Impacts of Enclosure on Livelihoods and Activities of Residents in Desertified Areas: A Postprint

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Abstract

To investigate the impacts of establishing protected areas on the livelihoods of residents in desertified lands across different ecosystem types, this study analyzes economic indicators including annual gross household income, Engel coefficient, and income structure index, as well as ecological indicators such as resource dependency, human activity impact index, and ecological awareness sensitivity, in the protected areas (project zones) and unprotected areas (control zones) of Maqu, Minqin, and Shandan, the 2017 pilot counties for protected area establishment in Gansu Province, using questionnaire surveys and interview methods. The results show that: for economic indicators, both annual gross household income and income structure index exhibit the pattern of Maqu < Minqin < Shandan; the Engel coefficient shows the opposite trend, with values for Maqu, Minqin, and Shandan being (project zone 0.35, control zone 0.33), (project zone 0.34, control zone 0.29), and (project zone 0.30, control zone 0.26), respectively. The Engel coefficient demonstrates a significant negative correlation with annual gross household income, with correlation coefficients of (project zone -0.946, control zone -0.923), (project zone -0.894, control zone -0.927), and (project zone -0.901, control zone -0.961), respectively; for ecological indicators, resource dependency and human activity impact index follow the pattern of Maqu > Shandan > Minqin, while ecological awareness sensitivity exhibits the characteristic of Maqu < Minqin < Shandan. For economic indicators, the Engel coefficient and Minqin' s income structure index are higher in project zones than in control zones, while annual gross household income and the income structure indices of Maqu and Shandan are lower in project zones than in control zones, with all indicators except the Engel coefficient showing significant differences ($P < 0.05$); for ecological indicators, resource dependency, human activity impact index, and ecological awareness sensitivity are all higher in project zones than in control zones, and all show significant differences ($P < 0.05$). Overall, the ecological and economic conditions in control zones are

better than those in project zones; however, the trend of ecological degradation in project zones has been curbed to a certain extent, and income structures have shifted from singular to diversified. These conclusions provide a basis for guiding the transformation of economic growth patterns, rational zoning, and regional sustainable development in desertified land protected areas.

Full Text

Impact of Land Closure on Livelihoods and Activities of Residents in Desertified Areas

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Abstract

To investigate the impact of establishing closed protection reserves on the livelihoods of residents in desertified lands across different ecosystem types, this study employs questionnaire surveys and interviews to analyze economic indicators—including average annual gross household income, Engel coefficient, and income structure index—and ecological indicators—including resource dependence, human activity impact index, and ecological awareness sensitivity—in both closed (project) and unclosed (control) areas of Maqu, Minqin, and Shandan counties in Gansu Province, which were designated as pilot counties for desertification closure protection in 2017. Results indicate that economic indicators of average annual gross household income and income structure index exhibit the pattern of Maqu < Minqin < Shandan, while the Engel coefficient shows the opposite trend. The Engel coefficient demonstrates a significant negative correlation with average annual gross household income, with correlation coefficients of 0.946 and 0.923 for Maqu, 0.894 and 0.927 for Minqin, and 0.901 and 0.961 for Shandan in project and control areas, respectively. Ecological indicators of resource dependence and human activity index follow the pattern of Maqu > Shandan > Minqin, while ecological awareness sensitivity shows Maqu < Minqin < Shandan. The Engel coefficient and Minqin' s income structure index are higher in project areas than control areas, whereas average annual gross household income and the income structure indices of Maqu and Shandan are lower in project areas than control areas, with significant differences ($P<0.05$) observed for all indicators except the Engel coefficient. Resource dependence, human activity impact index, and ecological awareness sensitivity are all higher in project areas than control areas, with significant differences ($P<0.05$). Overall, while the ecological and economic status of control areas is better than that of project areas, the trend of ecological degradation in project areas has been curbed to some extent, and income structures have shifted from single to diversified sources. These conclusions provide empirical evidence for guiding the

transformation of economic growth patterns, rational zoning, and sustainable regional development in closed desertification protection reserves.

Key words: prohibition; desertified land; Engel coefficient; resource dependence

1. Study Area Overview

Land desertification refers to a land degradation process characterized by wind-sand activities, occurring in arid, semi-arid, and partially semi-humid regions with sandy foundations and dry, windy conditions, resulting from excessive human activities that are incompatible with environmental resources. This represents one of the most severe environmental challenges facing Northwest China. By 2017, Gansu Province had established multiple closed protection reserves for desertified land. As pilot programs for closed protection have advanced, the ecological, social, and economic benefits of these measures have become a research focus, with numerous scholars investigating indicator systems, methods, and conclusions for ecological protection performance evaluation.

Located in the inland hinterland of Northwest China, Gansu Province faces severe desertification, with extensive sandy land areas. Around 2015, the state implemented grazing bans in areas with serious grassland degradation. Wackernagel' s ecological footprint concept, which comprehensively evaluates the ecological impact of human activities, has been widely applied. Multidisciplinary approaches have been integrated into payment for ecological service value projects in Switzerland, and research has explored principles and methods for benefit evaluation indicator screening. Wei Huilan et al. analyzed ecological change trends in the Qinling Nature Reserve from ecological protection and economic development perspectives, concluding that energy diversification should be achieved in stages to meet household fuel demands. Du Min et al. studied the effectiveness of closure protection measures in the Hulunbuir Sandy Land, demonstrating that desert-oasis ecosystems within closed areas have become more balanced and stable. However, while closure achieves ecological protection effects, it simultaneously generates both positive and negative impacts on local residents' lifestyles and production patterns. Currently, research on how closure affects local residents' livelihoods and activities remains limited.

Maqu County, located on the eastern edge of the Qinghai-Tibet Plateau, serves as an important "water reservoir" and "water source replenishment area" for the upper Yellow River. Minqin County is one of the most severely desertification-affected regions in Gansu and even nationwide. Shandan County lies in the central Hexi Corridor at the farming-pastoral ecotone, known as the "throat of Gansu and key passage of the corridor." To address Gansu' s extensive and severe desertification, the Ministry of Finance and State Forestry Administration launched pilot closed protection programs in Maqu, Minqin, and Shandan in 2017. To date, no studies have reported on the socio-economic impacts of these desertification closure protection programs on residents' livelihoods and activ-

ities in these three critical regions. This research addresses this gap through questionnaire surveys and interviews conducted in these counties.

According to China' s fifth national desertification and sandification monitoring report, the national desertified area in 2015 was 172.1175 million hectares, accounting for 17.93% of total land area, with Gansu ranking among the top provinces. This study selected three national desertified land closed protection reserves in Gansu as research areas: Anggebu in Maqu County, Qingtu Lake Shangbalangjing in Minqin County, and Dongle Nantan in Shandan County (Fig. 1).

Maqu County is situated at the eastern end of the Qinghai-Tibet Plateau, with elevations ranging from 3,300 to 4,800 meters and a cold, humid climate. The average annual temperature is 1.2°C, and average annual precipitation is 615.5 mm. Maqu' s total desertified land area is 1,217.02 km^2, representing 1.53% of the county' s total land area. The Maqu closed area (project area) includes Oula Township, Nima Town, and Hequ Horse Farm, with geographic coordinates of 102°12 08 E/33°54 06 N (northeast corner) to 101°51 09 E/34°15 00 N (southeast corner) and 101°52 02 E/34°22 02 N (southwest corner) to 102°08 00 E/33°51 06 N (northwest corner). The Maqu unclosed area (control area) selected Manrima Township and OulaxiuMa Township.

Minqin County is located in the northeastern Hexi Corridor of Gansu Province, with an average elevation of 1,367 meters, average annual temperature of 7.8°C, and average annual precipitation of approximately 162.9 mm. Minqin' s total desertified land area is 10,000 hm^2, with concentrated contiguous distribution, representing a typical arid desert region. The Minqin closed area (project area) is Qingtu Lake on the northern line of the Minqin Oasis, with coordinates of 103°48 53.11 -103°55 11.84 E and 39°09 28.96 -39°17 29.76 N. The Minqin unclosed area (control area) selected Hongshaliang Town, Datan Town, and Donghu Town.

Shandan County lies in the central Hexi Corridor, with elevations of 1,550–4,440 meters, average annual temperature of 5.9°C, and a continental cold semi-arid climate. Shandan' s total desertified land area is 10,115.72 hm^2, with concentrated contiguous distribution, making it an important dust source area and dust storm pathway in Northwest China. The Shandan closed area (project area) includes Dongle Town and Qingquan Town, with coordinates of 100°47 40 - 101°00 58 E and 38°42 14 -38°48 32 N. The Shandan unclosed area (control area) selected Chenhu Town and Weiqi Town.

[Figure 1: see original paper]

2.1 Data Sources

Research data were obtained through random sampling surveys conducted in closed (project) and unclosed (control) areas of Maqu, Minqin, and Shandan.

The field survey administered 630 questionnaires, with an overall effective rate of 98.41%. Specifically, 380 questionnaires were distributed in project areas, with 374 valid responses (98.41% effective rate). In control areas, 250 questionnaires were distributed, with 246 valid responses (98.31% effective rate). The questionnaire quantity and validity meet survey requirements and achieve expected objectives (Table 1).

2.2 Research Methods

The study conducted three rounds of surveys from 2017 to 2019 in the desertification closed protection project areas and surrounding control areas of Maqu, Minqin, and Shandan. Data were collected through questionnaires and interviews. Economic indicators—including average annual gross household income, Engel coefficient, and income structure index—and ecological indicators—including resource dependence, human activity impact index, and ecological awareness sensitivity—were used to reflect the impacts of closure on residents' livelihoods and activities.

2.2.1 Average Annual Gross Household Income

Average annual gross household income primarily describes residents' annual income status, reflecting that lower-income households experience greater poverty, while higher-income households enjoy greater prosperity.

2.2.2 Engel Coefficient

The Engel coefficient represents the proportion of food expenditures in total household consumption expenditures, calculated as:

$$\text{Engel Coefficient} = \frac{\text{Food Expenditure}}{\text{Total Consumption Expenditure}} \times 100\%$$

This coefficient describes the relative degree of household poverty (or prosperity) and exhibits a significant negative correlation with household development indicators such as production resources and income level, while showing a positive correlation with the intensity of human desertification activities.

2.2.3 Income Structure Index

The household income structure index is defined as a weighted measure based on income categories and their environmental impact. The theoretical value range is (-1, 1), where positive values indicate that changes in income structure are positive for biodiversity conservation, while negative values indicate the opposite trend.

2.2.4 Resource Dependence

Resource dependence refers to the proportion of household income directly derived from desert resources. Income from desert resources includes monetary equivalents of fuel, construction wood, sand and soil extraction obtained from the desert, as well as income from livestock breeding using desert and natural grassland resources. Calculated as:

$$\text{Resource Dependence} = \frac{\text{Income from Desert Resources}}{\text{Total Income}} \times 100\%$$

The theoretical value range is (0, 1), where higher values reflect greater dependence of residents' production activities on desert systems, which is less favorable for ecological protection.

2.2.5 Human Activity Impact Index

The human activity impact index (EI) measures the environmental impact of activities undertaken by sample households and their members, considering both impact scope and intensity:

$$EI = \sum_{k=1}^{n} \frac{S_k}{S} \cdot \varepsilon_k$$

where S represents the total area available for production and living activities (assumed constant), S_k represents the actual area used for the kth activity type, and ε_k represents the impact intensity of the kth activity type, with values defined between 0 and 1. The theoretical value range of EI is (0, 1), where values closer to 1 indicate greater environmental impact from the scope and intensity of human activities.

2.2.6 Ecological Awareness Sensitivity

Ecological awareness sensitivity (CBI) measures the transformation trend of community members' consciousness and behavior under project influence. Assuming m aspects of project impact (awareness and behavior) are considered, with θ_k representing the total number of people involved in the kth aspect, and $\theta_{RES,k}$ representing the number of residents who effectively participated in the kth project activity, CBI is calculated as:

$$CBI = \frac{1}{m} \sum_{k=1}^{m} \frac{\theta_{RES,k}}{\theta_k}$$

This represents the average participation rate of sample area residents in conservation activities, reflecting both individual development from an awareness and behavioral perspective and the potential social and ecological outcomes of the project. The value range is (0, 1), where higher values indicate higher average participation rates and greater ecological awareness sensitivity.

3.1.1 Changes in Average Annual Gross Household Income

Both project and control areas show the pattern of Maqu < Minqin < Shandan for average annual gross household income (Fig. 2). In Maqu, Minqin, and Shandan, project area household incomes are 30.77%, 30.92%, and 28.50% lower than control areas, respectively, with average incomes of [values] in project areas versus [values] in control areas. These differences are statistically significant ($P<0.05$) across all counties.

[Figure 2: see original paper]

3.1.2 Changes in Engel Coefficient

Engel coefficients in Maqu, Minqin, and Shandan project areas are [values], compared to [values] in control areas, showing the pattern of Maqu > Minqin > Shandan (Fig. 3). The average Engel coefficient in project areas is 13.79% higher than in control areas (0.33 vs. 0.29). While the difference between Maqu's project and control areas is not significant, Minqin and Shandan show significant differences ($P<0.05$).

[Figure 3: see original paper]

3.1.3 Changes in Income Structure Index

Across all three pilot counties, Shandan exhibits the highest income structure index, followed by Minqin, with Maqu showing the lowest. Income structure indices in Maqu, Minqin, and Shandan project areas are [values], with Minqin' s project area index 36.14% higher than its control area, while Maqu and Shandan project areas are 39.47% and 20.92% lower than their respective control areas. The control area average is [value], and project area income structure indices are significantly lower than control areas ($P<0.05$).

[Figure 4: see original paper]

3.2.1 Changes in Resource Dependence

As shown in Fig. 5, Maqu County' s project area resource dependence is [value], 26.15% higher than its control area. Minqin and Shandan counties show resource dependence values of [values] in project areas, representing increases of 195.24% and 143.75% over control areas, respectively. All three pilot counties demonstrate significantly higher resource dependence in project areas compared to control areas ($P<0.05$).

[Figure 5: see original paper]

3.2.2 Changes in Human Activity Impact Index

Human activity impact indices in the three pilot counties' project areas are 8.05%, 10.88%, and 14.42% higher than control areas, respectively. Project

areas show an average index of [value] versus [value] in control areas, with the pattern of Minqin > Shandan > Maqin observed in both project and control areas (Fig. 6). Differences between project and control areas are statistically significant (P<0.05).

[Figure 6: see original paper]

3.2.3 Changes in Ecological Awareness Sensitivity

Ecological awareness sensitivity values in Maqu, Minqin, and Shandan project areas are [values], compared to [values] in control areas. Minqin shows the greatest increase (39.42%), followed by Shandan (25.60%), with Maqu showing the smallest increase (8.14%). Average ecological awareness sensitivity is 30.48% in project areas versus [value] in control areas, with significant differences (P<0.05) observed across all three counties (Fig. 7).

[Figure 7: see original paper]

4.1.1 Economic Characteristic Indicators

The study reveals that average annual gross household income and income structure index follow the pattern of Maqu < Minqin < Shandan, while the Engel coefficient shows the opposite trend (Shandan < Minqin < Maqu). These patterns primarily reflect differences in economic structure across counties. Maqu is a pure pastoral county without cultivated land, with income mainly from livestock production, resulting in a relatively singular income source. Minqin has more diverse income sources, with many residents working as migrant laborers or running businesses, though drought conditions affect crop and grain income. Shandan, located in the farming-pastoral ecotone, benefits from diverse income structures, concentrated rainfall, and advantageous agricultural and pastoral development, with diverse alternative livelihoods making residents relatively prosperous.

Engel coefficients in both project and control areas across the three pilot counties show significant negative correlations with average annual gross household income (Table 2). Correlation coefficients are 0.946 and 0.923 for Maqu, 0.894 and 0.927 for Minqin, and 0.901 and 0.961 for Shandan in project and control areas, respectively. These findings align with Chenery and Syrquin' s research on development patterns.

Average annual gross household income and income structure indices in Maqu and Shandan show project area < control area patterns, primarily because fencing and enhanced patrols in project areas have greatly reduced grazing, herb collection, and stone extraction, substantially limiting main income sources compared to control areas. This aligns with Zhu Hongge et al.' s findings on the negative impacts of comprehensive logging bans on forest area residents' household income. In Minqin, however, the number of migrant workers increased

after closure, with labor income becoming a primary household income source, resulting in project area > control area patterns for income structure index.

Engel coefficients and Minqin' s income structure index show project area > control area patterns across the three counties. Project areas are relatively poor townships with severe desertification where grain cultivation is difficult, food expenditures are high, and economic life is relatively singular and disordered. Control areas, mostly near county towns, have more diverse economies based on self-employment, migrant labor, and cash crop cultivation, with relatively wealthy households showing higher Engel coefficients. This aligns with Wu Beibei et al.' s findings on significant differences in food consumption levels and structures across different income groups.

4.1.2 Ecological Characteristic Indicators

Resource dependence and human activity impact index across the three pilot counties follow the pattern of Maqu > Shandan > Minqin. Maqu is a pure pastoral county where grassland constitutes over 90% of land area, with production and livelihood heavily dependent on grassland resources, resulting in extremely high resource dependence. The county' s main income source from livestock production involves high-intensity human activities such as overgrazing and fuelwood collection, significantly impacting natural grasslands and creating unfavorable conditions for ecological protection. Shandan, located in the farming-pastoral ecotone, represents a fragile ecosystem where agriculture and pastoralism are major economic elements with substantial dependence on and impact to grasslands and farmland. In Minqin, despite having agriculture, forestry, and animal husbandry, the rapid increase in migrant workers after closure has reduced dependence on resources, particularly desert resources, minimizing environmental impact and favoring natural resource restoration and regeneration. This aligns with Duan Wei et al.' s finding that higher-income households have lower natural resource dependence and Wei Jianbing et al.' s conclusion that rational human activities reduce environmental impact and facilitate ecological restoration.

Ecological awareness sensitivity shows the pattern of Maqu < Minqin < Shandan. This primarily reflects that most residents in Maqu are Tibetan nomads with limited communication and language barriers, making environmental awareness campaigns difficult to transmit effectively, resulting in weaker environmental consciousness and participation. Minqin residents live in relatively concentrated areas with numerous organized environmental awareness activities, facilitated communication, and implemented government reward-penalty systems that significantly influence residents' environmental awareness and behavior. Shandan, located in the farming-pastoral ecotone, has effective environmental awareness campaigns and relatively complete policy systems that guide and constrain residents from both awareness and institutional perspectives, playing a protective role for Shandan' s ecological environment. This aligns with Wang Xueting et al.' s conclusion that environmental penalty systems promote

rural residents' participation in governance.

All three pilot counties show project area > control area patterns for resource dependence, human activity impact index, and ecological awareness sensitivity. Project areas are located in regions with large concentrated sandy areas and the most severe desertification hazards, formed by both drought conditions and excessive resource exploitation, frequent agricultural production, and animal husbandry activities. After establishing desertification closed protection reserves, government advocacy and shifts in resident awareness have created favorable conditions for the ecological environment. This aligns with Xu Zengwei et al.' s research that government should strengthen guidance on new environmental governance models, establish effective self-interest incentive mechanisms, ensure favorable transformation of farmers' interests and ecological environment, and improve farmers' environmental cognition levels. However, control areas have been somewhat neglected in environmental advocacy, resulting in lower environmental governance awareness among residents. Therefore, only when household living conditions are improved can residents' environmental awareness be enhanced to standardize their behavior and properly handle the relationship between economic development and environmental protection. Diverse economic income structures can reduce resource dependence, as human activities' impact on Earth becomes increasingly evident and both government advocacy and public environmental awareness promote positive ecological development.

4.2 Conclusion

Average annual gross household income and income structure index across Maqu, Minqin, and Shandan follow the pattern of Maqu < Minqin < Shandan, while the Engel coefficient shows the opposite trend. Resource dependence and human activity impact index follow the pattern of Maqu > Shandan > Minqin, while ecological awareness sensitivity shows Maqu < Minqin < Shandan.

Average annual gross household income (project area: [value]; control area: [value]), resource dependence (project area: [value]; control area: [value]), human activity impact index (project area: [value]; control area: [value]), and ecological awareness sensitivity (project area: [value]; control area: [value]) all show project area > control area patterns, with significant differences ($P<0.05$). Engel coefficient and Minqin' s income structure index also show project area > control area patterns, while average annual gross household income and income structure indices of Maqu and Shandan show project area < control area patterns, with significant differences ($P<0.05$). In summary, while control areas exhibit better ecological and economic status than project areas, the trend of ecological degradation in project areas has been curbed to some extent, income structures have shifted from single to diversified sources, and residents' environmental protection awareness has improved. These conclusions provide empirical evidence for guiding economic growth pattern transformation, rational reserve zoning, and sustainable regional development in closed desertification protection reserves.

References

[1] WANG Xinyuan, WANG Cunlu, YU Lin, et al. Preliminary study on the investigation and research program of desertification in alpine ecology area: Taking Maqu County as an example[J]. China Soil and Water Conservation, 2018(9): 38-41.

[2] [Inspection on the construction of the national desertified land closed and forbidden reserve in our province by the State Desertification Control Office[EB/OL]. Gansu Forestry Network, 2018, http://lycy.gansu.gov.cn/content/2018-05/66087.html.]

[3] WACKERNAGEL M, REES W E. Our ecological footprint: Reducing human impact on the earth[M]. Gabriola island: New Society Publishers, 1996.

[4] HUBER R, BRINER S, PERINGER A, et al. Modeling social-ecological feedback effects in the implementation of payments for environmental services in pasture woodlands[J]. Ecology and Society. 2013, 18(2): 41.

[5] WANG Xiaoke, YANG Ning, WU Fan, et al. Ecological benefits and their evaluation: II. Evaluation content and evaluation index screening[J/OL]. Acta Ecologica Sinica. 2019, (15): 1-8.

[6] WEI Huilan, YANG Xinyu. Analysis of the impact of farmers' economic behavior on ecological environment in sandy land conserved protected area: An empirical study based on the sandification land blocking and protection project area of Gansu Province[J]. Journal of Shandong Agricultural University (Social Science Edition), 2017, 19(3): 24-30, 119.

[7] CHEN Changwei, WU Yongqiu, TAN Lihua, et al. Desertified land change and its causes in Co Nag Lake region along Qinghai Tibet Railway[J]. Arid Land Geography, 2019, 42(4): 885-892.

[8] WEI Huilan, YANG Kaikai. Evaluation of the protection effect of Qinling Nature Reserve[J]. Ecological Economy (Academic Edition), 2013(1): 374-379, 383.

[9] DU Min, JING Lu, HU Xinpei, et al. Study on the effect of closure and protection measures in Hulunbuir sandy land[J]. Forestry Science and Technology communication, 2016, (1): 13-15.

[10] CHEN Wenye, ZHANG Jin, QI Dengchen, et al. Quantitative analysis of the dynamic evolution trend and driving factors of alpine meadow desertification in Maqu County, the first bend of the Yellow River[J]. Journal of Grassland Industry, 2013, 22(2): 11-21.

[11] HU Mengjun, PAN Ninghui, ZUO Hailing, et al. Temporal and spatial evolution of land desertification in Maqu Plateau Based on RS and GIS[J]. Journal of ecology, 2017, 37(3): 922-931.

[12] WEI Shuwei, LI Shu, ZHEN Bao, et al. Study on the diversity of macrofungi

and myxobacteria in minqin county of Gansu Province[J]. Journal of Arid Land Resources and Environment, 2019, 33(9): 140-144.

[13] [Strengthen the protection and restoration of the sand land and build up the ecological security barrier in the sand area[EB/OL]. China forestry network, 2017, http://www.forestry.gov.cn/main/3957/content-988433.html.]

[14] AI Li. Analysis of factors affecting farmers' ecological environment expectation: Taking Gansu Province' s banned protected area as an example[J]. Agricultural Outlook, 2017, 13(7): 33-36.

[15] CHANNERY Hollis, SELKUN Mois. Type of development: 1950–1970[M]. LI Xinhua, etc. Beijing: Economic Science Press, 1988.

[16] ZHU Hongge, ZHANG Shaopeng, HU Qinxin. The impact of comprehensive cutting cessation policy on household income of state owned forest residents[J]. Forestry Economic Issues, 2019, 39(5): 457-464.

[17] CHEN Menggen. Regional income, food price and Engel coefficient[J]. Statistical Research, 2019, 36(6): 28-41.

[18] GUO Biao, YANG Yi. A study on the family income structure and housing inequality of urban residents in China: An empirical analysis based on CFPS[J]. Journal of Wuhan University of science and Technology (Social Science Edition), 2019, 32(5): 70-76.

[19] WU Beibei, CHEN Yongfu, YI Fujin. The impact of income distribution change of urban families on their food consumption: Also on the comparison with the results of static simulation[J]. Agricultural Modernization Research, 2019, 40(2): 264-272.

[20] HAN Lei. The impact of family income structure on China' s residents consumption[J]. Commercial Economic Research, 2019, (10): 49-52.

[21] WANG Junli. Industrial structure adjustment and economic growth in resource based areas[D]. Taiyuan: Shanxi University, 2014.

[22] DUAN Wei, REN Yanmei, FENG Yi, et al. Study on the natural resource dependence of farmers based on livelihood capital: Taking Hubei protected area as an example[J]. Agricultural Economics Issues, 2015, (8): 74-82.

[23] WEI Jianbing, XIAO Yining, XIE Fuju. Evaluation and regulation of human activities on ecological environment[J]. Progress in Geography, 2006, 25(2): 36-45.

[24] ZHAN Yan, XIONG Kangning, ZHOU Jianping, et al. Research on natural resource dependence of surrounding communities in protected areas: Taking Fanjingshan World Natural Heritage Nominees as an example[C] // China Urban Planning Society, Hangzhou Municipal People' s Government. Sharing and Quality: 2018 Proceedings of the Annual Conference of China Urban Planning (09 Urban Cultural Heritage Protection). China Urban Planning Society, Hangzhou Municipal People' s Government, 2018: 13.

[25] WANG Hui, ZHAO Yawen, WEN Yali. Study on the evaluation of natural resource dependence of farmers based on factor remuneration: A case study of six nature reserves in Yunnan Province[J]. China Population, Resources & Environment, 2017, 27(12): 146-156.

[26] ZHANG Yanting. The impact of human activities on climate change in semi arid areas[D]. Lanzhou: Lanzhou University, 2018.

[27] ZHANG Hongyun, ZANG Shuying, ZHANG Yuhong, et al. Study on the impact of human land use activities on nature reserves: A case study of Heilongjiang Province[J]. Environmental Science and Technology, 2015, 38(11): 271-276.

[28] XU Zengqi, YAO Shunbo, MIAO Shanshan. The deviation of will and behavior: A study on the factors affecting farmers' willingness to pay and payment behavior in rural domestic waste[J]. Journal of Arid Land Resources and Environment, 2016, 30(2): 1-6.

[29] WANG Xueting, ZHANG Junxi, HE Ke, et al. Study on the participation behavior of rural residents' collaborative governance in rural areas: analysis based on psychological perception and environmental intervention[J]. Resources and Environment in the Yangtze River Basin, 2019, 28(2): 459-468.

[30] ZHOU Lihua, HOU Caixia. Key problems of grassland utilization and the graze ban policy in farming-pastoral ecotone of northern China[J]. Arid Land Geography, 2019, 42(2): 354-362.

[31] CHEN Junsong, WEN Yi, CHU Xiaoyuan. Study on the influence of different enclosure protection measures on the moisture content and particle size of desertified land[J]. Forest Investigation Planning, 2018, 43(5): 36-39, 44.

[32] ZHOU Xiaobo, WEI Wei, DONG Lu. The impact of resource dependence on regional economic growth: Based on the analysis of economic cycle and industrial structure[J]. Modern Finance and Economics (Journal of Tianjin University of Finance and Economics), 2017, 37(7): 102-113.

[33] GUAN Xiaodan, CHENG Shanjun, GUO Ruixia, et al. Research progress on numerical simulation of soil moisture in arid and semi arid areas[J]. Journal of Arid Meteorology, 2014, 32(1): 135-141.

[34] ZHOU Yi, CHEN Shaogang. Analysis of Chinese urban residents' consumption structure and new Engel' s coefficient model[J]. Modern Business & Trade, 2019, 40(17): 9-12.

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