Impact of Poverty Alleviation Resource Allocation on Income of Low-Income Rural Households: A Case Study of 18 Villages in Qinghai Province (Postprint)

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Abstract

Preventing poverty onset and relapse and establishing long-term mechanisms for poverty alleviation are critical foundations for consolidating and expanding the achievements of poverty alleviation. Investigating the income status of low-income farming households and their influencing factors can provide insights and references for establishing mechanisms to prevent poverty onset and relapse. Based on household survey data from 18 administrative villages in 3 counties of Qinghai Province, this study analyzes the income characteristics of the surveyed low-income farming households from the household perspective. Using the Geodetector model and Tobit model, the study examines the influencing factors affecting household income and income structure, determines the explanatory power and significance of these factors, and proposes policy recommendations based on the analysis results. The results indicate: (1) The total household income of low-income farming households has increased significantly, demonstrating notable income growth effects and remarkable poverty alleviation effectiveness. (2) Through the allocation of poverty alleviation resources, households' willingness to increase income and endogenous motivation have been significantly enhanced, with wage income becoming the primary source of income for farming households. (3) The explanatory power of single factors on income impact varies considerably, and the driving force of two-factor interactions is higher than that of single factors. Among these, the interaction between the number of laborers and the number of registered impoverished individuals exhibits the greatest influence. (4) The allocation of public poverty alleviation resources has a significant impact on the income structure of farming households, with different influencing factors for various income channels. During the income enhancement stage, particular attention should be paid to factors with higher degrees of contribution.

Full Text

Impact of Poverty Alleviation Resource Allocation on Income of Rural Low-Income Farmer Households: A Case Study of 18 Villages in Qinghai Province

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Abstract: Preventing poverty relapse and establishing a long-term mechanism for consolidating poverty alleviation achievements represent critical foundations for expanding the outcomes of poverty eradication efforts. Investigating income conditions among low-income farmer households and their influencing factors can provide valuable insights for developing mechanisms to prevent poverty recurrence. Based on survey data from 18 administrative villages across three counties in Qinghai Province, this study analyzes income characteristics of low-income farmer households from a micro-level perspective. Employing the Geographic Detector model and Tobit model, we examine factors influencing household income and income structure, determine the explanatory power and significance of these factors, and propose policy recommendations based on our findings. The results demonstrate: (1) Total household income among low-income farmers increased significantly, with a notable income growth effect and remarkable poverty alleviation outcomes. (2) Through poverty alleviation resource allocation, farmers' willingness to increase income and endogenous motivation improved substantially, with wage income becoming the primary income source. (3) Single-factor explanatory power varies considerably across income impact factors, while the driving force of two-factor interactions consistently exceeds that of single factors. The interaction between labor force size and number of registered poverty 档案 individuals shows the greatest influence. (4) Public poverty alleviation resource allocation significantly affects household income structure, with different income channels influenced by distinct factors. During income enhancement phases, priority should be given to factors with higher contribution levels.

Keywords: poverty alleviation resource allocation; low-income farmer households; Geographic Detector; Tobit model

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1.1 Study Area Overview

Qinghai Province, located on the Qinghai-Tibet Plateau, is a region rich in natural resources but economically underdeveloped. It has long been one of China' s most challenging provinces for poverty alleviation and development. By the

end of 2015, the province' s poverty incidence rate reached 36.6%, substantially higher than the national average. By the end of 2020, all impoverished populations in Qinghai had been lifted out of poverty, with the per capita disposable income of rural residents reaching 53.9$\times$10^{3}$ yuan. However, this figure remains significantly below the national rural average of 1.89$\times$10^{4}$ yuan, indicating that relative poverty among Qinghai' s rural population warrants continued attention.

This study focuses on low-income farmer households in impoverished villages within nationally designated poverty counties in Qinghai Province. The surveyed villages include: Ebotu, Dongzhigou, Bianmacun, Tianjiagou, Tiejiazhuang, and Quanjiawan villages in Datong County; Lijia, Muchang, Yima, Zhuangke, Dazhaizi, and Sang' ang villages in Ping' an District; and Dongtai, Xueshicang, Benkanggou, Gandujie, Gong' er, and Qingquan villages in Hualong County [Figure 1: see original paper].

1.2 Data Sources and Processing

Following a random sampling methodology to ensure scientific rigor and generalizability, we selected three counties from Qinghai' s list of poverty-alleviated counties, extracting three villages from each county—including both poverty-alleviated villages and non-poverty villages (totaling 18 villages). The target sample size averaged 30 households per village and 180 households per county. While the initial plan focused on surveying poverty-alleviated households, some non-poverty villages had insufficient numbers, necessitating supplementation from poverty-alleviated villages with larger populations to ensure comprehensive representation of low-income household income conditions and the impact of poverty alleviation resource allocation.

Between July and August 2021, our research team conducted household interviews using questionnaire surveys, ultimately obtaining 540 total samples, with 521 valid samples. Survey data encompassed basic household composition, labor production conditions, poverty alleviation policy benefits, and income structure. Following existing research, income structure was categorized into four types: operational income, wage income, property income, and transfer income [4,20-22]. Qinghai Province' s administrative boundaries and elevation data were obtained from the Geospatial Data Cloud and the Chinese Academy of Sciences' Resource and Environmental Science Data Center.

1.3.1 Geographic Detector Model

The Geographic Detector is an effective tool for detecting spatial distribution patterns of geographic phenomena and their driving factors [23]. Compared with traditional models, it offers advantages including immunity to multicollinearity and avoidance of causal relationships between independent and dependent variables [24]. Given that some influencing factors involve assigned-value variables, the Geographic Detector effectively reduces errors while avoiding collinearity is-

sues. Therefore, we employed the factor detection module of the Geographic Detector to analyze factors influencing total household income among low-income farmers. The calculation formula is:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2}$$

where q represents the explanatory power of a driving factor, with a value range of [0,1]; larger values indicate greater influence. L denotes the number of strata for the variable factor; N and N_h represent the total sample size and sample size within stratum h, respectively; and σ^2 and σ_h^2 represent the variance for the entire study area and for stratum h, respectively.

1.3.2 Tobit Regression Model

The Tobit model employs maximum likelihood estimation to analyze dependent variables that are continuous but subject to certain constraints, and is frequently used in income structure analysis [25]. Since some samples exhibit zero values for certain income types, using the Geographic Detector for global detection could introduce errors. Drawing on domestic and international research examining factors influencing resident income, we utilized the Tobit regression model to analyze factors affecting different income types among Qinghai farmer households. The regression results compare contribution degrees of different factors for the same income type without conducting interaction analysis. The calculation formula is:

$$\rho = \lambda F_n + \varepsilon$$

where ρ represents a specific income type (operational, wage, property, or transfer income); λ denotes the distance vector and regression parameter vector; F_n represents indicator variables (x_1 to x_{14}); and ε is the error term.

2.1 Income Growth Changes

Statistical analysis reveals that total household income among low-income farmers increased significantly, with all four income components—operational, wage, property, and transfer income—showing varying degrees of improvement . Average total household income rose from 1.175$×10^{4}$ yuan in 2015 to 5.233$×10^{4}$ yuan in 2020, representing a 345.36% growth rate, indicating substantial overall improvement after receiving poverty alleviation resources.

Operational income increased from an average of 0.263$×10^{4}$ yuan in 2015 to 1.131$×10^{4}$ yuan in 2020, a 330.04% growth rate. Local governments actively organized cooperatives, creating opportunities for low-income groups to expand operational scale. With poverty alleviation resource support, farmers fully utilized their labor and land resources, with some returning to farming

or starting businesses, increasing investment in traditional agriculture or other industries to achieve scale effects and notable income gains. However, elderly households lacking labor capacity could not participate in agricultural work and thus saw no improvement in operational income.

Wage income grew from an average of 0.446$\times$10^{4}$ yuan in 2015 to 2.662$\times$10^{4}$ yuan in 2020, a 509.15% increase. In 2015, some low-income households with labor capacity lacked employment skills and channels, primarily participating in poverty alleviation workshops or public welfare positions with low wages. After local governments organized employment training and facilitated migrant work, these farmers were trained as skilled workers and absorbed by urban labor markets, substantially increasing income and exerting a significant positive effect on household wage earnings. Again, elderly and disabled households without labor capacity could not obtain wage income.

Property income increased from 0.029$\times$10^{4}$ yuan in 2015 to 0.371$\times$10^{4}$ yuan in 2020, a 1,179.31% growth rate. With strong motivation to escape poverty, farmers actively participated in government-organized cooperatives and poverty alleviation enterprises, obtaining dividend income through shareholding. Some farmers also transferred their cultivated land for rental income. However, property income remained a minor component, as shareholding amounts were generally low and most low-income farmers owned limited cultivated land, often transferred to relatives, resulting in modest earnings.

Transfer income grew from 0.437$\times$10^{4}$ yuan in 2015 to 1.069$\times$10^{4}$ yuan in 2020, a 139.69% increase. Primarily comprising government social protection policies, transfer income supported households facing serious illness or other special circumstances through "whole-household protection" programs. Additionally, relatives, friends, and adult children provided financial gifts to ensure basic livelihoods. While both the number of policies and income amounts increased, the proportion of transfer income declined significantly, reflecting the government' s adherence to the principle of "supporting the diligent, not the lazy."

2.2 Income Structure Changes

After receiving poverty alleviation resources in 2020, low-income households experienced substantial income structure changes, though multi-channel income structures remained relatively stable . Operational income' s share decreased slightly from 22.38% in 2015 to 21.61% in 2020, indicating continued effective land utilization. The Qinghai Provincial Government formulated the "Qinghai Province Rural and Pastoral Areas Poverty Alleviation and Development Regulations," vigorously supporting characteristic advantageous industries including planting, breeding, agricultural product processing, rural tourism, and traditional ethnic handicrafts, which largely guaranteed farming and breeding incomes. Local governments also distributed free seeds and breeding stock through agricultural stations, effectively mobilizing farmers' enthusiasm.

Wage income' s share increased dramatically from 37.96% in 2015 to 50.87% in 2020, becoming the dominant income source. With low returns from traditional agriculture, labor-capable households sought alternative employment. Through technical training and government-organized labor export, these farmers acquired skills and opportunities, making wage income the primary source —consistent with national rural household income patterns. Property income' s share increased from 2.47% to 7.09% but remained low, as land transfer to relatives and modest cooperative dividends generated limited earnings. Transfer income' s share decreased markedly from 37.19% to 20.43%, falling below operational and wage income. Though still important, its declining proportion reflects successful policy implementation that reduced dependency while maintaining basic livelihood support.

2.3 Detection of Factors Affecting Total Household Income

Poverty alleviation resource allocation includes channels and methods [26]. Drawing on literature and actual conditions, we designed corresponding indicators. Resource channels comprise central fiscal funds (x_1), provincial fiscal funds (x_2), municipal fiscal funds (x_3), county-level fiscal funds (x_4), and other agriculture-related funds (x_5), represented as dummy variables (1 for received, 0 for not received). Resource methods include skill training provision (x_6), direct subsidy funds (x_7), industrial assistance provision (x_8), capital share dividends (x_9), public welfare positions (x_{10}), education subsidies (x_{11}), micro-credit provision (x_{12}), and medical security provision (x_{13}), plus household characteristic variables: labor force size (x_{14}), village attributes (x_{15}), and number of registered poverty 档案 individuals (x_{16}) .

Geographic Detector risk detection analysis [Figure 2: see original paper] identified 10 factors significant at the 0.05 level: x_1, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{14}, and x_{16}. Among public resource channels, all funding sources showed strong explanatory power and passed significance tests, confirming that regardless of allocation channel, poverty alleviation resources effectively increase low-income farmers' income. Explanatory power (q) ranked as x_1 (0.341) > x_4 (0.321) > x_5 (0.297) > x_2 (0.286) > x_3 (0.276), indicating central and county-level fiscal funds outperform provincial, municipal, and other agriculture-related funds. Due to administrative compulsions in poverty alleviation systems, resource allocation channels may develop dependencies that constrain allocation methods and affect income outcomes.

Among public resource methods, all factors except x_{13} passed significance tests, with q values ranking as x_7 (0.412) > x_{10} (0.387) > x_9 (0.364) > x_8 (0.342) > x_6 (0.321) > x_{11} (0.298) > x_{12} (0.287). Direct subsidies (x_7) most directly impact income but risk creating dependency, potentially limiting endogenous development if households become overly reliant on government support. Public welfare positions (x_{10}) effectively stimulate endogenous motivation, providing stable employment opportunities for semi- or weak-labor-capacity households through low-intensity, short-duration work aligned with their capabilities. Cap-

ital share dividends (x_9) enhance value chains and benefit distribution through voluntary, mutually beneficial cooperation between leading enterprises, cooperatives, and farmers, promoting income growth across different household types.

Among household characteristic variables, x_{14} and x_{16} passed significance tests with q values of 0.298 and 0.387, respectively. The number of registered poverty 档案 individuals correlates significantly with government subsidy income—more registered individuals indicate higher poverty recurrence risk and thus more targeted, comprehensive support policies. China' s poverty eradication efforts during the designated period substantially increased these households' income, consistent with actual conditions. Labor force size remains a key determinant of rural poor household income, representing human capital levels that constitute the primary factor causing income disparities among low-income families.

Building on single-factor results, we conducted interaction detection among significant factors . All two-factor combinations showed enhanced comprehensive explanatory power compared to single factors, exhibiting either nonlinear enhancement or two-factor enhancement without any weakening or independent effects. Interaction q values increased relative to single factors, with $x_{14} \cap x_{16}$ showing the greatest influence (0.564). Generally, households with more registered poverty 档案 individuals receive more poverty alleviation resources, with deeper poverty levels prompting more targeted, stronger local government support, making this interaction most influential. Other factor interactions such as $x_7 \cap x_{16}$ and $x_9 \cap x_{16}$ also showed nonlinear enhancement, indicating low-income household income results from multiple driving factors acting in concert.

2.4 Analysis of Regression Results for Different Income Types

Using Stata 16.0, we conducted Tobit regression analysis on different income types . Operational income analysis passed 0.05 significance tests, with x_8 (industrial assistance) showing the most significant impact. Government-provided industrial support policies, such as Qinghai' s 2020 "five measures" (developing characteristic advantages, strengthening benefit linkages, enhancing technical services, improving living environments, and leveraging collaborative assistance), boosted farmer enthusiasm and production efficiency while increasing sales revenue and reducing costs. Some households expanded cultivation of cash crops or livestock breeding through industrial assistance, significantly increasing agricultural and livestock incomes.

Wage income analysis passed 0.05 significance tests, with x_{10} (public welfare positions) and x_{14} (labor force size) showing significant positive correlations. For weak-labor-capacity households, obtaining market-based employment proves difficult; local governments continuously developed public welfare positions to enable such labor to achieve employment. After receiving these positions and basic service skills training, households increased income through simple labor, motivating self-improvement. As crucial productive capital in rural areas, labor force size significantly increased non-farm employment opportunities and

income through government-organized skills training and labor export. Factor x_7 (direct subsidies) negatively affected wage income, as financial support for basic livelihoods led some households to substitute local farming for migrant work, with lower-return activities occupying family labor time and reducing wage earnings.

Property income analysis did not pass overall significance tests, though x_9 (capital share dividends) significantly influenced property income. Property income primarily derives from providing financial assets or control over non-productive tangible assets to others [27], thus correlating mainly with x_9 in resource allocation methods.

Transfer income analysis passed 0.05 significance tests, with all factors except x_{12} (micro-credit) showing significance. Factor x_7 (direct subsidies) demonstrated substantially higher influence than other resource allocation methods. Qinghai' s timely implementation of various agricultural and pastoral transfer payment subsidies, agricultural insurance, student loans, rural subsistence allowances, public welfare position subsidies, and disability subsidies enabled farmers to receive diverse direct subsidies, increasing transfer income.

Overall, public poverty alleviation resource allocation significantly impacts low-income farmers' income structure, with different factors influencing each income type. From a village perspective, tailored household-specific strategies should guide farmers to modify income structures and increase earnings, laying a solid foundation for rural revitalization. From farmers' perspective, during income improvement phases, priority should focus on high-contribution factors to rapidly raise income levels and optimize income structure.

3.1 Conclusions

1) Total household income among low-income farmers increased significantly, rising from 1.175$×10^{4}$ yuan in 2015 to 5.233$×10^{4}$ yuan in 2020, demonstrating remarkable income growth effects and poverty alleviation achievements.

2) Through poverty alleviation resource allocation, farmers' willingness to increase income and endogenous motivation improved substantially. In 2015, low-income households primarily relied on government-supported transfer income (37.96% of total income), whereas by 2020, wage income became dominant at 50.87%, with transfer income declining to 20.43%, indicating significantly enhanced endogenous capacity.

3) Single-factor explanatory power for household income varies considerably, ranking from high to low as: x_7, x_{10}, x_9, x_8, x_6, x_{11}, x_{12}, x_1, x_4, x_5, x_{16}, x_{14}, x_2, x_3, x_{13}, x_{15}. Any two-factor interaction strengthens explanatory power, showing either two-factor enhancement or nonlinear enhancement. The interaction between labor force size and number of registered poverty 档案 individuals ($x_{14} \cap x_{16}$) shows the greatest influence, with x_{16} exerting

the strongest effect on other factors.

4) Public poverty alleviation resource allocation significantly affects household income structure, with different influencing factors for each income channel. During income enhancement phases, priority should focus on high-contribution factors: for operational income, factors rank as x_8, x_7, x_{16}, x_6, x_{14}; for wage income, x_{10}, x_{14}, x_7, x_8, x_9; for property income, x_9, x_7, x_8; and for transfer income, x_7, x_{10}, x_9, x_8, x_{11}.

3.2 Recommendations

These findings align with related research showing that poverty alleviation resource allocation significantly enhances low-income farmers' total income and self-sustaining capacity. Moreover, our combined Geographic Detector and Tobit model analysis reveals that income-influencing factors are multifaceted, encompassing macro-level institutional and policy factors alongside micro-level human capital accumulation, physical capital investment, financial assets, and household characteristics, with differential impacts on income structure. Following comprehensive poverty eradication, China has entered a new stage characterized by secondary and relative poverty, with target groups shifting to transitional and potentially poor populations [28]. In this post-poverty era, enhancing income sustainability and preventing relapse constitutes both a practical requirement and an objective necessity for rural revitalization [29]. Based on these empirical results, improving low-income farmers' income requires comprehensive, targeted policy measures.

1) Strengthen employment training, industrial skills development, and public welfare position development to enhance farmers' "self-generating" capacity beyond basic social protection. Some households receiving extensive policy support have achieved basic livelihood security but exhibit insufficient development motivation, resulting in income structures overly dependent on government subsidies. For labor-capable low-income households, subsequent development should avoid excessive reliance on baseline policies. Adhering to the principle of "supporting the diligent, not the lazy," employment assistance and skills training should enhance households' self-generating functions.

2) As wage income now constitutes a high proportion of household income and labor represents important productive capital with significant positive impacts, households with abundant labor should avoid over-developing primary industries that may occupy time for migrant work and reduce household income. While introducing employment opportunities for labor-abundant households, governments should actively attract investment to create local job opportunities, prevent hollow village phenomena, encourage collective transfer of cultivated and forest land, optimize labor allocation, and fully utilize rural land resources.

3) Promote rural industry integration to increase operational income. Lever-

age demonstration effects from specialized large-scale growers, family farms, and farmer cooperatives to unite dispersed farmers and create scale effects. Encourage cooperatives to expand into agricultural product processing and sales, extend industrial chains, improve commercialization and scale, and increase farmers' income through enhanced agricultural production efficiency.

4) Implement "one household, one policy" to effectively increase household income. Different low-income households possess varying productive and social resources. Households with relatively abundant productive resources but limited social resources should focus on optimizing operational income through policy support for industrial assistance, capital share dividends, and micro-credit. Households with relatively abundant social resources but limited productive resources should optimize transfer income, as these households typically have fewer production materials and weaker labor capacity, relying primarily on transfer income for basic livelihood. Such households should receive maximum eligible policy subsidies to guarantee basic living needs. At the village level, different development stages should prioritize enhancing specific income types, concentrating poverty alleviation resources on primary influencing factors to effectively raise overall household income while ensuring basic livelihood security.

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