



## Unveiling the Spatio-Temporal Characteristics and Driving Mechanisms of Non-Grain Land Use Dynamics in Agricultural Socio-Ecosystems: A Case Study of the Sichuan Basin, China

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Against the backdrop of the global heightened geopolitical tensions and climate change, the issue of food security is a major topic currently faced by countries around the globe. As the most populous country in the world, China's food security issues will impact the sustainability of global food production and supply stability. Despite the emphasis on food security and cultivated land protection, China is facing the latent threat to food production caused by the non-grain use of cultivated land, where land previously used for cultivating food crops is being extensively planted with cash crops or used for forestry development. Not only will this phenomenon increase the pressure on China's self-sufficiency in food, but it will also damage the stability of the agricultural ecosystem and weaken the sustainability of food production in the long term. As the main grain-producing area in Sichuan Province and even in western China, the Sichuan Basin has a solid agricultural foundation. In recent years, the phenomenon of non-grain use has become increasingly prominent, necessitating an exploration of its driving mechanisms and the implementation of governance measures. Set in the Sichuan Basin, this paper employed the sliding window method to continuously monitor and extract the non-grain patches between 1991-2018 in the study area based on the annual China Land Cover Dataset (CLCD). We used advanced data-driven approaches, including geographically weighted regression models and geographical detector models, to explore the direction and strength of the impact of driving factors on the non-grain phenomenon. Finally, using process tracing based on policy texts, non-grain evolution is interpreted. In conclusion, increased economic activity exacerbates non-grain use, and objective spatial positions constrain the impact of locational factors on non-grain use. Natural factors fundamentally and decisively explain the level of non-grain use. Decreased temperature and increased slope will intensify this phenomenon, and the impact of precipitation on non-grain exhibits a threshold effect. China's three agricultural structural adjustments have potentially influenced the overall trend of the non-grain phenomenon. The Wenchuan earthquake and subsequent reconstruction had a short-term impact, while the central and local government's attention to the issue of non-grain and a series of arable land protection measures are the main reasons for the sharp decrease in the non-grain phenomenon after 2015. Differentiated policy measures are recommended for mountainous and plain regions to address these socio-ecosystem changes, balancing the goals of food production and ecological protection. This approach will

ensure grain production is more adaptable to climate change and aligned with the intensity of economic activities.