# Practice and Reflections on Science and Technology Poverty Alleviation Activities in Kulun Banner, Inner Mongolia: Postprint

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## Abstract

Horqin Banner is a banner county in Inner Mongolia Autonomous Region designated for assistance by the Chinese Academy of Sciences (CAS). This article reviews and summarizes the primary content and achievements of CAS's science and technology poverty alleviation initiatives in Horqin Banner from 2013 to 2018, analyzes the challenges confronting science and technology poverty alleviation under the guidance of the targeted poverty alleviation and targeted poverty eradication strategy, and argues that promoting long-term and fundamental poverty eradication and sustained socioeconomic development in Horqin Banner necessitates addressing the development mindset of impoverished farmers and herders, leveraging the advantages of coordinated industrial operations, division of labor, cooperation, and mutual benefit, and integrating science and technology poverty alleviation with talent-based poverty alleviation.

## Full Text

## Preamble

**Poverty Alleviation Through Science and Technology: Practices and Reflections on Science and Technology Poverty Alleviation Activities in Kulun County, Inner Mongolia Autonomous Region, China**

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Kulun County is a designated poverty alleviation partner of the Chinese Academy of Sciences (CAS) in the Inner Mongolia Autonomous Region. This

article reviews and summarizes the main content and achievements of CAS's science and technology poverty alleviation work in Kulun County from 2013 to 2018, analyzes the challenges faced by science and technology poverty alleviation under the guidance of targeted poverty alleviation strategies, and argues that only by addressing the development concepts of impoverished farmers and herders, leveraging the advantages of coordinated industrial development, division of labor, cooperation, and mutual benefit, and combining technology-driven poverty alleviation with talent-driven poverty alleviation can Kulun County achieve lasting, fundamental poverty eradication and sustainable socioeconomic development.

**Keywords:** science and technology poverty alleviation, poverty eradication, buckwheat industry, grass husbandry, agro-pastoral ecotone

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## Introduction

Kulun County is located in southern Tongliao City, Inner Mongolia Autonomous Region, situated in the transitional zone between the Horqin Sandy Land and the shallow hilly loess region of western Liaoning, representing a typical area of the northern agro-pastoral ecotone in China [1]. Since 1994, Kulun County has been designated as one of the 592 nationally recognized impoverished counties [1,2]. According to the "Notice on Launching a New Round of Central Government and State Organs Designated Poverty Alleviation Work" (Guo Kai Ban Fa [2012] No. 78), CAS established Kulun County as its designated partner for targeted and counterpart assistance in Inner Mongolia beginning in 2013.

From 2013 onward, CAS (hereinafter referred to as "the Academy") aligned with local technological needs and industrial development directions, using science and technology poverty alleviation as a guiding principle. The Academy established a development concept that leverages local characteristic resource advantages, improves and perfects traditional industrial efficiency, and introduces and demonstrates advanced technologies to achieve poverty eradication. The focus has been on promoting the transfer and transformation of scientific and technological achievements, scientifically and rationally deploying leading projects, and developing cooperatives and village-level collective economies to achieve targeted poverty alleviation for existing impoverished farmers and herders [1,3]. Through concerted multi-year efforts, the number of registered impoverished households in Kulun County decreased from 5,633 households with 14,021 people at the end of 2015 to 2,618 households with 6,848 people by September 2018.

This article reviews and summarizes the recent science and technology poverty

alleviation work and practical activities conducted by CAS in Kulun County, analyzes current challenges and solutions, and aims to provide replicable and scalable scientific paradigms for poverty eradication in similar regions. The goal is to integrate successful technological models, industrial development frameworks, and continuously improved new technologies to support comprehensive targeted poverty alleviation and sustainable development.

## Scientific Planning for Regional Socioeconomic Development

### Formulating Development Plans

To scientifically and rationally deploy science and technology poverty alleviation projects, in 2014 the project team first formulated a 10-year "Kulun County Science and Technology Poverty Alleviation Medium- and Long-Term Plan" based on local natural conditions, economic development status, scientific and technological potential, and poverty alleviation needs. The plan anticipates that within approximately 10 years, through the application and demonstration of modern science and technology, Kulun County will significantly improve its scientific and technological development level in crop cultivation, animal husbandry, ecological environment construction, and agricultural and livestock product deep processing. This will substantially enhance farmers' and herders' abilities and awareness of scientific production, processing, and management, promote comprehensive and rapid economic and social development, and ensure the sustainable development of regional ecological security barriers, reducing the poverty population ratio to less than 1% of the total population. The plan also aims to attract 3-6 enterprises, transform 15-30 scientific and technological achievements, train 2,000 professional cadres and farmer-herder technical experts, and conduct more than 15,000 person-times of technical training.

In 2017, we organized eight institutes from the CAS Beijing Branch to formulate the "13th Five-Year Plan for National Economic and Social Development of Kulun County, Inner Mongolia Autonomous Region" (Figure 1 [Figure 1: see original paper]) according to the overall layout concept of "one industry per township, integrated planning for the whole county." By analyzing the causes of poverty, we identified industrial development tasks and poverty alleviation measures and pathways to provide efficient and precise industrial development projects for smooth poverty eradication implementation. We aimed to enable Kulun County to completely escape its current poverty status and achieve the dream of sustained and stable prosperity. Over 6-7 months, expert groups visited villages and households 231 person-times to formulate science and technology poverty alleviation implementation plan reports for eight townships in Kulun County. We proposed seven county-level poverty alleviation and eradication special plans (Table 1 ) and eight township-level science and technology poverty alleviation plans (Table 2 ), which received widespread recognition and high praise from municipal and county-level party committees, governments,

and the public.

Currently, according to these implementation plans, two projects have been deployed, mainly involving grass husbandry, water-cellar greenhouse construction, understory poultry farming, and ecological engineering courtyards. The full implementation of these plans is expected to assist and drive more than 85% of the currently registered impoverished households, enabling all to achieve poverty eradication by 2020 according to current standards. The county will establish at least 8-10 demonstration bases focused on special plans or demonstration content, ensuring that registered impoverished households in these bases achieve stable poverty eradication income levels by 2020.

## Leveraging Agro-Pastoral Ecotone Advantages to Develop Characteristic Industries

### Comprehensive Buckwheat Industry Development and Poverty Alleviation

#### (1) High-end Buckwheat Health Food Processing for Regional Poverty Eradication

Leveraging Kulun's advantage as the "Hometown of Buckwheat Culture" and seizing opportunities for industrial transformation in local cement enterprises, CAS played a connecting role to facilitate the transfer and transformation of buckwheat deep-processing technologies from Jiangnan University. This led to the establishment of Qiaotai Biotechnology Co., Ltd. in Kulun County. The company has invested 180 million RMB to research, develop, and produce functional health products from buckwheat bran—buckwheat instant soluble granules—and has built a production line with annual processing capacity of 30,000 tons of buckwheat and production of 200 million packets of buckwheat granules. The production line began operation in October 2017, and by August 2018, had processed, produced, and sold more than 50,000 packets. Qiaotai's establishment has broadened income channels for buckwheat growers in Kulun County and realized the common development of the entire buckwheat industry chain. Impoverished households can obtain benefits through two pathways: First, processing enterprises increase buckwheat purchase prices, benefiting growers; second, registered impoverished households can increase income by working in buckwheat production bases. Based on current averages of 15-20 mu of buckwheat planted per household, with yield of 100 kg per mu and an additional income of 1 yuan per kg, each household can increase net income by approximately 1,500-2,000 yuan annually, or 400-500 yuan per capita. This single measure can enable 1,000-1,500 impoverished households, approximately 2,000-2,500 people, to achieve stable poverty eradication within 2-3 years.

#### (2) Buckwheat Demonstration Base Construction for Targeted Household Assistance

From 2014 to 2017, the CAS project team introduced 84 new buckwheat vari-

eties from the Chengdu Institute of Biology (CAS), Gansu Academy of Agricultural Sciences, Dingxi Academy of Agricultural Sciences (Gansu), Chifeng Academy of Agricultural Sciences (Inner Mongolia), and Tongliao Academy of Agricultural Sciences (Figure 2 [Figure 2: see original paper] shows performance of some varieties). The team established a 150-200 mu buckwheat germplasm resource nursery and variety comparison demonstration zone in Wenduban Village, Kulun Town, Kulun County (Figure 3 [Figure 3: see original paper]). This promotes the sustainable development of buckwheat in Kulun County, provides a foundation for buckwheat variety improvement and seed purification and rejuvenation, supplies excellent raw materials for buckwheat deep-processing enterprises, and contributes to increasing economic income for buckwheat growers. The demonstration aims not only to publicize that Kulun buckwheat is delicious and nutritious but also to showcase comprehensive varieties and optimal high-yield technologies, thereby strengthening the connotation of the "Hometown of Buckwheat Culture." Currently, the demonstration zone involves 15 households, including 3 impoverished households with 14 impoverished people. Through land compensation, fertilizer and machinery subsidies, and sale of improved seeds, per capita income has increased by 2,100-2,500 yuan annually.

**(3) Poverty Alleviation Effects of the Comprehensive Buckwheat Industry Chain Development Model**

The establishment of Qiaotai Biotechnology Co., Ltd. and the official production and market launch of high-end functional buckwheat products represent a qualitative leap in Kulun County's buckwheat industry development and comprehensive development of the buckwheat industry chain, realizing a long-held dream of deep buckwheat processing in Kulun County. The effects and significance are mainly manifested in: First, leveraging regional buckwheat characteristic resource advantages to address actual needs, the buckwheat industry drives broad-based poverty eradication with obvious overall benefits; Second, the collaborative system development model of "Resources + Capital + Government + Technology + Linkage" is fundamental to making the buckwheat industry chain a reality; Third, CAS leverages its scientific and technological advantages, starting from variety breeding, cultivation technology research and development, and improved seed propagation, creating superior conditions for Kulun County's buckwheat industry to obtain economic benefits through multiple links and pathways including selling improved seeds, demonstrating technologies, and marketing high-end processed products; Fourth, establishing an exemplary model that organically combines technology-driven poverty alleviation with targeted poverty eradication technologies, enterprise and industrial development, and talent cultivation and attraction.

**Developing Grass Husbandry: Large-Scale Cattle and Sheep Breeding and Poverty Alleviation Effects**

**(1) Introduction of Silage Processing Technology to Promote Poverty Eradication Through Animal Husbandry**

The project team introduced high-efficiency silage fermentation agents from the Institute of Microbiology (CAS) to transfer and transform silage processing technology. In 2015, a demonstration zone of four households was established, building 230 $m^3$ of silage pits and processing 180 tons of silage corn feed and 50 tons of yellow-stored corn feed with remarkable results. In 2016, the demonstration expanded to 28 households (distributed across Kulun Town, Manghan Sumu, Elesun Town, Xianjin Sumu, and Shuiquan Township), processing 3,000 tons of silage corn feed. In 2017, the technology was promoted to 63 households, processing 6,000 tons of corn silage feed, including 25 registered impoverished households processing 3,000 tons of silage corn feed. In 2018, promotion reached 92 households, processing 8,100 tons of corn silage feed (Figure 4 [Figure 4: see original paper]). This provides diversified feed and rationalized nutritional ratios for beef cattle breeding in Kulun County and enables more effective utilization of local plant resources to promote targeted poverty eradication for registered households. Preliminary estimates indicate this technology increases costs by only 10 yuan per ton while generating 40-50 yuan of direct economic benefits. Based on an average annual requirement of 40-50 tons of high-quality silage feed per impoverished household, this technology can directly increase income by 1,200-1,500 yuan annually, enabling stable poverty eradication within 2-3 years.

**(2) Changing Planting Structure Combined with Soil Improvement to Achieve Demonstration Effects for Poverty Eradication**

Through technical demonstration support, a livestock breeding cooperative grew from small to large and from weak to strong, fundamentally because it effectively resolved the relationships among forage planting, feed processing, and new technology application, thereby improving beef cattle breeding efficiency. The effects are manifested in: First, achieving integrated planting and breeding, focusing on maximizing small-plot land production potential while protecting and restoring surrounding degraded vegetation to promote continuous regional ecological environment improvement; Second, building on traditional breeding practices and targeting key links (application of silage agents and planting of sweet sorghum, oats, and Leymus chinensis) to improve beef cattle breeding efficiency; Third, cultivating wealth creation experts and professional cooperatives to lead the poor with the rich and promote development with new technologies to achieve common prosperity; Fourth, establishing a new "Cooperative + Targeted Poverty Eradication" model through shareholding dividends or entrusted breeding models to achieve socialized and diversified national poverty alleviation support.

The Eerdun Bala family in Aradart Gacha, Manghan Sumu, Kulun County, fell into poverty due to illness, with the wife suffering from chronic disease requiring long-term medication and the family lacking labor force. They were included as demonstration households for soil improvement and silage corn planting under the CAS science and technology poverty alleviation project. In 2015, the project team conducted soil improvement on 25 mu of severely wind-eroded and

water/nutrient-leaching sandy land and installed an irrigation system. In the first year, following the household's preference, grain corn was planted, achieving an average yield increase of approximately 15.7%. Using the saved expenses on fertilizer and seeds, the family purchased two breeding cows. In 2016, the team recommended planting silage corn, which yielded an average of 3.5 tons of silage per mu. Combined with silage bacterial agents from the Institute of Microbiology (CAS), all was processed into high-quality silage feed. By early 2017, the family owned three breeding cows and sold one calf for 6,000 yuan. Based on preliminary calculations including demonstration site construction investment, the household achieved the poverty eradication standard in 2017, realizing stable poverty eradication. In 2018, the family owned six breeding cows and sold one calf for 7,500 yuan.

**(3) Introduction of Forage Sweet Sorghum to Promote Cattle and Sheep Breeding and Accelerate Poverty Eradication**

Since 2015, the project team has introduced sweet sorghum for small-area comparative cultivation trials in Kulun Town and Elesun Town. Results showed that small-field comparative fresh biomass reached 7-8 tons. New forage sweet sorghum varieties F438 and F968 are suitable for cultivation in the Kulun region. In 2018, the combined promotion area for these two varieties reached 2,000 mu. At a sweet sorghum field observation meeting on August 8, 2018, the measured yield of dryland sweet sorghum in the southern loess-like shallow hilly region reached 3.7-4.5 tons, 30%-50% higher than 同期 silage corn biomass, receiving widespread acclaim from experts, leaders, and the public. The supporting technical system including single-seed sowing technology, weed control technology, and harvest silage processing technology has created rare opportunities for the development of cattle, sheep, and even donkey breeding in Kulun County. The successful dryland cultivation of sweet sorghum not only promotes large-scale development of cattle and sheep breeding in the southern hilly region but also provides a new case study for regional grain-to-forage conversion and grass husbandry development. Particularly, the application of silage wrapping machine technology (Figures 5 [Figure 5: see original paper] and 6 [Figure 6: see original paper]) has enabled farmers and herders to earn substantial income from selling silage corn or silage sweet sorghum products, changing their historical understanding that only grain sales could generate income.

**(4) Grass Husbandry Model (Forage Planting + Silage Processing + Beef Cattle Breeding)**

The grass husbandry model demonstrates strong poverty alleviation effects through integrated development. The cooperative model effectively solves the problem of scattered, small-scale household operations, enhances the ability to withstand natural and market risks, and increases the degree of organization in agricultural production. It promotes the standardization, scaling, and branding of agricultural products, improves market competitiveness, and increases farmers' and herders' income. The "Cooperative + Base + Farmers" industrialized management model enables small farmers to connect with large

markets, solves difficulties in technology application, funding shortages, and product sales, and promotes the transformation of traditional agriculture toward modern agriculture.

## Distributed Photovoltaic Poverty Alleviation Model and Development

The project team established a distributed photovoltaic household power station demonstration village in Wuxing Immigrant Village, Kouhezi Town, Kulun County (Figure 7 [Figure 7: see original paper]), with installed capacity of 50 kWp, and a greenhouse distributed photovoltaic power station demonstration base in Tashihai, Liujiazi Town, Kulun County, with installed capacity of 225 kWp. The total installed capacity is 275 kWp, capable of generating 370,000 kWh of electricity. These two models can directly promote and serve stable poverty eradication for 107 registered households with approximately 400 people initially, and can drive 500 households with approximately 1,750 people to stable poverty eradication based on three-year dynamic adjustments.

Distributed photovoltaic power stations have significant social and ecological benefits. The combination of photovoltaics with agriculture enables early-stage income to promote facility agriculture industrialization and characteristic agricultural product quality improvement, allowing impoverished farmers and herders to completely escape the root causes of poverty. Democratic decision-making and supervision in collective economic income distribution makes benefit distribution more fair and just, while mobilizing villagers' enthusiasm for participating in rural self-governance. This can play a role in supporting aspirations and intelligence, making farmers and herders treat village affairs as their own for management and decision-making [5].

### (1) Introduction of Low-Cost Cloud Health Engineering Technology

The low-cost cloud health engineering technology (also called "General Practitioner Workstation") from Shenzhen Institute of Advanced Technology (CAS) is a powerful tool for solving difficulties in rural medical treatment, health examinations, and disease prevention in China. Given the characteristics of Kulun County—vast territory with sparse population, long distances to medical facilities, and difficulties in public health surveys—the project team introduced this technology in 2015 and piloted it in Liujiazi Town, Kulun County. Currently, the server is installed at Kulun County Mongolian Medicine Hospital, and 10 General Practitioner Workstations have been fully installed in 10 villages in Liujiazi Town. After debugging and trial operation, the technology has received widespread praise and attention from rural doctors and farmers and herders, who appreciate the convenience and comfort brought by new technology. Preliminary calculations show that transportation cost savings alone can average 80-100 yuan per impoverished person annually, indirectly playing a poverty alleviation role. The "General Practitioner Workstation" currently achieves high-quality wireless data transmission, which will make significant contributions to

big data analysis for patients in agricultural and pastoral areas in the future. Under the guidance of this technology, the entire county achieved full coverage of "General Practitioner Workstations" in 2017.

**(2) Introduction of Education-Science-Health Synchronous Interactive Platform**

To address communication inconveniences in rural areas caused by spatial distances for technology training, government affairs activities, and doctor-patient exchanges, we introduced synchronous interactive technology from the Institute of Computing Technology (CAS) to establish an education-science-health synchronous interactive platform. This technology enables long-distance interactive communication, improving upon the previous limitation of one-way communication (such as video conferences). It not only demonstrates modern synchronous interactive communication technology but also establishes good government communication channels between townships and villages. Combined with platform transmission systems, it can also achieve barrier-free communication and information transmission between teachers and parents, students and parents, and doctors and patients. Currently, the platform serves government synchronous interaction between Liujiazi Town and Xingshuwa Village in Kulun County.

**(3) Establishment of Intelligent Vegetable Seedling Greenhouse**

The project team cooperated with Kulun County Oasis Food Co., Ltd. to construct an intelligent greenhouse of 1,479 square meters (Figure 8 [Figure 8: see original paper]), initiating a new chapter for demonstrating facility agriculture technology platforms in Kulun County. The greenhouse can annually provide 5,000 mu of high-quality vegetable seedlings for organic vegetable farmers and enterprises in Kulun County, offering a new pathway for poverty eradication among registered impoverished households engaged in dried vegetable industry development in Kulun Town.

## Challenges and Prospects for Science and Technology Poverty Alleviation in Kulun County

Since the mid-1980s, China's poverty alleviation and development strategies achieved tremendous success under contemporary conditions, helping more than 200 million people escape poverty [6]. However, these strategies also had inherent deficiencies, mainly manifested in unclear poverty population data, weak targeting, and inaccurate poverty alleviation orientation. Some genuinely impoverished farmers and herders did not receive assistance or received insufficient support, while considerable valuable poverty alleviation resources flowed to non-poor populations. President Xi Jinping's forward-looking poverty alleviation thought in the new era—the "targeted poverty alleviation, targeted poverty eradication" strategy—has pointed out the direction, implementation pathways, and ultimate goals for China to completely escape absolute poverty [7]. Kulun

County has earnestly practiced the essence of poverty alleviation concepts such as “five batches” and “six precisions” in its poverty eradication campaign.

In science and technology poverty alleviation work, the project team has always been guided by the targeted poverty alleviation and targeted poverty eradication strategy. Despite achieving some gratifying results, there remains a long journey to meet the overall requirement of achieving comprehensive and lasting poverty eradication in Kulun County. Many practical problems require continuous efforts and struggle.

**(1) Many Single-Item Mature Technologies, but Lack of Complete Technical Packages**

While causes of poverty may be single-factor and transient, solving poverty problems requires comprehensive, effective, complete technical packages and sustained, precise application to stimulate endogenous motivation. Only then can scientific and technological advantages be fully leveraged to permanently free impoverished households from poverty. Future efforts should deploy more comprehensive scientific and technological projects that promote industrial development.

**(2) Scarcity of Grassroots Scientific and Technological Talent Reduces Application Effectiveness**

Targeted poverty alleviation requires not only firm determination but also technical means and talent to tackle hard problems. Whether at the township level or in professional cooperatives and industrial enterprises, talent shortage has become an important factor limiting rapid growth, technological advantage utilization, and leading role exertion. Strengthening local scientific and technological talent teams through science and technology poverty alleviation makes poverty alleviation results more effective and sustainable, serving as an important guarantee for continuous victory in the poverty eradication battle. Future efforts should increase talent and technical training intensity in science and technology poverty alleviation projects.

**(3) Science and Technology Demonstration Parks Require Continuous Strengthening**

Practice has proven that science and technology poverty alleviation demonstration bases and parks have strong driving effects, broad coverage, numerous beneficiaries, high poverty alleviation efficiency, and low return-to-poverty rates. Kulun County, guided by precise development planning and breakthroughs in targeted industrial development with talent and technology training as support points, first addresses impoverished farmers’ development concepts and encourages wealth creation through diligence. Second, it improves farmers’ scientific management skills for land operation and implementation of cultivation and breeding. Third, it encourages collective wealth creation by leveraging advantages of coordinated operation, division of labor, cooperation, and mutual benefit. Combining technology-driven poverty alleviation with talent-driven poverty

alleviation promotes sustained socioeconomic development in Kulun County. Under the guidance of targeted poverty alleviation strategies, we believe science and technology poverty alleviation work will continuously take new steps, reach new levels, and achieve new realms, making greater contributions to winning the poverty eradication battle.

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