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Technology-Driven “Three Changes” Reform for Establishing a Long-Term Mechanism of Technology-Based Poverty Alleviation: Practice and Exploration of the Chinese Academy of Sciences’ Targeted Technology Poverty Alleviation in Shuicheng County, Guizhou Province (Postprint)

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Abstract

Shuicheng County, Liupanshui City, Guizhou Province, is a designated assistance county of the Chinese Academy of Sciences (CAS). This article reviews the principal content and achievements of the science and technology poverty alleviation efforts undertaken by CAS in Shuicheng County in recent years: harnessing comprehensive scientific and technological advantages, tailoring initiatives to local conditions to develop characteristic sci-tech poverty alleviation projects, with emphasis on cultivating the self-generating capabilities of impoverished areas. It summarizes successful experiences, explores novel models of leveraging sci-tech poverty alleviation to facilitate the “Three Transformations” reform, strengthens scientific and technological support, promotes targeted poverty alleviation, and establishes a long-term mechanism for science and technology poverty alleviation.

Full Text

Promoting the “Three Changes” Reform Through Science and Technology to Establish a Long-Term Mechanism for Poverty Alleviation: Practice and Discussion on Targeted Science and Technology Poverty Alleviation by the Chinese Academy of Sciences in Shuicheng County, Guizhou Province

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Abstract

Shuicheng County is a designated poverty alleviation partner of the Chinese Academy of Sciences (CAS). This article reviews the main contents and achievements of CAS's science and technology poverty alleviation work in Shuicheng County in recent years: leveraging comprehensive scientific and technological advantages, creating characteristic science and technology poverty alleviation projects tailored to local conditions, and focusing on cultivating self-sustaining capabilities in impoverished areas. The article summarizes successful experiences, explores new models of using science and technology poverty alleviation to promote the “Three Changes” reform, strengthens scientific and technological support, advances targeted poverty alleviation, and establishes a long-term mechanism for science and technology poverty alleviation.

Keywords: science and technology poverty alleviation, “Three Changes” reform, targeted poverty alleviation, industrial development, kiwi fruit, basalt fiber

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Introduction

Science and technology poverty alleviation constitutes an important component of China's poverty alleviation and development strategy. As the initiator, advocate, and practitioner of "science and technology poverty alleviation" in China, the Chinese Academy of Sciences (CAS) has consistently regarded this work as an extremely important political task[1]. Under the unified deployment of the State Council Leading Group Office of Poverty Alleviation and Development, Shuicheng County in Liupanshui City, Guizhou Province was designated as a targeted assistance county for CAS in 2017.

Shuicheng County is located in the karst rocky desertification mountainous area of Southwest China, specifically in western Guizhou, with a total area of 3,607.82 square kilometers and a population of 930,000. Due to various factors, the county faces extensive poverty, deep deprivation, and large wealth disparities, making it a nationally designated impoverished county and one of 14 deeply impoverished counties in Guizhou Province. In 2017, the county had 171 impoverished villages, 48,600 impoverished households, and 154,700 impoverished people, with a poverty incidence rate of 18.9%. By 2018, there remained 110 impoverished villages, 31,900 impoverished households, and 107,000 impoverished people, with the poverty incidence rate reaching 15.88%—more than double the average rate in Guizhou Province.

The difficulties and challenges are unprecedented, making reform and innovation imperative. In the journey toward synchronized poverty alleviation and moderate prosperity, finding a new path for targeted poverty alleviation in western regions has become an urgent issue. Shuicheng County took the lead in exploring and innovating the rural "Three Changes" reform: transforming resources into assets, capital into shares, and farmers into shareholders. Through this reform, the county has activated urban and rural stock assets, natural resources, and human capital, thereby increasing agricultural production efficiency, farmers' income, and rural ecological value, ultimately advancing poverty alleviation. Currently, the innovative value and demonstrative significance of the "Three Changes" reform have attracted widespread attention, becoming a model emulated by many regions, and was incorporated into the central government's No. 1 Document for two consecutive years in 2017 and 2018.

"CAS Science and Technology Support for Township Precision Poverty Alleviation in Shuicheng County Recommendation Report," June 2017.

Organizational Structure and Approach

The science and technology poverty alleviation work in Shuicheng County is led by the CAS Poverty Alleviation Leadership Group, organized by the CAS Bureau of Science and Technology for Development, coordinated by the Kunming Branch of CAS, and implemented by the Institute of Geochemistry, Chinese

Academy of Sciences (hereinafter referred to as “IGCAS”). As the responsible unit for targeted poverty alleviation in Shuicheng County, IGCAS established a Science and Technology Poverty Alleviation Work Leadership Group, formulated detailed work plans, created the “CAS Shuicheng Poverty Alleviation Party Branch,” formed a poverty alleviation work team, and dispatched outstanding cadres to hold temporary positions in Shuicheng County. To align CAS’s science and technology poverty alleviation efforts with the county party committee and government’s central poverty alleviation tasks and the most urgent precision poverty alleviation missions of each township (town, street), CAS and the Shuicheng County Government jointly established project headquarters and implementation teams, achieving seamless integration with local government.

To comprehensively analyze and map poverty conditions across Shuicheng County’s townships, the county’s science and technology poverty alleviation team conducted thorough scientific research and demonstration based on local needs for CAS assistance in township precision poverty alleviation and industrial development. This work identified science and technology poverty alleviation pathways for each impoverished township, proposed implementation recommendations, and established demonstration projects to provide concrete suggestions and references for local party committees and governments, thereby ensuring the successful completion of the targeted assistance task assigned by the Party Central Committee and State Council.

In March 2017, the Shuicheng County science and technology poverty alleviation team organized 13 research groups comprising 38 CAS experts to develop the “Science and Technology Support for Township Precision Poverty Alleviation in Shuicheng County Recommendation Report.” Based on the experts’ disciplinary backgrounds, they were divided into five general township investigation groups and ten special investigation groups. The first step involved township-level investigations, conducting field surveys of 25 townships in Shuicheng County (excluding five northern townships assisted by other units) to obtain first-hand reliable data and submit targeted poverty alleviation recommendation reports and demonstration project proposals for each township. The second step involved special investigations, focusing on common problems faced by relevant townships or industries. Leveraging CAS’s scientific and technological capabilities and Shuicheng County’s poverty alleviation needs, ten special investigation groups conducted targeted research on kiwi fruit, tea, edible mushrooms, health and medicinal plants, mineral water, coal-to-liquid, basalt fiber, and other industries to enhance their technological content and boost poverty alleviation through industrial development.

After more than two months of village visits, household surveys, and in-depth fieldwork, including discussions with township officials, interviews with impoverished and previously impoverished households, and analysis of resource endowments, industrial conditions, poverty status, and alleviation measures, the team compiled the 200,000-word “Science and Technology Support for Township

Precision Poverty Alleviation in Shuicheng County Recommendation Report.” This included 14 special investigation reports such as “Shuicheng County Basalt Fiber Industry Precision Poverty Alleviation Investigation” and “Shuicheng County Coal Chemical Industry Precision Poverty Alleviation Investigation,” along with 25 township-specific poverty alleviation recommendation reports for the 25 townships under CAS assistance. These documents provided substantive, implementable, and demonstrable suggestions and solutions for further poverty alleviation work in Shuicheng County, earning high recognition from local government and widespread praise from the public.

Science and Technology Poverty Alleviation Projects

CAS has continuously increased its support for Shuicheng County, investing a total of 14.55 million yuan in science and technology poverty alleviation project funds in 2017 and 2018 alone. Guided by the county’s poverty alleviation and industrial development needs, CAS implemented 13 projects covering agriculture, industry, ecology, tourism, education, and other fields . Through technology introduction, high value-added product development, demonstration and promotion, and technical training, these projects comprehensively enhanced industrial poverty alleviation effectiveness and strengthened sustainable development capacity. Impoverished populations have directly benefited from increased production and employment opportunities, achieving targeted poverty alleviation while establishing a sustainable long-term development model.

Currently, CAS has established two academician workstations in Shuicheng County, with characteristic projects such as basalt fiber, potato, and kiwi fruit industries playing significant roles in poverty alleviation.

Basalt Fiber Industry

Basalt fiber is a new material derived from basalt rock, characterized by high strength, high modulus, excellent high and low temperature resistance, acid and alkali resistance, oxidation resistance, radiation resistance, thermal and sound insulation, fire retardancy, good filtration properties, and high compressive and shear strength, making it suitable for various environments. Basalt fiber can be widely applied in firefighting, environmental protection, aerospace, military, automotive and ship manufacturing, engineering plastics, construction, and other fields, offering comprehensive performance, high cost-effectiveness, long industrial chains, and broad applications. As one of China’s four major high-performance fibers (alongside carbon fiber, aramid, and ultra-high molecular weight polyethylene fiber), basalt fiber is hailed as a new environmentally friendly green fiber for the 21st century that “transforms volcanic rock into silk” and “turns stone into gold.”

Shuicheng County possesses abundant basalt resources and energy advantages. The local government has designated basalt fiber as an emerging pillar indus-

try, constructing the Liupanshui Basalt Science and Technology Industrial Park covering 2,000 mu with a total investment of 2.75 billion yuan. Consequently, the county submitted a major request to CAS for scientific and technological support in industrial development.

On April 10, 2017, Shuicheng County signed an agreement with Academician Liu Jiaqi from the Institute of Geology and Geophysics, CAS, establishing the county's first academician workstation to build a common technology R&D platform and an open, shared technology innovation service platform for the basalt industry. The project team conducted extensive work in raw material screening, production process improvement, technical standard formulation, new product development, quality control, professional training, and industrial chain integration, providing strong scientific and technological support for the rapid development of the basalt fiber industry. The industry has become an important emerging pillar industry for poverty alleviation in Shuicheng County and Liupanshui City, with projected annual production capacity of 80,000 tons of basalt fiber and products by 2019, generating output value of 10 billion yuan and creating 4,000 jobs.

Potato Industry

The research team led by Zhong Naiqin from the Institute of Microbiology, CAS, has long been engaged in R&D and demonstration of green high-yield potato technology, creating an energy-efficient and low-cost potato tissue culture method and developing multiple patented technologies including portable potato virus detection kits, environmentally friendly fertilizer synergists, and potato-specific foliar fertilizers. These technologies have been demonstrated and promoted across more than 5 million mu in major northern potato production regions. Potato is one of Shuicheng County's agricultural pillar industries, but its yield is only 1,000 kg/mu with backward production levels and low returns, representing a key constraint on industrial poverty alleviation. At the request of local government, the Institute of Microbiology dispatched experts to conduct special investigations and transplanted mature technologies from its green high-yield technology system to potato poverty alleviation work in Shuicheng County, Guizhou. Through the export and support of advanced agricultural technology, CAS explored a new path for science and technology poverty alleviation, establishing a "technology + precision" poverty alleviation model through industry-academia-research collaboration.

Major achievements include: (1) signing a science and technology cooperation agreement with Shuicheng County and establishing an academician workstation and science and technology poverty alleviation base; Academician Fang Rongxiang, Researcher Zhong Naiqin, and others visited Shuicheng County multiple times to deliver scientific reports and technical lectures, training over 600 personnel and effectively enhancing the scientific and technological capabilities of grassroots managers and farmers; (2) completion and operation of a seed potato breeding center in June 2018, producing 15 million high-quality virus-

free test-tube seedlings, 30 million micro-tubers, and 12,000-15,000 tons of original seeds annually to support 100,000 mu of commercial potato production in Shuicheng County; and (3) conducting technical demonstrations to support industrial poverty alleviation by cooperating with local enterprises, selecting targeted assistance recipients, and establishing impoverished household cooperatives to teach new agricultural technologies through field demonstrations. In 2017, green and efficient planting technology demonstrations enabled bumper harvests of potatoes, ginseng fruit, and chili peppers in Tianba Village, Qinglin Township, helping 228 households with 695 people escape poverty. In 2018, demonstrations in Muke Village, Yushe Township increased original potato seed yields by 40-80%, helping 199 impoverished people escape poverty.

Kiwi Fruit Industry

Since 2012, the research team led by Zhong Caihong from the Wuhan Botanical Garden, CAS, has been based in Shuicheng County, serving Liupanshui City, to conduct comprehensive science and technology poverty alleviation work for the kiwi fruit industry, including technical training, introduction of improved varieties, construction of science and technology demonstration bases, wild resource surveys, pest and disease surveys and identification, and formulation of technical regulations. The team established a core demonstration base in Miluo, a high-altitude variety base, and a science and technology exhibition hall, formulated nine production technical standards for the “Liupanshui City Kiwi Fruit Production Technology Standard Group,” and trained over 500 mid-level technicians and more than 6,000 grassroots frontline technicians.

Through years of continuous work, Shuicheng County’s kiwi fruit cultivation area has expanded from nearly 20,000 mu initially to over 60,000 mu now, distributed across 19 townships, while Liupanshui City has developed over 146,000 mu, achieving production in the third year after planting. The fourth year will enter the high-yield period, with orchard yields increasing by about 20% and premium fruit rates rising from the initial 30% to 60%. The CAS patented new variety “Donghong” has gradually become the main cultivar. From 2015 to 2017 alone, the application of new varieties and technologies generated cumulative output value of 1.027 billion yuan and profits of 230 million yuan, creating the “Liangdu Mini Red” and “Shuicheng Red Heart Kiwi” brands that sell well both domestically and internationally, providing scientific and technological support for the construction of Shuicheng County’s “National Agricultural Modernization Park” (the first such approval in Guizhou).

Currently, the kiwi fruit industry has become the leading industry for poverty alleviation in Shuicheng County and a typical case of agricultural development in Guizhou Province. Project team members personally demonstrated techniques and provided hands-on guidance to fruit farmers, earning widespread welcome and praise from the public. Farmers in Liupanshui City have experienced significant changes in mindset, enhancing their emphasis on technology learning. The city’s kiwi fruit industry development has shifted from “small, scattered, and

chaotic” to large-scale, specialized, and technological production. The project’s long-term implementation has promoted standardized and orderly development of Liupanshui City’s kiwi fruit industry.

Ginger Industry

Shuicheng small yellow ginger is one of the county’s most distinctive agricultural products, one of three ginger varieties in Guizhou granted national geographical protection, and a key industry in the county’s current poverty alleviation plan. The IGCAS research team, based on its own scientific research achievements, has conducted in-depth cooperation with Shuicheng County’s Agriculture Bureau and local leading ginger enterprises to carry out demonstration planting, establish guaranteed purchase prices, and help impoverished planting households escape poverty. In 2018, seven demonstration planting sites totaling 160 mu were selected based on altitude distribution. Through soil surveys, selection of premium varieties, application of advanced planting techniques, and yield guarantee measures for high-altitude areas, some regions achieved yield increases of 80%, with significant farmer income growth transforming reluctance to plant into strong willingness to expand cultivation in the following year.

Using gingerol content as the core standard, the team established storage and primary processing technical specifications for Shuicheng small yellow ginger to improve the quality of dried ginger and other primary products. Through comprehensive scientific and technological support including high-tech deep processing, new product development, and industry standard formulation, the team comprehensively enhanced the technological level and added value of leading enterprises, extended industrial chains to promote industrial development, and further radiated to drive local poverty alleviation.

Black Goat Husbandry

The CAS Shuicheng County Science and Technology Poverty Alleviation Work Leadership Group actively promoted the ecological grass-based animal husbandry science and technology demonstration project led by Researcher Jing Haichun from the Institute of Botany, CAS, to take root in Shuicheng County. Guided by the development principle of “planting for breeding, matching grass and livestock, and creating a virtuous cycle,” the project integrates the scientific research advantages of water collection demonstrations in karst mountainous areas and characteristic kiwi fruit industries with the regional advantages of Guizhou Province’s Institute of Animal Husbandry and Veterinary Medicine in efficient black goat breeding. The project introduced a large enterprise—XinKong Group, a subsidiary of the CAS Bureau of Administrative Affairs—to support the industry through government-enterprise collaboration, drive black goat industry development through “technology-driven self-sustaining capacity,” and promote local farmers’ production and income increase to ultimately achieve industrial and targeted poverty alleviation.

Future plans involve investing 200 million yuan to create a complete black goat grass-livestock integration industrial chain. Upon full operation, the project will restore productivity to 640,000 mu of grassland and slopes, achieve annual slaughter of 600,000 black goats, produce 18,000 tons of refined 分割 and processed products, generate annual output value exceeding 2 billion yuan, create tax revenue of over 200 million yuan, and provide employment and income increase for ten thousand people. XinKong Group and Shuicheng County Agriculture and Forestry Investment Development Co., Ltd. jointly established Guizhou Xin Fengrui Animal Husbandry Co., Ltd. to promote black goat industry development, with relevant work being implemented in an intensive and orderly manner.

The “Three Changes + Science & Technology” Model

CAS’s greatest advantage lies in its scientific and technological strengths. The key question is how to leverage CAS’s comprehensive advantages in talent, projects, achievements, facilities, and science popularization resources to innovate methods and forms of science and technology poverty alleviation and expand its connotations and approaches. CAS’s successful experience in Shuicheng County lies in integrating science and technology poverty alleviation with the rural “Three Changes” reform to achieve poverty alleviation goals and explore the establishment of a long-term mechanism for science and technology poverty alleviation, enabling impoverished areas to continuously improve their “self-hematopoiesis” function and become prosperous through science and technology[3-6].

For example, CAS conducted beneficial explorations and attempts in providing scientific and technological support for the creation of the “Shuicheng County National Modern Agricultural Industrial Park” (hereinafter referred to as the “Industrial Park”). As the birthplace of the “Three Changes” reform, the Industrial Park focuses on kiwi fruit and tea as its leading industries. Through the “Three Changes + Science & Technology” model, CAS relied on its own scientific research achievements and technological strengths, combined with the Industrial Park’s kiwi fruit industry development plan, and established multiple expert teams including academicians to continuously carry out in-depth science and technology poverty alleviation work.

The Industrial Park covers 35,200 households with 133,800 people. Within the park, 31,400 mu of village collective land and 152,900 mu of land have been transformed from resources to assets; 25.5924 million yuan of financial funds at all levels, 3.4 million yuan of village collective funds, and 328 million yuan of social funds have been transformed from capital to shares; and 26,400 households with 92,300 people have become shareholders through various equity participation models. The Industrial Park has been listed as a national rural reform pilot zone and a pilot for integrated development of primary, secondary,

and tertiary industries in rural areas. In 2017, per capita disposable income of farmers in the park reached 19,150 yuan, projected to exceed 27,340 yuan by 2020, with all impoverished households in the park achieving poverty alleviation.

Through the “Three Changes + Science & Technology” innovation model, the CAS science and technology poverty alleviation team comprehensively enhanced industrial technological levels, achieving goals of increasing yield, improving quality, and boosting efficiency through science and technology. The team played an important supporting role in creating the National Modern Agricultural Industrial Park, driving farmer income growth, injecting new momentum into the “Three Changes” reform, and earning widespread recognition and affirmation from all levels of departments and society.

Currently, poverty alleviation work has entered the final critical stage, facing new requirements and challenges[7]. CAS’s targeted poverty alleviation work in Shuicheng will conscientiously summarize successful experiences from typical cases, explore replicable and scalable new models of science and technology poverty alleviation promoting the “Three Changes” reform, strengthen scientific and technological support, advance targeted poverty alleviation, establish a long-term mechanism for science and technology poverty alleviation, elevate science and technology poverty alleviation to new heights, and make greater contributions to Shuicheng County’s goal of eliminating poverty by 2019.

Next Steps for Science and Technology Poverty Alleviation in Shuicheng County

Although CAS has achieved remarkable results in its science and technology poverty alleviation work in Shuicheng County, the county has only been a designated assistance target for CAS for nearly two years, making the task of achieving comprehensive poverty elimination on schedule still arduous. The next steps for science and technology poverty alleviation in Shuicheng County will follow CAS’s overall deployment for science and technology poverty alleviation, conduct further in-depth investigations, conscientiously summarize successful experiences, focus on the central goal of eliminating poverty in Shuicheng County, take targeted measures, and promote continuous strengthening and expansion of characteristic poverty alleviation industries such as kiwi fruit, basalt fiber, potatoes, ginger, and integrated black goat grass-livestock systems through scientific and technological innovation.

During the implementation of other demonstration projects including ecological fisheries, prickly pear, edible mushrooms, drinking water, Chinese medicinal herbs, black leaf monkey protection and ecological science popularization, and tourism planning, the “Three Changes + Science & Technology” model will be vigorously promoted to expand demonstration effects and enhance poverty alleviation benefits. Resources will be integrated to innovate methods of education poverty alleviation and improve education levels. In response to new demands

from local areas for new industries such as *Vernicia fordii*, active research and development will be conducted to provide strong scientific and technological support for rural revitalization in Shuicheng County.

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