Grain sowing area (logged)			
	(1)	(2)	(3)	(4)
MGPA*Year ₂₀₀₅₋₂₀₁₅ *Inspection	0.022 (0.030)	0.051* (0.028)		
MGPA*Year ₂₀₁₅₋₂₀₂₀ *Inspection	0.050** (0.022)	0.052** (0.021)		
MGPA*Year ₂₀₀₅₋₂₀₂₀ *Inspection			0.039* (0.021)	0.051*** (0.018)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.100** (0.040)	0.119** (0.049)	0.098** (0.040)	0.119** (0.049)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.331*** (0.087)	0.379*** (0.086)	0.335*** (0.084)	0.379*** (0.083)
Inspection	0.010 (0.019)	0.000 (0.017)	0.010 (0.019)	0.000 (0.017)
Constant	7.661*** (0.019)	7.897*** (1.451)	7.661*** (0.019)	7.898*** (1.453)
Control Variables	NO	YES	NO	YES
Year Fixed Effect	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES
Observations	570	570	570	570
R-squared	0.989	0.991	0.989	0.991

Note: All composite terms are added in this interaction models. Robust standard errors clustered at province are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Given that the Party conducts its National Congress every five years—a time characterized by significant personnel changes and heightened aspirations for promotion—we scrutinized this period's potential impact on provincial governance. Prior research has linked these congress years to various policy and administrative shifts, such as in investment (Zou, 1991), coalmine accidents (Nie et al., 2013), tax-break policies (Chen and Zhang, 2021), and land transfer (Chiang et al., 2022). We hypothesized that if provincial governors are indeed accountable for boosting grain production, this responsibility would be particularly emphasized during National Congress years. To investigate this, we introduced a dummy variable, denoted as PC, to flag observations coinciding with National Congress years between 2002 and 2020. Specifically, PC is set to 1 for years aligning with the 17th Congress (2007), the 18th Congress

(2012), and the 19th Congress (2017). Following a similar approach as in the analysis presented in Table 9, we adopt the triple-difference framework. The triple interaction aimed to assess both the independent and combined effects of the two responsibility systems during Congress years. The analysis was structured with the independent effects tested in the initial columns and the combined effects in the latter columns in Table 10. The results show significantly positive coefficients for the triple interaction terms, indicating an intensified focus on increasing grain sowing area during these politically pivotal years. This finding is consistent with our accountability hypothesis, suggesting that provincial governors exhibit heightened efforts to ensure increased grain sowing areas in years critical for career advancement.

The third strategy is inspired by the competition for promotion among provincial leaders in the Chinese Communist Party's personnel structure. Given that provincial governors often aspire to ascend to higher positions such as provincial party secretaries or central government ministers, their career trajectories are of great interest. However, as Pang et al. (2018) note, only a fraction of governors attain such promotions. Jiang (2018) further observes that a governor's likelihood of promotion dwindles markedly if not achieved within three years of their tenure. This timeframe has hence become a focal point in empirical studies assessing the career prospects of provincial governors (Lu et al., 2022).

We theorize that governors who have exceeded a three-year term and

Table 10

Mechanism: using political cycle to elucidate the strengthening of accountability.

Dependent Variable	Grain sowing area (logged)			
	(1)	(2)	(3)	(4)
MGPA*Year ₂₀₀₅₋₂₀₁₅ *PC	0.010 (0.008)	0.011 (0.010)		
MGPA*Year ₂₀₁₅₋₂₀₂₀ * PC	0.029*** (0.008)	0.026* (0.013)		
MGPA*Year ₂₀₀₅₋₂₀₂₀ * PC			0.016** (0.007)	0.016** (0.006)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.100** (0.040)	0.121** (0.048)	0.099** (0.039)	0.120** (0.048)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.344*** (0.088)	0.391*** (0.085)	0.346*** (0.088)	0.393*** (0.085)
Constant	4.123*** (0.014)	6.518*** (0.779)	4.123*** (0.014)	6.519*** (0.778)
Control	NO	YES	NO	YES
Year Fixed Effect	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES
Observations	570	570	570	570
R-squared	0.989	0.991	0.989	0.991

Note: All composite terms are added in this interaction models. Robust standard errors clustered at province are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11

Mechanism: using governor's tenure as a source of promotion incentive.

Dependent Variable	Grain sowing area (logged)			
	(1)	(2)	(3)	(4)
MGPA*Year ₂₀₀₅₋₂₀₁₅ *Tenure _{>=3}	−0.024** (0.011)		−0.017 (0.014)	
MGPA*Year ₂₀₁₅₋₂₀₂₀ *Tenure _{>=3}	−0.037** (0.016)		−0.034* (0.020)	
MGPA*Year ₂₀₀₅₋₂₀₂₀ *Tenure _{>=3}		−0.029*** (0.010)		−0.024* (0.013)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.114** (0.042)	0.116*** (0.041)	0.131** (0.054)	0.134** (0.051)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.365*** (0.088)	0.361*** (0.089)	0.411*** (0.088)	0.405*** (0.087)
Tenure _{>=3}	0.020* (0.010)	0.020** (0.010)	0.016* (0.009)	0.016* (0.009)
Constant	7.653*** (0.019)	7.652*** (0.019)	7.848*** (1.464)	7.856*** (1.460)
Control Variables	NO	NO	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES
Observations	570	570	570	570
R-squared	0.989	0.989	0.991	0.991

Note: All composite terms are added in this interaction models. Robust standard errors clustered at province are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

consequently face diminished promotion prospects might exhibit less vigor in fulfilling food security and grain production mandates. To empirically examine this hypothesis, we introduced a dummy variable to denote whether a governor's tenure exceeded three years and interacted this variable with the Difference-in-Differences (DID) term. The outcomes of this analysis are presented in Table 11. Our findings indicate that, under most conditions, the triple interaction term is negative. While not entirely consistent across all scenarios, these results provide suggestive evidence supporting the notion that it is primarily the accountability to their superiors that motivates provincial governors to enhance grain sowing areas in their jurisdictions. This lends further credence to the accountability mechanism.

5.2. Alternative mechanisms

Apart from the accountability mechanism, there may be other mechanisms contributing to the increase of grain sowing area. The inclusion of farmland protection and grain production in the assessment criteria for provincial governors could potentially create spillover effects, such as increased subsidies for grain cultivation and higher profits via regulatory measures. Consequently, it's plausible that economic motivations might drive farmers towards more active grain planting, independent of the strengthened accountability of provincial governors. To examine this alternative hypothesis, we employed a two-step method aimed at evaluating the intermediary role of economic incentives. In the first step, our objective was to ascertain whether the responsibilities regarding farmland protection and grain production led to enhanced subsidies and profits for grain cultivation. The second step involved assessing the influence of these economic factors on grain sowing area. Only if both steps yield positive results can this economic mechanism be deemed valid.

The results of this investigation are compiled in Table 12. The analysis pertaining to the subsidy mechanism is presented in columns (1) and (2), while columns (3) and (4) focus on the profit mechanism. Specifically, columns (1) and (3) correspond to the first step of our mechanism tests. Our findings reveal that integrating farmland protection and grain production into the assessment system for provincial governors does not significantly affect neither subsidies nor profits. In summary, our analysis suggests that economic incentives, namely subsidies and profits, are unlikely to be the primary drivers behind the observed increase in grain sowing area, which further consolidates our hypothesis on accountability mechanism.

Table 12

Alternative Mechanisms: economic incentives.

Dependent Variable	Subsidy effect Subsidy (logged)	Grain sowing area (logged)	Income effect Profit (logged)	Grain sowing area (logged)
	(1)	(2)	(3)	(4)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.040 (0.078)		−0.038 (0.026)	
MGPA*Year ₂₀₁₅₋₂₀₂₀	−0.077 (0.111)		0.008 (0.038)	
Log(subsidy)		−0.208*** (0.046)		
Log(grain income)				0.215 (0.133)
Constant	4.341*** (1.237)	5.552*** (0.384)	−0.423 (0.670)	5.501*** (0.372)
Control Variables	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Province Fixed Effect	YES	YES	YES	YES
Observations	570	570	570	570
R-squared	0.989	0.989	0.875	0.988

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table 13**

Effect on grain yield.

Dependent variable	Grain output (logged)	
	(1)	(2)
MGPA*Year ₂₀₀₅₋₂₀₁₅	0.170*** (0.062)	0.211*** (0.060)
MGPA*Year ₂₀₁₅₋₂₀₂₀	0.380*** (0.108)	0.450*** (0.098)
	(0.027)	(1.372)
Control Variables	NO	YES
Year Fixed Effect	YES	YES
Province Fixed Effect	YES	YES
Observations	570	570
R-squared	0.986	0.989

Note:

(1) Robust standard errors clustered at province are in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6. Effect of strengthening accountability on grain yielding

In our concluding analysis, we sought to quantify the impact of strengthened accountability on food security, with a specific focus on grain yields as the most direct indicator. Utilizing grain yield as the dependent variable, we applied the Difference-in-Differences (DID) model to evaluate the effectiveness of integrating farmland protection and food security into the assessment system for provincial governors. The results of this analysis are detailed in Table 13. Our findings indicate a marked difference in grain yields between MGPA provinces and their NMGPA counterparts. Specifically, after the implementation of policies centered on farmland protection and food security, MGPA provinces exhibited significantly higher grain yields. Drawing from the coefficients in column (2) of Table 13, these policies are associated with an increase of 21.1 % and 45 % in grain yields for the respective policy areas. To contextualize these percentages, consider the average grain yield of NMGPA provinces in 2004, which was 7.58 billion kilograms. Applying our findings, this translates to an incremental yield of 1.60 billion kilograms and 3.41 billion kilograms for farmland protection and food security, respectively. Using the Food and Agriculture Organization's (FAO) standard of a minimum daily energy requirement of approximately 1,800 kcal (or about 500 g of grains per person per day), these additional yields have substantial implications for food security. Specifically, the increased grain production could meet the basic food needs of at least 8.76 million people annually. Therefore, our back-of-the-envelope calculation demonstrates the significant increase in grain yields attributable to strengthened accountability, which substantially enhances China's food security.

7. Discussions and policy implications

This paper presents compelling empirical evidence supporting the efficacy of top-down food localization governance strategies, such as the responsibility system of farmland protection and grain production, in augmenting food security. In contrast to the procedural and rule-based approach prevalent in Western administrative practices (Von Braun, 2009), China's food security governance adopts a logic of administrative contracting within its public administration framework. The successful implementation of national policies on farmland protection and food security assurance hinges upon the extent to which local organizational structures effectively execute them. This necessitates the concerted efforts of governments at various levels and related functional departments within the hierarchical system. The zealous enforcement of farmland protection and food production regulations by local governments is principally motivated by their pursuit of political achievements, as well as the pressure and task-based administrative work model that exists between different levels of government. To enhance policy clarity, the responsibility system establishes precise assessment metrics, with quotas for farmland protection and grain production being allocated by provincial administrations to city (municipal) governments. Reinforcing the top-down accountability is a performance management system that connects the implementation of food security governance measures with the career prospects of government officials. Our study findings uncover that due to career incentives, senior officials are motivated to monitor farmland protection and grain production through the performance management system, while state agents are driven to conserve farmland and expand the area dedicated to grain cultivation in order to meet performance targets. In the absence of electoral accountability within transitional states, it is indeed evident that top-down accountability can effectively facilitate the execution of food security policies. The United Nations Food Systems Summit (UNFSS) has formulated numerous plans and frameworks to address the most critical challenges confronting food systems (Willett et al., 2019). The Editors of the Global Food Security Journal eloquently underscore the paramount importance of accountability to ensure that the UNFSS does not merely amount to empty rhetoric (Covic et al., 2021). A top priority lies in establishing an

accountability mechanism that effectively monitors the fulfillment of commitments and actions undertaken at the Summit. China's accountability system, which potentially translates objectives into tangible action 'on the ground,' may serve as an exemplary reference for other countries.

However, the concurrent policy imperatives of the central government—namely, economic expansion and farmland conservation—necessitate a balancing of interests during the local authorities' policy enactment phase. The Chinese context, with its pronounced reliance on land-based fiscal strategies, renders this particularly pertinent. Farmland forms the cornerstone of local governments' land finance systems, which operate on the principle of leveraging land for developmental progress. Despite the central government's institution of a rigorous land regulation framework centered on farmland safeguarding, local governments frequently engage in a nuanced negotiation with central mandates, propelled by the strong impetus for economic advancement. The incentives for professional advancement, advocating land finance, are intricately linked with the 'land use risks' posed by stringent land regulations, thus creating a perverse incentive for local authorities. This results in an emphasis on maximising land procurement, constrained by the imperative to mitigate land use-related risks (Wang, 2019).

Besides, it is imperative to acknowledge that this administrative-led approach to farmland protection and food production has inadvertently exacerbated detrimental consequences, including irrational competition and the implementation of unreasonable administrative measures across regions. This has engendered irrational land development practices, diverting attention from food-oriented management approaches, cultivating local protectionism, and disregarding regional comparative advantages and rational resource allocation (Wang, 2019; Zhou et al., 2022). In certain instances, it has even instigated ecological crises within environmentally vulnerable areas. A critical aspect to bear in mind is that farmers stand as the primary actors in grain cultivation, driven by a fundamental behavioral logic centered on maximizing household benefits. Engaging in cash crop cultivation aligns with their economic rationality within this framework. However, when confronted with performance assessment pressures from higher-level government entities, local governments often resort to compulsory interventions or enhanced subsidies to incentivize grain cultivation (Hao et al., 2023; Zhou, 2007). Through the formulation of targets, local governments delegate the responsibility of grain cultivation to grassroots township governments and village committees, encompassing a pivotal element in performance evaluation within rural areas. These administrative villages serve as the most immediate implementers and enforcers of government directives, relying on higher-level administrative powers and their own authority to forcibly promote grain cultivation and fulfill superior objectives. For instance, according to news reports, a farmer in Guidong County, Hunan Province, cultivated 1.5 mu of ginger on his contracted land, only to have it eradicated by the township government and other departments before maturity. Government staff responded with an explanation stating that this was done to fulfill the superior mandates of eliminating the non-grain use of farmland in order to stabilize grain production tasks.⁶ Consequently, farmers become the ultimate subjects of government orders. These administrative mandates distort the planting behavior that farmers would naturally adopt under market mechanisms, consequently increasing transaction costs (Rogers et al., 2021).

The aforementioned discussions illuminate two types of policy dilemmas: on the one hand, the economic growth and farmland preservation that local governments grapple with, and on the other, the food security that is of mutual concern to both central and local governments, as well as the livelihoods of farming households. These complexities help to elucidate why the accountability system instituted in 2005 was

⁶ <https://www.163.com/dy/article/I49PKTDI0534A4SC.html>.

less effective than the one revised in 2015. Initially, in contrast to managing farmers' activities, the stringent implementation of farmland protection—under the premise of contradictory expectations with economic development—yielded a lower level of proactivity from local governments. Particularly prior to 2015, China was in the midst of rapid urbanization and industrialization, requiring substantial land for local development. After 2012, President Xi placed a high emphasis on farmland protection and food security, elevating their political priority and thereby intensifying accountability measures. Existing research indicates that the frequency of vocabulary pertaining to farmland protection and grain production in governmental work reports from both local and central authorities has been consistently on the rise, with a particularly marked increase post-2012, especially following the introduction of the responsibility system of grain production in 2015 (Gan et al., 2023). This trend signifies a gradual intensification of political priority, accompanied by a more centralized management approach to reinforce oversight of food security.

The policy implications are clear. Compared to MGPA, NMGPAs lack sufficient incentives for farmland preservation and ensuring grain production (Vivero-Pol, 2017). Optimization of assessment indicators, based on NMGPAs' agricultural conditions, is crucial. This would effectively motivate NMGA officials to actively address food security concerns, especially given the heightened risks of land occupation and marginalized grain production in these regions. While top-down accountability measures have enhanced food security, they lack a bottom-up feedback mechanism, as previously mentioned. This contradiction between coercive administrative interventions and farmers' choices leads to social problems. Addressing this requires establishing a bottom-up feedback mechanism that continuously improves assessment indicators based on feedback, thus reconciling conflicting administrative intentions and farmers' interests. Under the promotion tournament mechanism, officials should strive for a competitive advantage in horizontal rankings rather than merely meeting prescribed assessment indicators. However, this may engender mounting pressure and data falsification. Thus, it is imperative to determine assessment indicators reasonably and set different ranges based on regional conditions. Strengthened supervision by the central government, employing remote sensing satellites to monitor indicators like cultivated land area and planting area, is vital.

China's responsibility system for managing food security establishes precise action targets, providing actionable evidence to stakeholders. This enables governments to hold accountable for driving transformative changes in the food system. The collaboration of experts from 27 academic institutions, non-governmental organizations, and UN agencies from various continents has reached a consensus: the importance of good governance in food systems has never been greater, and monitoring plays a vital role in supporting this endeavor (Fanzo et al., 2021). China's establishment of systematic accountability mechanisms through monitoring and evaluation potentially provides an excellent model for governing the food system.

Unlike China's state-driven model, Western food policy might benefit from integrating elements of governmental oversight within its market-oriented framework. This could involve the introduction of accountability measures for key stakeholders in the agricultural sector, potentially leading to a more robust and responsive food security system. Such integration could balance the efficiency of market mechanisms with the strategic direction and oversight that government policies can provide, especially in times of crisis or fluctuating market conditions.

Additionally, the incentive structures of officials' promotion in China that have effectively motivated increased grain production offer a template for Western nations. By designing incentive mechanisms that

align the interests of farmers, agribusinesses, and other stakeholders with national food security goals, Western countries can potentially enhance their agricultural productivity. This approach necessitates a careful examination of the political and economic contexts within which Western food policies operate, including the role of democratic accountability, the influence of agribusinesses, and the impact of international trade agreements. Furthermore, the study invites Western policymakers to explore innovations in policy design and implementation, such as public-private partnerships or community-based initiatives that blend market efficiency with governmental oversight. In conclusion, while the contexts in China and Western countries are markedly different, the lessons from Chinese food policy underscore the potential for governance and accountability to play a more integral role in Western food security strategies, adapting to their unique political and economic landscapes.

8. Conclusions

This paper relies on the natural experiment emerging from the “responsibility system for farmland protection and grain production of provincial governors” to interrogate the efficacy of strengthened accountability for enhancing food security. The results show that MGPA, characterized by a stronger correlation between the promotion of their governors and the success of food production, manifest a conspicuous escalation in both the expanse of farmland and the extent of grain cultivation areas vis-à-vis other provinces. This implies that enhancing accountability has the potential to mitigate the negative repercussions of decentralized food security governance. We have also ruled out the influence of factors such as economic incentives and identified that the crucial role is played by the accountability inherent in China's performance-based cadre evaluation system. By conducting a rough calculation, we have determined that the bolstered accountability measures directly contribute to increased grain production, thereby ensuring a sufficient food supply for a minimum of 8.76 million people annually. Furthermore, we discussed the concerns related to top-down accountability, such as the adverse effects of irrational competition, detrimental forced interventions affecting farmers' interests, and the problem of data falsification. To tackle these challenges, we put forward pertinent strategies for mitigation and resolution.

CRedit authorship contribution statement

Yingnan Zhang: Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Shenghua Lu:** Writing – review & editing, Writing – original draft, Software, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Appendix A. Supporting figures and tables

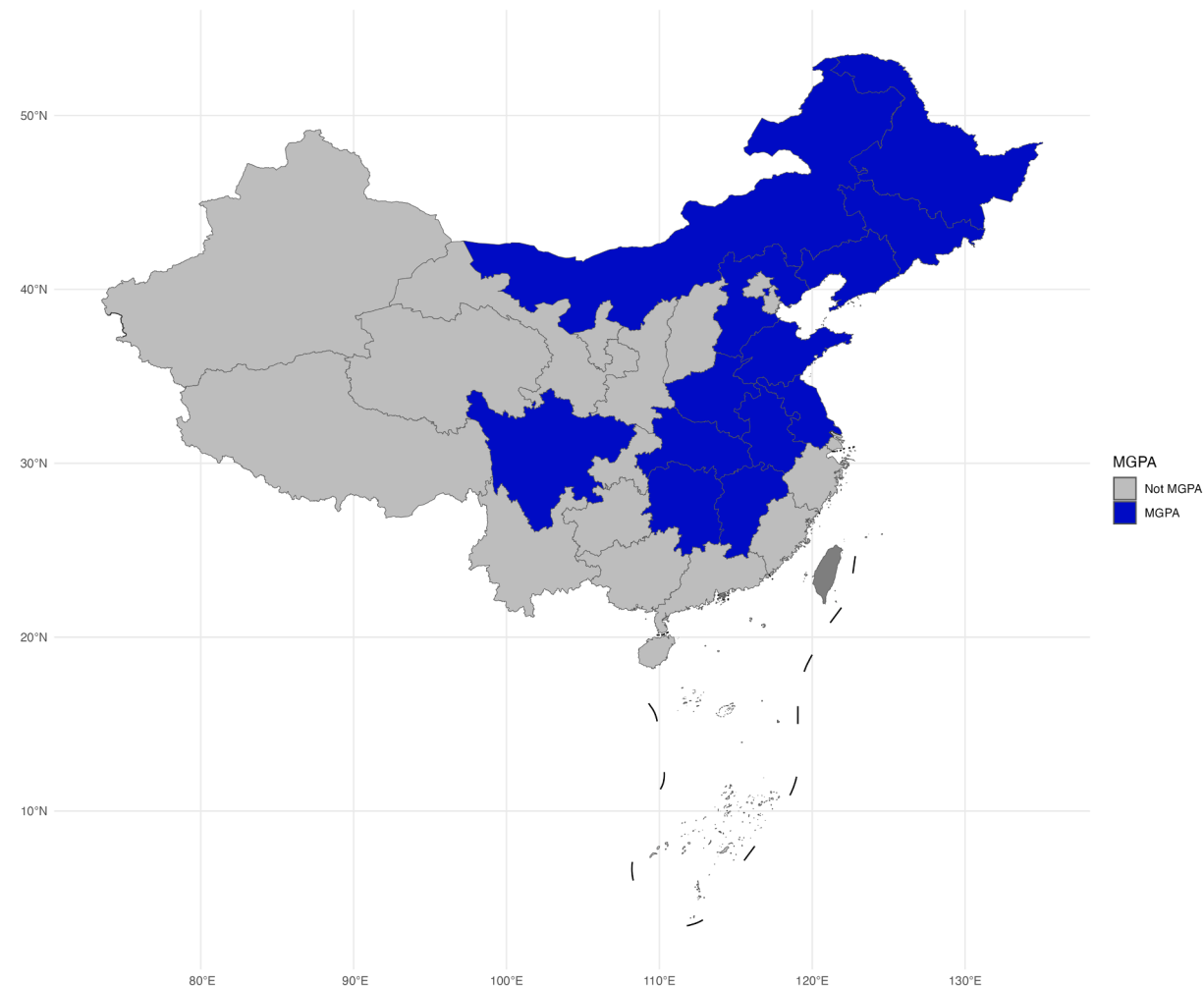


Fig. A1. Distribution of MGPAs in China. *Notes: This figure is produced using the standard map with the approval number GS(2024)065 from The Ministry of Natural Resource.*

Table A1
Effect of political connections on appointment to MGPA.

Dependent Variable	MGPA = 1 Logit (1)	(2)	Probit (3)	(4)
Party Sec. Connected	0.073 (0.281)		0.028 (0.166)	
Governor Connected		0.290 (0.263)		0.181 (0.158)
Control Variables	YES	YES	YES	YES
Observations	570	570	570	570

Note: Robust standard errors clustered at province are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

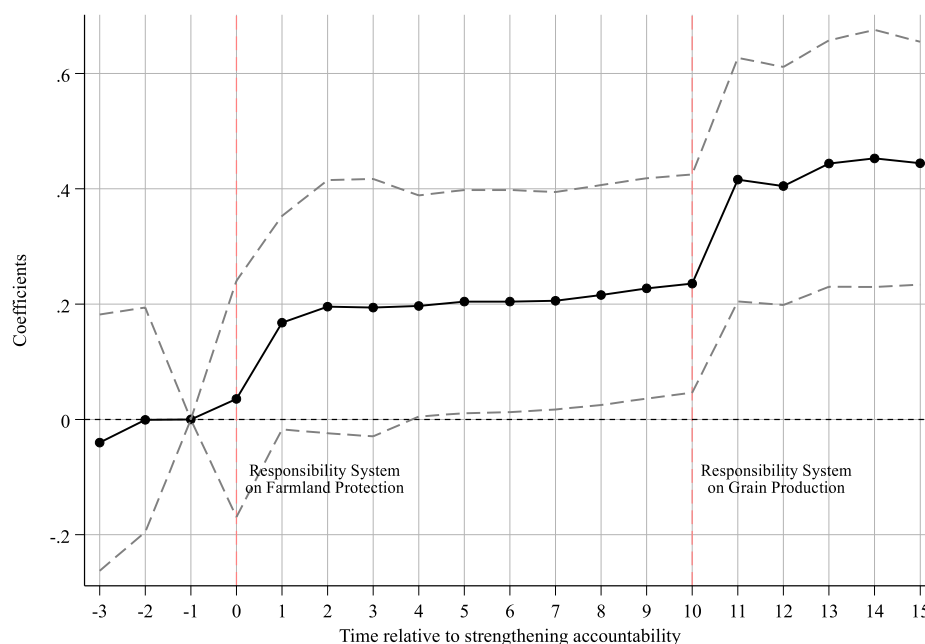


Fig. A2. Event study using matched samples

Appendix B. Details of triple difference framework

We introduce how triple-difference framework is adopted to affirm the underlying mechanism is accountability. The reasonability of this design is that the dispatch of inspection teams could be viewed as an external shock of strengthening accountability, and the introduction of responsibility system on food production further strengthens accountability. Therefore, the triple-difference framework could be presented as follow:

$$\text{GrainSowingArea}_{it} = \alpha_0 + \beta_1 \text{MGPA}_i * \text{Responsibility}_t * \text{Inspection}_{it} + \beta_2 \text{MGPA}_i * \text{Responsibility}_t + \beta_3 \text{MGPA}_i * \text{Inspection}_{it} + \beta_4 * \text{Responsibility}_t * \text{Inspection}_{it} + \beta_5 \text{Inspection}_{it} + \theta X_{it} + \xi_i + \vartheta_t + \mu_{it}$$

In this triple-difference setting, the coefficient of $\text{MGPA}_i * \text{Responsibility}_t$, β_2 , captures whether the introduction of responsibility system has more significant effect on grain sowing area in MGPA (baseline), and after controlling all the relative interactive terms, the coefficient of $\text{MGPA}_i * \text{Responsibility}_t * \text{Inspection}_{it}$, β_1 , elucidate whether the grain sowing area further grows due to there is inspection teams stationed. If both β_1 and β_2 are significantly positive, we could more convincingly draw the conclusion that the underlying mechanism is accountability. It is worth noting that the term of $\text{MGPA}_i * \text{Inspection}_{it}$ is omitted since all the inspection teams are dispatched after 2005, which makes this term be absorbed by $\text{MGPA}_i * \text{Responsibility}_t * \text{Inspection}_{it}$. The results are presented in Table 9 in the revised manuscript. As predicted by the accountability theory, both β_1 and β_2 are statistically significant, affirming the role of strengthening role of accountability in maintaining food security.

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