Postprint: Current Status, Problems, and Countermeasures of Crop Rotation and Fallow of Cultivated Land in Jiangxi Province

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Abstract

Currently, all localities nationwide are actively advancing the pilot implementation of the cultivated land crop rotation and fallow system in accordance with the strategic deployment proposed by the Party Central Committee and the State Council to "explore the implementation of pilot programs for the cultivated land crop rotation and fallow system." To facilitate further research and policy development in Jiangxi Province and other regions with similar conditions, and to provide references for the implementation of crop rotation and fallow pilots, this paper investigates the current status of cultivated land crop rotation and fallow in Jiangxi Province through literature research and field investigations, analyzes the existing problems, and proposes relevant countermeasures. The findings indicate that: crop rotation on cultivated land in Jiangxi currently features low proportional area, diverse modalities, broad geographical distribution, and significant benefits, while fallow is currently mainly implemented through two methods: returning farmland to forest/grassland and leisure fallow. Concurrently, the study identifies that current crop rotation in Jiangxi faces issues including limited scale, suboptimal modalities, inadequate management, and low economic returns, while fallow practices are predominantly passive, with problems such as inappropriate areal allocation, unsuitable land selection for fallow, monolithic approach, non-standardized cycles, and insufficient compensation. In response to these issues, countermeasures for promoting the pilot implementation of the provincial cultivated land crop rotation and fallow system in the future are proposed: (1) enhance publicity and education to improve farmer awareness; (2) develop scientific plans with categorized implementation; (3) delineate clear boundaries and strengthen management; (4) improve infrastructure and establish demonstration sites; (5) establish reasonable compensation standards to safeguard farmers' interests; (6) increase financial investment and develop human capital.

Full Text

Introduction

On October 29, 2015, the "Proposal of the Central Committee of the Communist Party of China on Formulating the 13th Five-Year Plan for National Economic and Social Development" explicitly called for "exploring the implementation of pilot programs for a cultivated land rotation and fallow system" in China [1]. This was further elaborated in the Central No. 1 Document of December 31, 2015, "Opinions of the CPC Central Committee and the State Council on Implementing New Development Concepts to Accelerate Agricultural Modernization and Achieve Comprehensive Moderately Prosperous Society Goals" [2], which proposed exploring pilot programs through rotation, fallow, conversion to forest/grassland, and alternative planting to comprehensively manage groundwater funnel areas, heavy metal pollution zones, and regions with severe ecological degradation. On June 24, 2016, ten ministries and commissions jointly issued the "Pilot Program for Exploring the Implementation of a Cultivated Land Rotation and Fallow System" [3-4], outlining overall requirements, pilot regions, technical pathways, subsidy standards, and safeguard measures, marking the formal launch of China' s pilot program.

As the saying goes, "All things grow from the soil, and food originates from the land." While continuous cropping can increase grain yields in the short term, it creates numerous long-term problems. Previous research [5-6] has shown that prolonged high-intensity cultivation leads to declining farmland quality, shallow plow layers, and soil acidification. Therefore, implementing rotation and fallow pilots is critically important. Existing studies have extensively covered this topic: Chen et al. [7] argued that establishing a rational rotation and fallow system maintains soil fertility and promotes sustainable agricultural development, while Liu et al. [8] suggested that such systems enhance farmland productivity, protect ecological environments, and improve agricultural competitiveness. However, research specifically on Jiangxi Province' s rotation and fallow status remains scarce. This study employs literature review and field investigation methods to examine the current situation, challenges, and appropriate countermeasures for cultivated land rotation and fallow in Jiangxi, providing theoretical foundations for implementation in the province and similar regions.

1. Current Status of Rotation and Fallow in Jiangxi

1.1 Rotation Status

Rotation represents the "essence" of China' s traditional agriculture [9] and a key technique of intensive cultivation, widely practiced throughout history. Recent field investigations reveal several distinct characteristics of crop rotation in Jiangxi. First, the area proportion is low. Due to large rice cultivation areas (double-crop or single-crop), rotation is practiced on only 15-20% of paddy fields province-wide, meaning 80-85% of rice paddies remain under continuous rice

cropping. Upland fields show higher rates, with 30-50% under rotation, 15-20 percentage points higher than paddy fields.

Second, diverse patterns exist [11]. In paddy fields, these include: (1) Rice-cotton rotation, where long-term rice fields are converted to cotton, implementing a "fallow-rice-rice → oilseed/cotton (2-3 years) → wheat-rice-rice" multiple-cropping rotation that improves soil structure, reduces bollworm damage, and promotes both grain and cotton production, practiced in cotton regions like Yongxiu County; (2) Rice-sugarcane rotation in southern Jiangxi' s traditional sugarcane areas, where alternating between sugarcane and rice fields achieves dual yield and efficiency gains; (3) Rice-sweet potato rotation in red soil hilly areas (Yujiang, Dongxiang, Jinxian counties) where late rice is replaced with sweet potatoes under "fallow-rice-sweet potato" systems, avoiding seasonal drought (summer-autumn dry spells) while increasing food and feed crop yields. Additional patterns include rice-vegetable, rice-melon, rice-tobacco [12], rice-medicinal herb [13], rice-grass, rice-fish, rice-duck (integrated rice-duck systems), rice-shrimp, rice-frog, rice-seedling (trees), rice-flower, and rice-fruit rotations. Upland fields support even more crop types, creating more diverse rotation systems.

Third, distribution is widespread [14]. Rice-cotton rotation dominates northern Jiangxi' s Jiujiang region, rice-sugarcane rotation is common in southern areas, rice-fish rotation is widely distributed around Poyang Lake, rice-tobacco rotation is concentrated in Xiajiang, Anfu, and Xingguo counties, rice-medicinal herb rotation is mainly found in Zhangshu City, and rice-vegetable rotation occurs primarily in suburban and township peripheries. Fourth, benefits are evident. As a soil-conserving practice adopted worldwide [15], rotation not only maintains or increases yields but also reduces weed infestation [16]. Compared with continuous cropping, early rice yields increase by 9.15% on average and late rice by 5.96% [17]. Rotation also enhances soil microbial activity, increasing beneficial microorganisms while reducing harmful ones [18].

1.2 Fallow Status

Fallow represents an effective means of protecting cultivated land and implementing the national strategy of "storing grain in the land and storing grain in technology." Currently, Jiangxi employs two main fallow approaches for farmland and ecological protection.

1.2.1 Conversion to Forest/Grassland Following the catastrophic floods of 1998, China launched a pilot program in 1999 in Sichuan, Shaanxi, and Gansu provinces to convert degraded farmland back to forest and grassland, fully implementing it in 2002 across 1,897 counties in 25 provinces and Xinjiang Production and Construction Corps [19]. From 1999-2016, the program converted 16.711 million hectares nationwide, including 7.0025 million hectares of farmland to forest and 9.7085 million hectares of barren hills to grassland [20]. Jiangxi officially launched its program in 2001. By 2010, the central government had

allocated 670,000 hectares for conversion, with 407,000 hectares during 2001-2005. According to a September 23, 2015 report [21], Jiangxi planned a new round of conversion covering 9,953 hectares across 28 counties in 8 prefecture-level cities, including 6,520 hectares of non-basic farmland slopes above 25° and 3,707 hectares of 15-25° slopes in key water source areas, with subsidies of 22,500 yuan per hectare. Beyond this program, Jiangxi also implemented a "returning farmland to lake" initiative around Poyang Lake, playing a crucial role in ecological protection and flood reduction.

1.2.2 Leisure Fallow Leisure fallow in Jiangxi occurs in three forms: seasonal, annual, and long-term (3-5 years or even 8-10+ years). Seasonal fallow is common, particularly as industrialization and urbanization divert rural labor, creating "fields without farmers." It includes three types: winter, autumn, and summer fallow, with winter fallow being most prominent. Research by Wang et al. [22] indicates that in 2012, southern China had 8.917 million hectares of winter fallow fields, with Jiangxi accounting for 712,000 hectares (7.98% of the southern total and 23.09% of Jiangxi' s 3.0835 million hectares of cultivated land). Recent investigations suggest Jiangxi' s winter fallow rate exceeds 70%, reaching over 90% in some areas, severely reducing winter agricultural resource utilization and productivity.

Autumn fallow affects considerable paddy area where, after early rice harvest, lack of irrigation prevents timely late rice transplanting, or where summer-autumn droughts cause poor yields, leading farmers to abandon late rice cultivation. This affects approximately 266,700-400,000 hectares. Summer fallow occurs in some areas due to labor shortages and low profitability, wasting valuable light, heat, water, and soil resources during the early rice planting season.

Annual fallow, where fields remain uncultivated for an entire year, causes compaction by humans and animals, weed infestation, and structural degradation. It affects roughly 2-3% of cultivated land, not exceeding 5%. Long-term fallow (3-10+ years) allows fields to "run wild," with weeds giving way to trees that eventually form woodlands after five years, making restoration difficult. Though not widespread, such cases exist in Jiangxi.

2. Existing Problems

2.1 Rotation Problems

Current crop rotation in Jiangxi faces four main challenges. First, the area is insufficient. With only 15-20% of paddy fields and 30-50% of upland fields under rotation, expanding these proportions to 30-40% or even 60-70% for paddies and 60-80% for uplands would fully realize rotation' s benefits for sustainable agricultural ecosystems.

Second, patterns are suboptimal. Despite diverse rotation patterns, small scale and fragmentation prevent dominant models from emerging. Achieving high-efficiency rotation requires deliberate selection and cultivation of optimized mod-

els featuring superior crop varieties, complementary combinations, advanced cultivation techniques, and integrated mechanization and standardization.

Third, management is poor. Most existing patterns suffer from extensive management practices that fail to unlock production, efficiency, and income potential, creating a situation where "rotation is easy but improving benefits is difficult." Modern agricultural technologies, particularly high-tech solutions, must be applied to maximize rotation' s potential for Jiangxi' s agricultural modernization.

Fourth, efficiency is low. Rotation theoretically delivers multiple benefits: yield increases, cost savings, soil improvement, pest and weed reduction, and enhanced economic, ecological, and social returns [23]. However, inappropriate pattern selection and poor management often prevent these benefits from materializing, resulting in underwhelming performance.

2.2 Fallow Problems

Fallow implementation in Jiangxi suffers from six key issues. First, it is predominantly passive. True fallow should be an active, positive soil-conserving measure to restore fertility, yet most fallow in Jiangxi is "passive" —resulting from labor shortages, low economic returns, or poor land quality—often simply abandoned without management.

Second, fallow area distribution is unreasonable. Winter fallow area is excessive while autumn and summer fallow areas are too small. A "3-2-1" system could be considered: 30% winter fallow, 20% autumn fallow, and 10% summer fallow.

Third, fallow fields are often inappropriate. Investigations reveal that many fallow fields have good water and fertility conditions that don' t warrant fallow, while many degraded fields that should be fallowed remain in cultivation.

Fourth, fallow patterns are too monotonous. Current "fallow" essentially means "leisure"without active soil management, leading to fertility decline and degraded soil quality. Active, diversified approaches such as tillage improvement, straw mulching, and planting green manure or legume crops would enhance soil quality for subsequent seasons.

Fifth, fallow cycles are irregular. Agricultural fallow should be short-term (one season or one year), but current farmer-initiated fallow lacks regular cycles, often extending indefinitely, which undermines stable agricultural development.

Sixth, fallow compensation is inadequate. Since current fallow is mostly spontaneous and unplanned, it receives no government support or ecological compensation. Sustainable development requires planning and economic compensation for farmers.

3. Countermeasures and Recommendations

To address these challenges and advance rotation and fallow systems under new conditions, Jiangxi should adopt the following measures.

First, intensify publicity to raise farmer awareness. Limited education leads many farmers to resist rotation and fallow, perceiving it as disruptive and income-reducing. Extensive outreach must convey the importance and necessity of these systems under China' s new economic normal, transforming traditional "high-yield, high-output" mindsets toward green, sustainable development concepts.

Second, develop scientific planning with classified implementation. As a systematic, long-term endeavor, rotation and fallow require rational planning and strict supporting measures. Pilot programs should focus on: (1) heavy metal pollution zones around mines and smelters; (2) soil erosion areas in southern mountainous slopes, northeastern red soil hills, and severely eroded lands around Poyang Lake; (3) continuous cropping obstacle zones in suburban vegetable greenhouses with excessive inputs and severe pests; (4) water-deficient drought zones lacking irrigation; and (5) non-point source pollution areas around large livestock farms. Each zone requires specific principles, standards, and technical specifications with integrated training, guidance, and implementation support.

Third, define clear scope and implement effective management. Rotation and fallow programs must identify specific areas and scales, using scientific methods for dynamic management. Representative counties, townships, and villages with solid foundations and strong capacity should be selected as pilots and developed into demonstration models for provincial and national learning, contributing to Jiangxi' s "Beautiful China" initiative.

Fourth, improve conditions and create demonstration models. Successful implementation requires enhanced agricultural infrastructure, particularly irrigation and road facilities, ensuring reliable water access and transportation. This creates the necessary conditions for effective rotation and fallow systems.

Fifth, establish reasonable compensation standards to protect farmer interests. Since land is farmers' fundamental livelihood and rotation/fallow reduces grain output and income, reasonable compensation must ensure no income reduction or livelihood disruption. Detailed subsidy standards and distribution procedures should guarantee farmers receive appropriate fallow payments. In 2016, the central government allocated 1.436 billion yuan for rotation and fallow subsidies nationwide [24], providing strong support. Jiangxi should also increase investment to ensure successful pilot implementation and expected outcomes. Additionally, talent development is crucial—training cadres and farmers, particularly rural youth, to "understand rotation, practice fallow, and achieve real results."

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Note: Figure translations are in progress. See original paper for figures.