

A Study on the Mechanism for Realizing the Value of Forage Ecological Products in the United States

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Abstract: This study systematically analyzes the driving factors behind the value realization of forage ecological products in the United States, based on policy documents and data from the U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA). The research indicates that the United States has established a multidimensional synergistic mechanism composed of policy incentives, market mechanisms, ecological compensation, and sustainable management. This mechanism effectively promotes the synergistic benefits of grassland ecological conservation and pastoral economic development, offering significant practical references and pathways for the value realization of global ecosystem services.

Keywords: Forage ecological products; policy incentives; market mechanisms; ecological compensation

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1 Introduction

Grassland ecosystems are vital reservoirs of terrestrial carbon sinks and biodiversity, yet their ecological value has long been insufficiently integrated into the economic system. Through policy and market innovations, the United States has explored pathways to realize the value of forage ecological products, providing a model for global sustainable agriculture. Existing research often focuses on individual policies or market tools, lacking a systematic analysis of the synergistic effects of this multidimensional mechanism. This paper focuses on forage ecological products in the U.S., integrating policy, markets, ecological compensation, and production practices to construct a "policy-market-ecology" synergistic framework. It aims to reveal the internal logic and practical effectiveness of its value realization mechanism, offering a new perspective for research on valuing similar ecosystem services.

2 Research Methods

2.1 Data Sources

This study reviews policy documents and statistical data from agencies such as the U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA).

2.2 Methodology

It employs a combination of quantitative and qualitative analysis methods, including data statistics, case studies, and comparative research.

3 Main Pathways for Realizing the Value of Ecological Products in the United States

3.1 Policy Support (Government Incentives and Regulations)

The U.S. government employs a "carrot-and-stick" policy mix, utilizing both financial incentives and regulatory constraints to provide an institutional guarantee for the value realization of forage ecological products.

In terms of financial incentives, the Conservation Reserve Program (CRP) under the federal Farm Bill is a core tool. Its Grassland CRP component provides annual rental payments, cost-sharing, and incentives to encourage ranchers to conserve grasslands while maintaining grazing. As of 2022, the Grassland CRP has protected over 6.3 million acres of land, with significant cumulative results (such as preventing over 8 billion tons of soil loss and sequestering approximately 43 million tons of carbon annually). Furthermore, programs like the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP) offer financial and technical support for implementing sustainable practices like rotational grazing and soil improvement, guiding ranch operators to protect soil, water sources, and biodiversity.

Regarding regulatory constraints, the Clean Water Act and the Endangered Species Act set requirements for water pollution and habitat protection on ranches, respectively. Federal land management agencies also impose limits on stocking rates and grazing seasons on public rangelands to prevent ecological degradation. These regulations form a necessary bottom-line constraint.

Overall, this policy combination, through economic incentives and a regulatory framework, effectively promotes the conservation and sustainable use of forage ecosystems in the United States.

3.2 Market Mechanisms (Pricing, Supply Chains, and Certification)

With growing public awareness of environmental and health issues, market demand for ecological forage products in the U.S. is steadily increasing. This demand is primarily reflected in consumers' willingness to pay a premium for labels such as grass-fed and organic. According to surveys, up to 83% of American consumers consider environmental and animal welfare factors when purchasing meat, often "selecting meat by its labels," such as choosing grass-fed beef or organic milk ^[1]. Between 2020 and 2021, sales of fresh grass-fed beef in the U.S. reached \$776 million, a year-on-year increase of about 5%, demonstrating steady market expansion ^[2]. Although ecological products like grass-fed are more expensive, some consumers are willing to pay the higher price, driving their market pricing above conventional products. For example, organic/grass-fed beef often costs several dollars more per pound than conventional beef, with the premium used to offset the costs of implementing ecological grazing practices. Consumer preference has created the market value foundation for forage ecological products.

In terms of the supply chain, an increasing number of industry players are joining to meet this growing demand. Some large meat companies and brands are integrating the grass-fed supply chain. For instance, Grass Fed Foods became the nation's largest grass-fed beef producer by acquiring SunFed Ranch and Teton Waters Ranch, and in 2022, it partnered with Matador Ranch in Montana (380,000 acres, 12,000 head of cattle) to ensure a stable, large-scale source of grass-fed cattle. Through vertical integration or contract farming, these companies have improved the supply chain management for ecological products, achieving controllable quality and traceability from pasture to processing to retail. Simultaneously, some ranchers are exploring direct sales and regional cooperative models, supplying ecological ranch products directly to local markets or restaurants to shorten the supply chain and secure higher profits. These market mechanism innovations all aim to convert ecological advantages into economic value, allowing farmers who practice sustainable ranching to share in the market dividends.

Another important aspect is the role of green certification systems in supporting market value. Various third-party certification labels help consumers identify eco-friendly ranch products, thereby granting them a price premium. For example, the "American Grassfed Association Certified" (AGA-CERTIFIED GRASS-FED) label requires a 100% forage diet, no antibiotics, and no hormones, ensuring the authenticity of grass-fed products. Through green certification and brand building, forage ecological products establish a differentiated advantage in the market, translating their ecological value into brand equity and price premiums, providing momentum for sustainable ranch operations.

3.3 Ecological Compensation (Carbon Trading and Payments for Ecosystem Services)

Beyond market sales channels, the value of forage ecological products is also realized through various ecological compensation mechanisms. Among these, carbon trading is a major pathway that has emerged in recent years. As carbon sinks, grasslands can generate carbon credits by reducing carbon emissions or increasing carbon sequestration. A new study from the University of California, Davis, found that "in the 21st century, California's grasslands and rangelands have greater

carbon absorption capacity than its forests." In the U.S., the voluntary carbon market has developed protocols for grassland carbon sequestration: landowners can generate greenhouse gas emission reduction credits by protecting grasslands from being converted to cropland and sell them on the market ^[3]. For example, following the methodology developed by the Climate Action Reserve, a rancher in southern Colorado protected two parcels of ranchland from being plowed for cultivation. The first batch of grassland carbon credits was generated and successfully sold—the land protected by the Southern Plains Land Trust (SPLT) generated 4,787 tons of carbon credits, which were purchased by Natural Capital Partners on behalf of Microsoft to offset the company's carbon footprint. This innovative case shows that ranches can directly receive financial compensation from the private sector for providing carbon sink services, monetizing the ecological value of their grasslands. Carbon market compensation provides a new source of income for ranch conservation, incentivizing more landowners to maintain grasslands to earn carbon returns.

Ecological compensation from government and non-profit sectors also plays a key role. The Conservation Reserve Program (CRP) is a model of the government purchasing ecosystem services, paying rent to farmers in exchange for implementing conservation measures. Permanent conservation easements are another core mechanism, where government or land trusts purchase the development rights to land (with compensation reaching 50%-75% of its market value) to permanently protect its ecological functions, while ranchers retain ownership and sustainable grazing rights. Additionally, "Payments for Ecosystem Services" (PES) mechanisms, such as water quality trading and habitat banking, involve beneficiaries (like downstream cities or developers) paying upstream ranchers for environmental services. These mechanisms collectively quantify the environmental protection value of grasslands into economic returns, completing the pathways for realizing the value of their ecological products.

3.4 Sustainable Development Models (Balancing Ecological Protection and Economic Benefits)

In the United States, sustainable forage production models achieve the value realization of their ecological products by balancing ecological and economic benefits. A core measure is rotational grazing, a system that divides pastures into smaller paddocks for high-intensity, short-duration grazing, followed by long rest periods. Studies show that rotational grazing significantly enhances ecosystem functions: it promotes vegetation regeneration, increases ground cover and biodiversity, improves soil structure and carbon sequestration, and enhances drought resistance while reducing soil erosion. Economically, rotational grazing lowers feed costs and increases per-unit profit by improving forage utilization efficiency and livestock weight gain. According to USDA data, about 40% of cow-calf ranches have adopted this model, confirming its long-term value in reducing costs and increasing efficiency.

In addition to rotational grazing, comprehensive soil health management is another key strategy. Practices such as interseeding legumes, optimizing stubble height, and applying manure can enhance soil organic matter and nutrient cycling, thereby improving the soil's water and fertilizer retention capacity and the ranch's resilience to extreme climates. Soil health is directly linked to a ranch's economic returns; for example, for every 1% increase in soil organic matter, its water-holding capacity can increase significantly, enhancing drought resistance. Furthermore, ranchers often combine ecological management with business innovation, such as adjusting grazing intensity, introducing diverse forage species, and developing ecotourism to diversify income sources. These practices collectively demonstrate that ecological conservation and livestock production are not a zero-sum game; a healthy grassland ecosystem is the cornerstone of sustainable pastoral development.

4 Case Studies (Typical Practices and Cooperative Models)

To more intuitively understand the mechanisms mentioned above, here are several typical cases of value realization for forage ecological products in the United States:

4.1 Malpai Borderlands Group

This is a successful example of combining grassland conservation with ranch operations, located at the border of Arizona and New Mexico. In the 1990s, local ranchers formed the non-profit Malpai Borderlands Group to collaborate with scientists and government agencies on cross-boundary, collaborative ecological management, maintaining wild ecological

processes while continuing traditional ranching. The Malpai Group balances ecology and production through two main initiatives: first, it partnered with government and foundations to secure conservation easements on 18 ranches, permanently protecting 88,000 acres of private ranchland from development; second, it restored the natural fire ecology of the grasslands, conducting prescribed burns on 20,000 acres over four years to control shrub encroachment and revitalize native grasslands. These measures ensured the integrity and productivity of large areas of grassland, and in return, ranchers received compensation and long-term operational security. In the Malpai model, ranchers, government agencies (like the Bureau of Land Management and the Natural Resources Conservation Service), and environmental organizations form a public-private partnership to co-manage the land. Ecological products, such as improved water source conservation and wildlife habitat, are maintained, and their value is realized through forms like easement compensation and reduced firefighting costs. This case demonstrates that when grassroots ranchers organize and cooperate with various stakeholders, they can achieve "large-scale grassland conservation and sustainable ranching," providing a model for other regions.

4.2 Matador Ranch

This case showcases an innovative mechanism promoted by a non-governmental organization to realize the value of ecological ranches. The Matador Ranch in Montana (approximately 60,000 acres) is owned and operated by The Nature Conservancy (TNC) and serves as a "grass bank" for surrounding ranches. The specific practice involves TNC allowing neighboring ranchers to graze their cattle on the ranch's abundant pastures at a discounted price or in exchange for in-kind services. In return, these ranchers must implement agreed-upon conservation measures on their own land. Through this "grass-for-conservation" incentive mechanism, ranchers gain additional forage resources to alleviate pressure during drought years, while TNC leverages this to promote ecological improvement across the entire region. The success of this model lies in using market-based instruments (grazing rights) to incentivize conservation behavior, realizing ecological value through mutually beneficial cooperation. By rationally allocating grazing rights, it achieves the sustainable use of the regional grassland as a whole, with the value of its ecological products reflected in both a healthier, large-scale ecosystem and tangible benefits for the ranchers.

4.3 White Oak Pastures

Located in Georgia, White Oak Pastures is a representative of a commercially successful private ecological ranch. Ranch owner Will Harris abandoned the traditional industrialized feeding model and adopted regenerative agriculture principles to graze multiple species of livestock locally, achieving mutual economic and ecological benefits. His ranch insists on grass-fed feeding, no fertilizers or pesticides, and processes its own meat on-site for direct sale to consumers. Thanks to sound ecological management, White Oak Pastures has not only obtained multiple certifications, such as organic and animal welfare, and its branded products are sold in high-end markets nationwide, but it also unexpectedly received a "negative" carbon footprint evaluation. A 2019 life cycle assessment by the third-party firm Quantis showed that the amount of carbon sequestered in the ranch's soil each year exceeds the total methane and other emissions from its cattle over their lifetimes, meaning its beef products achieved net-negative carbon emissions. This result garnered attention and endorsement from General Mills and academia. Through this ecological benefit, White Oak Pastures successfully secured additional commercial value, including partnerships with large food companies and opportunities for carbon offset transactions. Economically, White Oak Pastures has become the largest private employer in its county, creating local jobs and driving agricultural tourism. The case of White Oak Pastures shows that small ranches can also succeed in the market by taking a high-value-added ecological route; the value of its ecological products (high-quality, safe animal protein, carbon sinks, etc.) is realized through brand premiums and external investment. This "regenerative farm" model is inspiring an increasing number of ranchers across the U.S., promoting the sustainable transformation of the pastoral industry.

5 Conclusions and Recommendations

In summary, the United States has constructed a multidimensional system for realizing the value of forage ecological products through the synergy of policy support, market mechanisms, ecological compensation, and sustainable management models. In this system, the government provides institutional safeguards through financial incentives and regulatory

constraints; the market creates economic drivers through price signals and brand certification; ecological compensation mechanisms monetize intangible ecosystem services; and sustainable ranch management serves as the fundamental support for the entire system. These elements complement each other, achieving a win-win for grassland conservation and the ranch economy. The core of the U.S. experience lies in internalizing ecological value into the economic system, exploring a path of harmonious coexistence between humans and nature for global sustainable agriculture through a mechanism where "ecology has value, and ranchers benefit."

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