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EDITED BY

Sandagsuren Undargaa,
ANU, Australia

*CORRESPONDENCE

Xiaoning Zhang,
✉ 1542989628@qq.com

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Analysis of property rights practice contradictions and typical models in grassland pastoral areas: a field survey based on Abaga Banner, Xilingol League, Inner Mongolia

Xiaoning Zhang*

Inner Mongolia University of Finance and Economics, Hohhot, China

Based on 81 household interview data collected from Honggor Gol Town, Abaga Banner, Xilingol League, Inner Mongolia, this study systematically analyzes four core contradictions in the practice of property rights in desert rangeland pastoral areas: rangeland right certification contradictions, rangeland tenure contradictions, property rights dispute resolution contradictions, and contradictions between ecological policies and property rights implementation. By refining the operational guidelines of T-B's "Hoof and Leg Theory" and "Four-Point Balance" model, combined with cost-benefit analysis, this study proposes an optimization path of "collaborative right certification, standardized tenure allocation, professional mediation, and differentiated ecological policies." Responding to Ostrom's common-pool resource governance theory and context dependence theory, this research fills the gap in micro-level studies on property rights practice in ecologically sensitive desert rangeland areas, providing empirical evidence and theoretical support for the improvement of rangeland property rights systems in pastoral areas.

KEYWORDS

contradiction analysis, hybrid property rights, pastoral rangeland areas, property rights practice, social-ecological system

Introduction

Policy and practical context

Against the institutional backdrop of China's Rangeland Right Certification Policy (Chinese: 草原确权承包政策)¹ and the national "ecology-first, green development" strategy (Chinese: 生态优先, 绿色发展战略)², the pastoral rangeland property rights system³ has emerged as a core institutional pillar for balancing rangeland ecological conservation and pastoralists' livelihood security.

- 1 This national policy aims to complete the full registration and certification of rangeland use rights for all pastoral households in China, clarifying property rights boundaries and securing pastoralists' land use rights, building on the long-standing Household Contract Responsibility System (HCRS) for rangeland.
- 2 This is the core guiding strategy for China's ecological civilization construction, which prioritizes ecological protection over unrestricted economic development in ecologically sensitive areas.
- 3 This refers to the formal institutional system defining the ownership, use, transfer, and income rights of pastoral rangeland resources in China, which is built on the Household Contract Responsibility System and supplemented by subsequent right certification policies.

The Rangeland Right Certification Policy is supported by a three-tier authoritative institutional system: the Grassland Law of the People's Republic of China (3rd Amendment, 2021), which establishes the statutory basic framework for rangeland ownership and use rights (Standing Committee of the National People's Congress of the People's Republic of China, 2021); the national policy guideline that sets the core target of completing nationwide rangeland right registration and certification by 2025 (General Office of the State Council of the People's Republic of China, 2021); and the statutory operational specifications for unified natural resources right confirmation and registration issued by national competent authorities (Ministry of Natural Resources, Ministry of Finance, Ministry of Ecology and Environment, Ministry of Water Resources, and National Forestry and Grassland Administration of the People's Republic of China, 2019). The "ecology-first, green development" strategy, as the overarching guidance for this institutional design, is systematically elaborated in the top-level national programmatic document on accelerating the comprehensive green transformation of economic and social development (Central Committee of the Communist Party of China, and State Council of the People's Republic of China, 2024).

At the regional implementation level, the General Office of the People's Government of Inner Mongolia Autonomous Region (2022);⁴ explicitly mandates the full registration and certification of all rangeland property rights by 2025 in its official implementation rules for grassland protection and restoration, and identifies the clarification of rangeland property rights as the foundational project for regional rangeland governance.

Theoretical context and research gaps

As a typical social-ecological system, pastoral rangeland areas have long faced core challenges in property rights governance, including the "tragedy of the commons" (Hardin, 1968), "conflicts between formal institutions and informal norms" (Undargaa and McCarthy, 2016), and "insufficient policy adaptability" (Allington et al., 2024). The classic "tragedy of the commons" theory advocates solving resource overexploitation through privatization or state control (Hardin, 1968), while Ostrom's common-pool resource governance theory demonstrates that local communities can achieve sustainable resource management through self-designed rules and institutions (Ostrom, 1992). In recent years, two key research directions have emerged in this field: first, context dependence theory, which emphasizes that the effectiveness of property rights governance depends on resource variability and institutional adaptability to local contexts (Allington et al., 2024); second, scholarly debates on hybrid property rights, nested property rights systems, and Robinson's (2019) "complex mosaic property regimes," which advocate building dynamically adaptive governance systems through the decomposition and recombination of property rights bundles (Robinson, 2019; Moritz et al., 2015; Behnke, 2018; Tsering, 2024).

China's Inner Mongolia rangeland property rights system has undergone three major institutional transformations: "feudal aristocratic ownership → collective operation → Household Contract Responsibility System (HCRS)" (Li et al., 2007). Although the HCRS implemented in the 1980s stimulated short-term production enthusiasm, with the number of livestock increasing from 12.6 million in 1980 to 22.7 million in 1997, 48.6% of Xilingol's rangelands experienced severe degradation (Li et al., 2007). This echoes the ecological degradation caused by rigid property rights privatization in Kenya, Panama and other countries (Butt, 2015; Ficek, 2019). In contrast, Mongolia's hybrid system of "formal property rights coexisting with informal norms" (Allington et al., 2024) and Oman's "feed subsidies + traditional nomadism" model (Ball et al., 2020) provide important references for China's pastoral rangeland governance.

Existing studies have three key limitations: first, most focus on the regional macro level, with insufficient in-depth analysis of property rights practice contradictions at the micro banner/county scale; second, there is a lack of targeted analysis of the adaptive conditions of localized property rights governance models; third, the theoretical systematization of local practical experience needs to be improved (Li et al., 2007; Allington et al., 2024).

Research questions and significance

Against the backdrop of the socioeconomic and institutional modernization of China's pastoral regions (including the formalization of property rights, market-oriented production transformation, and state-led ecological governance), this study addresses three core research questions:

How can property rights practice in pastoral rangeland areas effectively coordinate legal norms, local informal rules, and the interests of multiple stakeholders?

What are the main types, formation mechanisms, and resolution paths of current property rights contradictions in China's desert pastoral areas?

How to achieve a balanced trade-off between conservation and development between ecological policies and property rights utilization?

Essentially, these questions respond to the core debate in global pastoral rangeland governance: what type of property rights arrangement is most suitable for the dual goals of rangeland ecological conservation and pastoralists' livelihood security (Allington et al., 2024)?

The academic value of this study is threefold: (1) It reveals the practical logic of property rights contradictions in desert rangelands based on micro-level field data, filling the research gap on property rights practice in ecologically sensitive areas; (2) It refines typical local governance models and engages in dialogue with global pastoral governance theories, enriching the application scenarios of social-ecological system theory; (3) It provides empirical support for the formulation of differentiated property rights policies, avoiding the governance dilemma of "one-size-fits-all" institutional design (Robinson, 2019).

Materials and methods

This study adopts a qualitative-dominant mixed-methods design based on an embedded single-case field survey paradigm, which is

⁴ The revised local regulation sets a mandatory target of completing full rangeland right certification by the end of 2025, and standardizes the management of rangeland use, ecological protection, and dispute resolution in Inner Mongolia.

standard for micro-institutional analysis in pastoral governance research. The research was conducted in two phases: a pilot study in July–August 2022, and a formal field investigation from July to September 2023.

Study site

The research was carried out in Honggor Gol Town, Abaga Banner, Xilingol League, a typical desert rangeland in the hinterland of the Hunshandak Sandy Land. As a key implementation area of China's 2018–2025 Rangeland Right Certification Policy, the town faces three major practical challenges closely related to the research theme: “difficulty in advancing right certification, uneven tenure distribution, and conflicts between ecological policies and production practices.” Among the 81 interviewed pastoralist households in the town, 62% reported “ambiguous rangeland boundary demarcation,” and 48% stated that “grazing ban and rest grazing policies have increased production costs” (Author's Field Survey, 81 Pastoralist Household Interviews, Abaga Banner, 2022–2023).

Ecologically, the area is dominated by desert rangeland, with an average annual precipitation of only 280 mm and rangeland vegetation coverage ranging from 55% to 65% (Abaga Banner Meteorological Bureau, 2023)⁵, which is highly representative of arid and semi-arid desert rangelands in northern China. Administratively and demographically, the town administers 8 gachas, has a pastoral population of 4,286, covers a total rangeland area of 5.82 million mu, and achieved a 78% rangeland right certification completion rate by the end of 2023. Additionally, as the birthplace of the mature “T-B hybrid rangeland governance model”⁶, the town provides a valuable localized practice sample for analyzing property rights contradiction resolution paths. These contradictory characteristics are highly consistent with the governance dilemmas of arid and semi-arid pastoral areas worldwide (Butt, 2015; Ficek, 2019).

Data collection

This study uses two complementary data sources: first-hand field data and second-hand authoritative data. For first-hand data, 81 pastoralist households were selected via stratified random sampling (stratified by gacha geographic distribution, household rangeland scale, and household head age structure) for 45–90 min semi-structured interviews, with full audio recording and verbatim transcription obtained only after voluntary oral informed consent. The interview outline covered five core dimensions: rangeland right certification, tenure allocation, dispute resolution, ecological policy response, and household production and operation. We also conducted 60–120 min interviews with 16 key informants, and completed 42 days of participatory observation to capture on-the-ground contextual information. For second-hand data, we collected 2010–2023 local meteorological data, rangeland governance policies,

regional statistical yearbooks, and global pastoral governance literature for reference. We selected interviewees according to the geographical distribution of the 8 gachas in the town, the scale of rangeland owned by pastoralist households (less than 3,000 mu, 3,000–6,000 mu, more than 6,000 mu), and the age structure of the household head, to ensure the representativeness of the 81 interviewed households covering different groups in the study area. The age of the household heads of the interviewed households ranges from 28 to 72 years old, with an average of 47 years old; the average household size is 5.2 people, with an average rangeland area of 5,800 mu per household; the main production mode is cattle and sheep breeding, with 64% of the households mainly raising cattle, 29% mainly raising sheep, and 7% engaged in diversified livelihoods such as feed sales and pastoral tourism.

Data analysis

For qualitative data, we adopted Braun and Clarke (2006) thematic analysis method, completing three-level coding via NVivo 12 software. We line-by-line coded 97 interview transcripts, extracted 218 initial coding nodes, and refined the study's core four-dimensional typological framework of rangeland property rights contradictions, with the constant comparison method applied to ensure all analysis was strictly grounded in original data. For quantitative data, we conducted descriptive statistical analysis of closed-ended survey data, and built a standardized full cost-benefit accounting framework for the T-B Model, with all parameters sourced from local pastoralists' actual production data.

Results

Rangeland right certification contradictions: ambiguous boundaries and policy implementation deviations

Manifestations of contradictions

The core manifestations of this category include undefined cross-regional boundaries, historical land allocation deficits, and neighborhood conflicts triggered by frequent boundary adjustments. For example, in Bayan Qinggeli Sum (with 380,000 mu of rangeland), cross-border areas with Lan Banner and other regions in Xilingol League have unclear ownership due to administrative barriers. In addition, 20,000 mu of rangeland in the sum has been occupied by the military, with a long-term absence of a reasonable compensation mechanism. In an interview, Tuya⁷, Women's Director of Bayan Qinggeli Sum, noted: “Up to now, the right certification work in our sum has not been completed, and some borders with Lan Banner

5 Meteorological data for Abaga Banner (2023), including annual precipitation and vegetation coverage statistics, were obtained directly from the official records of the Abaga Banner Meteorological Bureau, Inner Mongolia, during field investigations in July–September 2023.

6 5T–B is a pseudonym used to protect the identity of a well-known local pastoralist leader at the study site; this denotation is used uniformly in the subsequent text.

7 An elected official in the sum-level government responsible for women's affairs, pastoral livelihood support, and grassroots community governance, with long-term on-the-ground knowledge of local rangeland disputes. To protect the confidentiality and anonymity of our study participants, the personal name used herein is a pseudonym; this anonymization convention applies consistently to all personal names referenced in the remainder of the manuscript.

and Xilingol League remain undefined, leading to frequent disputes among pastoralists when grazing in the border areas”⁸.

Contradictions also manifest in historical land allocation deficits. During the distribution of mowing rangeland in 1983, some long-term⁹ local households received insufficient land allocations. During the 2022 rangeland right certification, only 90 mu per household was supplemented to pastoralists with insufficient rangeland allocations, while the actual land deficit of some households still reaches 2,000 mu, triggering disputes over “unfair supplementary allocation.” This unequal distribution originated in the 1983 rangeland allocation, where the initial distribution was based solely on household population size at that specific point in time, with no formal mechanism for subsequent adjustments as household demographics changed over the following 40 years. Households with population growth in the intervening decades have faced persistent rangeland deficits, while households with reduced population have retained their original allocation, creating a growing inter-household and intergenerational gap in rangeland access. Ulzii from Bayan Burd Sum reflected: “In 1983, my family of 5 was only allocated 5,000 mu of rangeland. Now the family size has increased to 8, but only 90 mu was supplemented in 2022, which is far from meeting the actual needs, while some long-term households own tens of thousands of mu of rangeland”¹⁰.

Frequent small-scale rangeland boundary adjustments (200–300 mu) have also intensified neighborhood conflicts, breaking the traditional pastoralist negotiation model of “reaching a general consensus”—a long-standing localized governance model that had been effectively used by local pastoralists for generations. In this model, neighboring pastoralist households resolved boundary and grazing disputes through flexible, mutually accommodative verbal agreements, rather than rigid formal demarcation. This model had functioned effectively for centuries to maintain community harmony and adapt to ecological variability in the region, but has been undermined by the formal right certification process’s focus on precise, fixed boundary demarcation. Mr Xu from Sarulatu Ya Sum pointed out: “A general agreement is sufficient. Repeatedly changing rangeland boundaries and dividing 200–300 mu of rangeland will breed many conflicts. Many problems can be solved by mutual accommodation without overly precise division”¹¹.

Such contradictions are common in global pastoral areas: land privatization in Kenya’s Maasai Mara has led to frequent border disputes (Butt, 2015), and formal property rights registration in some parts of Mongolia has been resisted by

pastoralists due to boundary demarcation issues (Allington et al., 2024).

Formation mechanisms of contradictions

The lack of an effective cross-administrative coordination mechanism for right certification between banners/counties and sums has resulted in “multiple management with no clear accountability” for cross-regional boundaries, which contradicts the core principle of “multi-level right coordination” emphasized in Robinson’s (2019) complex mosaic property regimes framework. Director Bao from Abaga Banner’s Agriculture and Animal Husbandry Bureau pointed out: “Right certification within the banner is mainly responsible for rangelands within the banner’s jurisdiction, while border issues with other banners/counties require coordination at the league level. Currently, there is no special coordination mechanism, leading to slow progress in the work”¹².

The disconnect between historical allocation and current reality stems from the lack of dynamic adaptability of the property rights system. The 1980s policy of “allocating rangeland according to population size” failed to anticipate long-term population changes, forming an intergenerational allocation gap. This is consistent with the widespread problem of “static property rights” after the implementation of China’s HCRS (Li et al., 2007). Most pastoralists born after 1991 have not been allocated any rangeland, resulting in a structural intergenerational distribution gap. Buren Bayar from Ganggen Xili Village reflected: “Young people born in the 1990s have not been allocated any rangeland. Only those born before 1991 have rangeland. Now young people can only make a living by renting rangeland or working outside the pastoral area”¹³.

A deeper structural contradiction lies in the inherent tension between the “exclusivity” of formal private property rights and the “mobility” of rangeland resources (Karplus and Meir, 2013). The design of fixed, exclusive boundaries has blocked traditional pastoralist strategies to cope with ecological variability and climate uncertainty.

Rangeland tenure contradictions: intergenerational allocation imbalance, intra-family distribution disputes, and collective rangeland governance failures

Manifestations of contradictions

Core manifestations include intergenerational tenure imbalance, intra-family distribution disputes, and low operational efficiency of collective rangelands. The post-1990s birth cohort faces a widespread dilemma of “having household registration but no rangeland allocation.” The scale of rangeland owned by

8 Interview with Tuya, Women’s Director of Bayan Qinggeli Sum, Abaga Banner, July 2023.

9 Native pastoralist families that have lived in the area for multiple generations and received larger initial rangeland allocations in the 1980s.

10 Interview with Ulzii, Bayan Burd Sum, Abaga Banner, August 2023.

11 Interview with Mr Xu, Sarulatu Ya Sum, Abaga Banner, August 2023.

12 Interview with Director Bao, Abaga Banner Agriculture and Animal Husbandry Bureau, September 2023.

13 Interview with Buren Bayar, Ganggen Xili Village, Abaga Banner, July 2023.

pastoralists in northern Abaga Banner is more than 10 times that of those in the southern part of the banner. For example, Mr He's family from Alatan Tuge Village owns more than 8,600 mu of rangeland, while some pastoralist households in southern Ganggen Xili Village (5 people per household) only have 5,000 mu, showing a significant gap in *per capita* rangeland area. Mr He pointed out: "One person's rangeland in Xi Ujimqin Banner is more than that of our entire family. Some people rent 10,000 mu and still have 20,000 mu of their own, while we have more people and less land here¹⁴."

Intra-family distribution is also a major source of conflict. The operation right of family-shared rangeland (such as Mr He's 8,600 mu) is often concentrated in the hands of one household member, and the distribution of rangeland subsidies relies on "humanitarian negotiation," which is prone to interest conflicts among family members. Mr. He mentioned in the interview: "The rangelands of my parents and two sisters are all managed by me alone, and the rangeland subsidies need to be distributed to my parents and sisters. Sometimes uneven distribution leads to disagreements, but since we are a family, we can only resolve them through slow negotiation¹⁵."

The operational efficiency of collective rangelands is generally low. Most sums have not established standardized operation mechanisms for collective rangelands. The operational efficiency of collective rangelands is generally low, defined by two core failures: first, most collective rangelands lack standardized, transparent management rules and benefit-sharing mechanisms, leading to widespread overgrazing and "free-rider" use by households, with no sustained investment in ecological restoration; second, collective rangelands rarely generate stable economic returns for local pastoralist households, with most remaining idle or informally occupied by a small number of households, rather than being managed to deliver shared livelihood or ecological benefits to the community. Only Bayan Burd Sum has achieved a "dividend of 390–430 yuan per cow per year" through the collective economy, which has demonstration significance but has not been widely popularized. Ulzii from this sum said: "Last year, the collective economy distributed a dividend of 390 yuan per cow, and this year it has increased to 430 yuan. After the completion of right certification, we will establish a cooperative. For example, if I have 500 mu of land and others have 500 cows, we can all become shareholders and receive dividends according to the shares at the end of the year¹⁶."

This is highly consistent with the universal contradiction of "conflicts between formal institutions and informal norms" in global pastoral areas: China's HCRS emphasizes "individual contracting with clear rights and responsibilities," but traditional pastoral areas in Inner Mongolia have long relied on informal rules of "community mutual assistance and seasonal shared rangelands" (Li et al., 2007). Pastoralists in Mongolia's

desert rangelands also divide grazing areas through long-standing verbal agreements (Allington et al., 2024).

Formation mechanisms of contradictions

The static nature of tenure arrangements violates the core claim of context dependence theory — property rights arrangements need to adapt to dynamic changes in resources and population (Allington et al., 2024). After certification, rangeland tenure remains unchanged for a long time, and no dynamic adjustment mechanism linked to population changes has been established. The deputy secretary Batu of Bayan Qinggeli Sum reflected: "When I was the secretary in 1997, my family of 5 owned 5,000 mu of rangeland. Now the population has increased, but the rangeland area remains the same. We can only allocate a small amount from the collective rangeland¹⁷."

The lack of formalized rules leads to the dependence of family and collective tenure distribution on "local humanitarian rules" without legal protection. This confirms the research conclusion of Undargaa and McCarthy (2016) that informal norms often play a more effective role in local resource distribution than formal institutions, and the degree of coordination between the two determines governance effectiveness. Odontuya from Ihe Boleg Sum mentioned: "Although there is mutual assistance among pastoralists, such as the two neighboring households of Jiao and Wu, their relationship has become tense due to disputes over boundary trees during the previous right certification. If there had been a written agreement at that time, the situation would have been much better¹⁸."

The root cause of the low efficiency of collective rangelands lies in the lack of core elements of the small-scale collective co-governance model: appropriate group size, high social trust, and low-cost implementation mechanisms (Iannotti and Lesorogol, 2014).

Property rights dispute resolution contradictions: judicial ineffectiveness and insufficient mediation mechanisms

Manifestations of contradictions

Micro-level boundary disputes between pastoralist households, caused by "boundary trees and the location of wire mesh fences," account for more than 80% of total rangeland property rights disputes. For example, two households in Ihe Boleg Sum had a broken relationship due to disputes over the ownership of boundary trees. Bidao from this sum said: "Rangeland disputes between pastoralists are difficult to resolve even if brought to court; disputes between sums ultimately require government intervention, and small disputes between households are more frequent, rooted in unclear boundaries¹⁹."

14 Interview with Mr He, Alatan Tuge Village, Abaga Banner, August 2023.

15 Interview with Mr He, Alatan Tuge Village, Abaga Banner, August 2023.

16 Interview with Ulzii, Bayan Burd Sum, Abaga Banner, August 2023.

17 Interview with Batu of Bayan Qinggeli Sum, Abaga Banner, September 2023.

18 Interview with Odontuya, Ihe Boleg Sum, Abaga Banner, July 2023.

19 Interview with Bidao, Ihe Boleg Sum, Abaga Banner, July 2023.

Judicial decisions on cross-sum disputes face severe enforcement difficulties. Judicial channels are largely ineffective in resolving disputes over ambiguous rangeland boundaries, and must rely on administrative intervention from the town or sum government to reach a resolution. For example, a cross-sum rangeland dispute took 6 months to reach a consensus through administrative coordination. Mayor Zang of Honggor Gol Town pointed out: “After a court decision on cross-sum rangeland disputes, enforcement is difficult due to the lack of clear boundary markers. In the end, the government still needs to organize both parties to conduct on-site surveys and resolve the dispute through negotiation²⁰.” Similar phenomena are common in Mongolia, Kenya and other countries, where the formal judicial system often fails due to the lack of localized evidence support (Allington et al., 2024; Butt, 2015).

Formation mechanisms of contradictions

The lack of judicial adaptability is essentially a disconnect between formal legal institutions and local pastoral practices. The formal legal system prioritizes “property rights certificates” as the core evidence, but rangeland boundaries in pastoral areas mostly rely on “pastoralists’ oral traditions and historical memory,” leading to insufficient admissible evidence and difficulty in enforcing judicial judgments. Police Officer Ao from Honggor Gol Town Police Station pointed out: “Many rangeland disputes lack written documents, and only rely on the oral testimony of older people pastoralists, making it difficult for courts to determine. Even if a judgment is made, enforcement faces significant difficulties²¹” (Li et al., 2007).

The lack of grassroots mediation mechanisms violates the core principle of Ostrom’s common-pool resource governance theory — establishing local supervision and conflict resolution mechanisms (Ostrom, 1992). Most sums have not established specialized mediation organizations, and dispute resolution mainly relies on “voluntary participation of prestigious pastoralists,” lacking stability and professionalism. Secretary E from Bayan Tu Sum said: “At present, there is no special mediation team in the sum. When disputes arise, we can only seek help from old party members or prestigious pastoralists. Sometimes no one is willing to come forward, and we have to turn to the town-level department for help²².”

The successful experience of community-based rangeland management (CBRM) organizations in Mongolia’s forest rangelands in resolving disputes through collective negotiation (Allington et al., 2024) confirms the critical importance of localized grassroots mediation mechanisms.

Contradictions between ecological policies and property rights implementation: policy rigidity and disconnection from production realities

Manifestations of contradictions

Ecological protection costs are largely shifted to pastoralist households. During the 45-day rest grazing period, the daily feed expenditure of a typical pastoralist household exceeds 1,000 yuan (a total of 40,000–60,000 yuan for the full 45 days). In 2023, the rest grazing period was extended by 15 days, resulting in an additional cost of 90,000 yuan for Secretary Buren’s family, which is close to 30% of the annual profit from cattle breeding. Buren Bayar said: “During the 45-day rest grazing period, it costs 2,000 yuan per day, and 90,000 yuan is gone just like that. This year, there is an extra 15-day indoor feeding period, which has a really big impact on pastoralists. We need to prepare much more forage²³.”

The subsidy standard is severely unbalanced with actual costs. The grazing ban subsidy is only 0.79 yuan per sheep unit, which can only cover 10% of the additional feed cost incurred by the policy. Pastoralists directly stated: “The subsidy money is spent quickly; it’s better to distribute forage directly.” A household from Ganggen Xili Village pointed out: “The grazing ban subsidy is 0.79 yuan. How many sheep can that feed? This subsidy is simply not enough. It’s better to give forage directly, which can really help pastoralists²⁴.”

The implementation effect of ecological compensation policies deviates significantly from the original policy goals. In drought years with little rainfall, the grazing ban leads to “no grass growth but mandatory indoor feeding”; in years with abundant rainfall, the grazing ban “wastes rangeland resources.” For example, pastoralists from Ganggen Xili Village reflected: “When there is heavy rain, ecological protection can be achieved even without a grazing ban²⁵.” Mr He from Alatan Tuge Village mentioned: “This is closely related to the annual climate. When there is no rain, the grazing ban is useless. When there is sufficient rainfall, not only do livestock have grass to eat, but we can also mow grass — one mu of land can produce 200–300 jin of grass²⁶.”

This is consistent with the universal dilemma of “imbalanced coordination between property rights reform and conservation-livelihood goals” in global pastoral areas: China’s HCRS has led to widespread rangeland degradation and a surge in forage costs (Li et al., 2007), while land privatization in Kenya has intensified ecological pressure and the wealth gap (Iannotti and Lesorogol, 2014).

20 Interview with Mayor Zang, Honggor Gol Town, Abaga Banner, September 2023.

21 Interview with Police Officer Ao, Honggor Gol Town Police Station, Abaga Banner, September 2023.

22 Interview with Secretary E, Bayan Tu Sum, Abaga Banner, August 2023.

23 Interview with Buren Bayar, Ganggen Xili Village, Abaga Banner, July 2023.

24 Interview with Pastoralist Household D, Ganggen Xili Village, Abaga Banner, August 2023.

25 Interview with Ganggen Xili Village Pastoralists, Abaga Banner, August 2023.

26 Interview with Mr He, Alatan Tuge Village, Abaga Banner, August 2023.

Formation mechanisms of contradictions

The “one-size-fits-all” policy design ignores the particularity of “highly variable precipitation” in desert rangelands, violating the core principle of context dependence theory (Allington et al., 2024). The grazing ban and rest grazing periods are uniformly set across the region, ignoring significant spatial and temporal differences in ecological conditions. Data from the Abaga Banner Meteorological Bureau (2023) shows that the annual precipitation fluctuation range of the banner is 180–350 mm. However, the grazing ban and rest grazing periods have not been adjusted according to actual precipitation conditions, leading to significant differences in policy effects across regions.

Insufficient interest compensation forms an unfair pattern of “pastoralists bearing conservation costs while the whole society shares ecological benefits.” This is essentially consistent with the problem of unfair distribution of property rights benefits in Panama, Inner Mongolia and other regions (Ficek, 2019; Tan et al., 2018). Ecological policies focus too much on “conservation goals” and fail to establish a compensation mechanism matching the actual losses of pastoralists, forming an unfair cost-sharing structure. Buren Bayar from Ganggen Xili Sum reflected: “The rangeland subsidy is only 3 yuan per mu, totaling 7,500 yuan for 2,500 mu of rangeland. Such subsidies should play a role in improving productivity, power grid construction, road improvement, and mechanical equipment. The simple cash subsidy has limited practical effect; pastoralists actually engaged in animal husbandry production need more support in these aspects²⁷.”

The core of the contradiction lies in the fact that the property rights system has not fully considered the public good attribute of rangeland ecology and the livelihood dependence of pastoralists, leading to the opposition between “ecological conservation” and “livelihood security” (Hardin, 1968; Ostrom, 1992).

Discussion

Local practical experience and global theoretical foundations

Practices of right certification and tenure optimization

Some areas have implemented supplementary allocation of collective rangeland to households with historical deficits, accompanied by the upgrading of wire mesh fence materials. During the 2022 right certification, 90 mu of rangeland was supplemented to each household with insufficient rangeland allocations, and old fences were replaced with willow and pine stakes to improve the stability of boundary markers and reduce subsequent boundary disputes. The operator of Anlong Hotel said: “Four or five merchants sell stakes. Many sums are conducting right certification, so the stakes need to be re-divided, and pastoralists need to buy new stakes. The price of stakes is

about ten yuan, with different thicknesses. Willow and pine are of better quality and relatively higher price²⁸.”

In terms of family-collective coordination, Mr. He’s family resolved intra-family conflicts through the model of “centralized operation right in one household member and subsidy distribution according to agreed shares”; Bayan Burd Sum is preparing to establish a “rangeland + livestock shareholding cooperative” to realize large-scale operation of collective rangelands. Ulzii from Bayan Burd Sum said: “After the completion of right certification, we will establish a cooperative. For example, if I have 500 mu of land and others have 500 cows, we can all become shareholders and receive dividends at the end of the year²⁹.”

These practices are consistent with Mongolia’s hybrid model of “formal property rights + informal norms” (Allington et al., 2024) and China’s exploration of “household contracting + community rotational grazing” (Liu et al., 2020), with the core of achieving dynamic institutional adaptation through the reorganization of property rights bundles (Robinson, 2019). The preparation plan for the collective cooperative in Bayan Burd Sum aligns with the successful conditions of the small-scale collective co-governance model—appropriate group size and a clear benefit-sharing mechanism (Iannotti and Lesorogol, 2014).

Practices of dispute resolution and ecological adaptation

The dispute resolution model combining neighborhood negotiation and administrative intervention confirms Undargaa and McCarthy’s (2016) conclusion that “informal norms often outperform formal institutions in local pastoral governance.” Small inter-household disputes are resolved through “mutual accommodation,” while cross-sum disputes rely on “on-site surveys + multi-party forums” organized by the local government. As Mr Xu from Sarulatu Ya Sum said: “A general agreement is sufficient. Repeatedly adjusting rangeland and dividing 200–300 mu will only increase contradictions. Everything can be solved by mutual accommodation³⁰.”

Mr He’s successful approach of compensating for policy-induced losses through livelihood diversification and breed optimization provides a practical reference: he offset losses during the rest grazing period by operating a feed store (annual sales volume of 30–40 tons) and selected cold-resistant cattle breeds to reduce warm shed costs, thereby reducing the impact of ecological policies on household income. Mr He mentioned: “During the rest grazing period, there’s nothing to do for 45 days. So I set up a family ranch and got the certificate. I also opened a feed store in Abaga Banner³¹.” “My cattle didn’t go out at all during the rest grazing period last winter, even though there was almost no snow. Other people’s cattle have to be kept in warm sheds, but mine can survive the winter in the wild³².”

28 Interview with Anlong Hotel Operator, Abaga Banner, August 2023.

29 Interview with Ulzii, Bayan Burd Sum, Abaga Banner, August 2023.

30 Interview with Mr Xu, Sarulatu Ya Sum, Abaga Banner, August 2023.

31 Interview with Mr He, Alatan Tuge Village, Abaga Banner, August 2023.

32 Interview with Mr He, Alatan Tuge Village, Abaga Banner, August 2023.

27 Interview with Buren Bayar, Ganggen Xili Sum, Abaga Banner, July 2023.

This is similar to Oman's "feed subsidies + traditional nomadism" model (Ball et al., 2020), with the core of reducing the impact of ecological policies through livelihood diversification.

The T-B model: a localized hybrid governance framework

Applicable conditions and core positioning

The core economic activity of the study population is grassland animal husbandry, which is the main source of household income (accounting for 87% of the total household income on average). The specific production and operation characteristics are as follows:

Livestock breed and scale: The main breeding breeds are Simmental improved cattle, local Mongolian cattle, and Mongolian sheep. Among the 81 interviewed households, 64% are mainly engaged in cattle breeding, 29% are mainly engaged in sheep breeding, and 7% have a mixed breeding structure of cattle and sheep. The average breeding scale of cattle-breeding households is 28 basic cows per household, with an average rangeland area of 6,200 mu per household; the average breeding scale of sheep-breeding households is 420 sheep per household, with an average rangeland area of 5,800 mu per household.

Product types and sales channels: The core products of the study population are live cattle and sheep, beef and mutton, and a small amount of wool and cashmere. 76% of the products are sold to local livestock brokers and slaughterhouses in Abaga Banner and Xilingol League; 18% of the products are sold through offline direct sales and online e-commerce channels to Hohhot, Beijing and other cities outside the league; only 6% of the products are used for household consumption and traditional reciprocal exchange among pastoralists.

Livelihood diversification: In addition to animal husbandry, 19% of the interviewed households have diversified livelihood activities, including operating feed stores, pastoral tourism, transportation services, and part-time work in local government and enterprises, which is an important way for pastoralists to cope with the cost pressure brought by ecological policies, as revealed in the subsequent analysis.

The T-B model is applicable to desert rangeland areas such as the Hunshandak Sandy Land, especially ecologically sensitive areas with annual precipitation of 200–300 mm and rangeland vegetation coverage below 60%. Honggor Gol Town, where the model was developed, has an average annual precipitation of 280 mm and is dominated by desert rangeland, which is consistent with the ecological conditions of most areas in Abaga Banner.

Its core goal is to achieve a "win-win outcome for ecology and economy": increase rangeland vegetation coverage by 3%–5% annually, reduce desertification area by more than 2%, and realize a sustainable cycle of "grass-livestock balance"; its economic goal is to increase the annual net household income to 150,000–200,000 yuan, reduce breeding costs by 20%–30%, and mitigate the livelihood risk of "climate-dependent income volatility."

This is highly consistent with the dynamic adaptation proposition of Robinson's (2019) complex mosaic property regimes framework. The model not only avoids the ecological degradation caused by the rigid privatization model (Hardin,

1968; Li et al., 2007) but also overcomes the efficiency dilemma of pure collective operation, forming a hybrid governance structure of "individual rights and responsibilities + collective coordination."

Specific operational norms

Livestock breed and scale control: The core breeds are Simmental improved cattle (80%) and local Mongolian cattle (20%), selected for their cold resistance, roughage tolerance, and high meat production rate; elimination criteria are set for cows over 12 years old with an annual calving rate below 70%, and bulls with weak constitution and slow growth, with the annual elimination rate strictly controlled within 10%. Table 1 presents a summary overview of the four principal types of rangeland property rights contradictions identified in the study area, along with their primary manifestations.

Reasonable stocking rate configuration: 30 basic cows (including 5 replacement heifers) and 2 breeding bulls, with an annual output of 15–18 calves (survival rate maintained above 90%). According to the "Hoof and Leg Theory" that "5 sheep are equivalent to 1 cow," the rangeland pressure of 30 cows is only equivalent to 150 sheep, which is much lower than the traditional model of "raising 500 sheep on 6,000 mu of rangeland," effectively reducing rangeland trampling intensity by 70%.

The operations such as rangeland zonal management, livestock breed optimization, and rotational grazing system design essentially control rangeland carrying pressure through the "Hoof and Leg Theory," which is consistent with the "resource quota mechanism" in Ostrom's common-pool resource governance theory (Ostrom, 1992). The conversion standard of 30 cows equivalent to 150 sheep effectively reduces rangeland trampling intensity by 70%, confirming Allington et al.'s (2024) conclusion that "property rights arrangements need to adapt to ecological carrying capacity." Table 2 provides illustrative examples of the inter-household and intergenerational disparities in rangeland allocation that characterise tenure contradictions in the region.

Cost-benefit accounting and outcome analysis

Outcome analysis: The annual net profit is 175,000 yuan (216,000 yuan total income minus 41,000 yuan total cost), with a *per capita* net profit of 87,500 yuan (calculated based on 2 household laborers). After 5 years of implementation, the rangeland vegetation coverage increased from 55% to 75%, the forage height increased from 15 cm to 30cm, and the desertified area decreased by 120 mu. Table 3 outlines the key operational parameters of the T-B model, including livestock breed composition, stocking rate configuration, and rangeland management practices. A detailed cost-benefit comparison between the T-B model and the traditional pastoral production model is shown in Table 4, highlighting the economic and ecological advantages of the hybrid governance framework.

Compared with the traditional model (raising 500 sheep on 6,000 mu of rangeland, with an annual net profit of about 80,000 yuan and an average annual decrease of 2% in rangeland vegetation coverage), the T-B model achieves a dual benefit of "doubled household profit + continuous ecological improvement."

This outcome outperforms the long-term performance of China's traditional HCRS model (Li et al., 2007), and echoes the

TABLE 1 Rangeland planning and zonal management of the T-B model.

Partition Type	Area Proportion	Core Function	Management Requirements
Mowing rangeland	30% (1,800 mu)	Winter forage reserve	Mow in mid-to-late August annually, with a stubble height of 8–10 cm; over-mowing is strictly prohibited
Grazing rangeland	60% (3,600 mu)	Spring, summer and autumn grazing	Divided into 3 rotational grazing plots, with each plot grazed for 30–40 days before rotation
Ecological restoration area	10% (600 mu)	Desertified and degraded rangeland restoration	Grazing prohibited throughout the year; planted with native drought-tolerant plants such as <i>artemisia desertorum</i> and <i>leymus chinensis</i>

TABLE 2 Seasonal management process of the T-B model.

Season	Time Range	Management Key Points
Spring	April-May	Indoor feeding during the rest grazing period, with 5 kg of green hay + 0.5 kg of concentrate per cow per day; transfer to rotational grazing plots at the end of May
Summer	June-August	Full-day grazing, with 50 g of salt supplemented per cow per day, drinking water provided once in the evening, and fattening during the period of vigorous forage growth
Autumn	September-November	Graze the mowed stubble land first, reserve forage in late October, with 1,500 kg of green hay + 500 kg of silage reserved per cow
Winter	December-March	Mainly indoor feeding, with 8 kg of green hay + 3 kg of silage per cow per day; supplement 1 kg of concentrate per cow per day when the temperature is below -30°C

TABLE 3 Annual Cost Details of the T-B Model (6,000 mu of rangeland + 30 cattle).

Cost Item	Amount (yuan)	Calculation Basis
Forage cost	18,000	$30 \text{ cattle} \times (1500 \text{ kg of green hay} \times 0.15 \text{ yuan/kg} + 500 \text{ kg of silage} \times 0.3 \text{ yuan/kg})$
Concentrate cost	9,000	$6 \text{ months (rest grazing period + winter), } 0.5 \text{ kg/cow/day} \times 30 \text{ cows} \times 180 \text{ days} \times 3 \text{ yuan/kg}$
Epidemic prevention and medical cost	6,000	$30 \text{ cattle} \times 200 \text{ yuan/cow}$
Machinery depreciation cost	5,000	Annual depreciation of mowing machines, tractors, and other equipment
Total cost	41,000	-

TABLE 4 Annual Income Details of the T-B Model (6,000 mu of rangeland + 30 cattle).

Income Item	Amount (yuan)	Calculation Basis
Calf sales income	180,000	Annual output of 15 calves, average selling price of 12,000 yuan/calf (6 months old, weight 300 kg)
Culled cow income	18,000	Cull 3 older people cows, average selling price of 6,000 yuan/cow
Total income	216,000	-

governance effects of Mongolia's CBRM model (Allington et al., 2024) and Kenya's small-scale cooperative organizations (Iannotti and Lesorogol, 2014), proving the adaptive advantage of hybrid property rights models in ecologically sensitive areas.

Promotion adaptability recommendations

The division of priority promotion areas and restricted promotion areas depends on regional ecological and socioeconomic conditions: priority promotion areas include

desert rangeland areas such as Abaga Banner and Sonid Left Banner in Xilingol League, as well as ecologically sensitive areas with annual precipitation of 200–300 mm; restricted promotion areas are extremely arid areas with annual precipitation below 150 mm (requiring supporting irrigation facilities) and small-scale pastoralist households with rangeland area less than 3,000 mu (facing low economies of scale).

Adhering to the core principle of context dependence theory (Allington et al., 2024), targeted policy support is required, including technical training, equipment subsidies, and special incentives:

Technical training: The banner-level Agriculture and Animal Husbandry Bureau organizes “theoretical + practical” training courses, focusing on core technologies such as rotational grazing planning, calf breeding, and cost control, with each training lasting 3 days and covering 100 households;

Equipment subsidies: Provide a 30% purchase subsidy for pastoralists buying mowing machines and silage cellars, with a maximum subsidy of 50,000 yuan per household;

Special incentives: Issue an additional “grass-livestock balance reward” to pastoralists adopting the model at a standard of 10 yuan per mu.

Drawing on the experience of Oman’s hybrid model of “government feed subsidies + traditional norms” (Ball et al., 2020), the feasibility of model promotion is improved through the coordination of formal institutional guarantees and informal practice guidance.

Policy optimization recommendations

Establish a collaborative cross-administrative right certification mechanism

Coordinate cross-regional right certification by establishing a “league-banner-sum” joint working group, which aligns with the “multi-level right coordination” emphasized in Robinson’s (2019) complex mosaic property regimes framework. Led by the league-level government, the joint working group should complete the ownership demarcation of undefined cross-administrative borders within 6 months, establish standardized electronic files, and make public announcements. Working group members should include representatives from the league’s Agriculture and Animal Husbandry Bureau, Natural Resources Bureau, relevant banner/county officials, and pastoralist representatives, to ensure that the certification results are recognized by all stakeholders.

A dynamic compensation mechanism, evaluated every 3 years, should be established to prioritize supplementing rangeland to households with historical allocation deficits and young pastoralists born after 1991. This not only resolves historical legacy issues but also adapts to dynamic population changes. Based on the “household population changes + rangeland deficit” situation, 15% of the collective rangeland quota should be reserved for supplementary allocation. The evaluation process should comprehensively consider the actual needs of pastoralists and rangeland quality, abandon the practice of “equalitarianism,” and ensure the fairness and rationality of compensation measures, avoiding the drawback of “static property rights” in the traditional HCRS model (Li et al., 2007).

Improve a standardized and dynamic tenure system

A dynamic tenure adjustment mechanism should be established to clarify the “population change - tenure adjustment” rules, and standardize agreement management through formal written distribution agreements. Specifically,

the adjustment ratio corresponding to “population increase (e.g., newborns) and decrease (e.g., women marrying out)” should be clearly defined to prevent intergenerational imbalance: newborns can enjoy 10% of the use right of the family’s rangeland, and married women have the right to choose to retain or withdraw from the original rangeland tenure, ensuring that the tenure adjustment process has clear and enforceable rules.

The agreement management process should be standardized. The sum government should be responsible for assisting pastoralists in formulating “family tenure distribution agreements” and “collective cooperative charters,” clearly defining the specific rules for operation, income distribution, and subsidy allocation, and submitting them to the sum government for filing. The agreement content must include core clauses such as rangeland area, use period, income distribution ratio, and dispute resolution mechanism, to avoid subsequent disputes caused by unclear verbal agreements.

This not only respects the traditional mutual assistance norms of pastoralists (Undargaa and McCarthy, 2016) but also reduces dispute risks through formal institutional constraints. The formulation of collective cooperative charters draws on the successful experience of the small-scale collective co-governance model (Iannotti and Lesorogol, 2014), balancing individual rights and responsibilities with collective interests.

Build a professional multi-level dispute resolution system

A sum-level professional mediation team should be established, composed of veteran party members, veterinarians, prestigious pastoralists, and legal consultants. The team is responsible for mediating inter-household disputes and must issue formal mediation opinions within 30 days. The mediation team needs to establish detailed mediation files, record the specific situation of the dispute, the mediation process, and the final result, and regularly report the work progress to the sum committee. This aligns with the “local supervision and conflict resolution” core element of Ostrom’s common-pool resource governance theory (Ostrom, 1992).

An “administrative + judicial” linkage mechanism should be established to recognize localized evidence such as “pastoralists’ oral testimony and historical photos.” Judicial departments and the local government should jointly formulate the Guidelines for Evidence in Rangeland Property Rights Disputes, recognizing localized evidence to improve the enforceability of judicial judgments. For disputes that cannot be resolved through mediation, the government can issue a formal “boundary confirmation opinion” as an important basis for judicial decisions, thereby realizing an effective connection between administrative and judicial governance.

This mechanism solves the problem of insufficient judicial adaptability (Li et al., 2007), and is consistent with Mongolia’s practice of coordinating conflicts through community-based organizations (Allington et al., 2024).

Implement differentiated and context-adaptive ecological policies

Grazing ban and rest grazing policies should be dynamically adjusted according to annual precipitation conditions, divided into three grades: “wet,” “normal,” and “drought,” corresponding to shortening, maintaining, or canceling the rest grazing period respectively. For example, when annual precipitation exceeds 300 mm, the rest grazing period is shortened from 45 days to 30 days; when it is less than 200 mm, the mandatory rest grazing period is canceled to avoid the disconnection between policies and actual ecological conditions. Precipitation data is based on the annual data provided by the banner/county meteorological bureau to ensure the scientificity and rationality of adjustments. This follows the core claim of context dependence theory (Allington et al., 2024), avoiding the “one-size-fits-all” policy design.

The subsidy distribution method should be optimized: increase the grazing ban subsidy standard to 2-3 yuan per sheep unit, or adopt a “50% cash + 50% forage” distribution model. At the same time, provide an additional subsidy of 100 yuan per ton of forage to pastoralists implementing the “reducing sheep and increasing cattle” strategy to promote the T-B model. Subsidy distribution should be closely linked to the ecological status of rangelands, with additional rewards given to pastoralists with significant ecological improvement, to form a positive incentive mechanism. This balances ecological conservation and pastoralists’ livelihoods through a targeted interest compensation mechanism, solving the problem of “protection cost shifting” (Ficek, 2019; Tan et al., 2018).

Conclusions and future directions

Core findings

Property rights contradictions in pastoral rangeland areas exhibit a highly intertwined and complex characteristic. The four core types of contradictions (right certification, tenure allocation, dispute resolution, and ecological policy mismatch) are mutually reinforcing, and essentially stem from conflicts in three dimensions: the “exclusivity” of formal property rights and the “mobility” of rangeland resources, formal legal institutions and local informal norms, and ecological conservation and pastoralists’ livelihood security (Karplus and Meir, 2013; Undargaa and McCarthy, 2016). Resolving these contradictions requires coordinated governance from multiple dimensions such as administration, law, and local norms; addressing only one type of contradiction is difficult to fundamentally improve property rights practice, and a systematic governance strategy must be adopted.

The essence of effective property rights practice is “two-way adaptation” between formal institutions and local realities. Top-down policies need to adapt to pastoral realities (through dynamic certification, differentiated ecological policies), and bottom-up pastoralist practices need to adapt to modern institutional norms (through standardized agreements, participation in cooperatives). This is consistent with the core claims of Robinson’s (2019) complex mosaic property regimes framework and context dependence theory (Allington et al., 2024). Only by achieving mutual adaptation between policies

and local practices can a sustainable and resilient property rights system be constructed.

The T-B model, through “reducing sheep and increasing cattle” and scientific zonal management, achieves a win-win outcome for ecological conservation and economic development. Its essence is the localized practice of a hybrid property rights governance model, providing a replicable property rights utilization framework for desert rangeland pastoral areas, and effectively avoiding the binary opposition between conservation and development (Ostrom, 1992; Li et al., 2007). The model has significant demonstration value for the governance of ecologically sensitive pastoral areas in China and globally.

Research limitations and future directions

This study focuses on the desert rangeland areas of Abaga Banner, and the findings may have limited generalizability to typical steppe areas with different ecological conditions. Future research can expand the study area to the entire Xilingol League, compare the differences in property rights practices between desert rangelands and typical steppes, and refine more generalizable conclusions. At the same time, the research objects can be expanded from pastoralist households to multiple stakeholders such as government departments and enterprises, to conduct an in-depth analysis of the interaction mechanisms among different stakeholders in property rights practice.

In terms of quantitative research, future studies can conduct a quantitative analysis of the specific impact of various property rights contradictions on pastoralists’ household income through large-scale pastoralist questionnaires and detailed cost-benefit accounting, to provide more accurate data support for policy optimization. In addition, GIS technology can be used to map rangeland tenure distribution, to intuitively show the status of property rights boundaries and provide strong technical support for right certification work. Finally, future research should further strengthen dialogue with global pastoral governance theories, improve the theoretical systematization of local practical experiences, and provide Chinese solutions for the design of property rights systems in global ecologically sensitive areas.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

This study employs questionnaire surveys to collect data from adult participants. The research does not involve clinical trials, animal experiments, or vulnerable groups, and thus does not require ethical approval. All participants provided informed consent prior to participation, and their personal information and survey data have been strictly kept confidential and desensitized.

Author contributions

The author is the sole contributor. Independently completed all research and publication work: conceived the research theme of grassland pastoral area property rights contradictions, designed the framework and theoretical dialogue system; developed methodology including semi-structured interviews and sampling strategies; conducted field surveys in Abaga Banner, interviewed 81 households and stakeholders, curated and verified data; analysed four core property rights contradictions, refined the T-B model, and conducted cost-benefit accounting; wrote the full manuscript and revised it multiple times to standardise expression and citations; coordinated research resources for fieldwork; ensured the final version complies with academic ethics and journal requirements, and assumes full responsibility for the research's scientificity and authenticity.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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