

Thoughts on the Agricultural Practice of the Party's Governance Strategy for Xinjiang in the New Era: Based on the New Productive Force and Technological Innovation-related Intellectual Property

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Abstract This paper introduces the current development status of new quality productive forces in agriculture, animal husbandry, and aquaculture in Xinjiang. It studies the development momentum of the seed industry in the autonomous region from aspects, including seed industry array-type enterprises, breeding and seed production bases, crop varieties, and seed production and operation. It also explores the current situation of intellectual property rights related to scientific and technological innovation in Xinjiang, covering new varieties of agricultural plants, forest and grass plants, livestock and poultry, bees, silkworms, and aquatic animals and plants, as well as invention patents, utility model patents, and design patents for the product itself. Based on an analysis of the main problems facing its new quality productive forces and sci-tech innovation, recommendations are put forward, including managing the agricultural ecological environment according to local conditions, developing facility agriculture and smart agriculture, strengthening the purification and rejuvenation of traditional varieties and the introduction and acclimatization of new varieties, cultivating varieties with independent intellectual property rights, protecting invention patents and utility model patents, creating design patents for the product itself, and empowering the development of agricultural new quality productive forces.

Key words New quality productive forces, Seed industry, Agricultural intellectual property rights, Sci-tech innovation, the Party's Governance Strategy for Xinjiang

0 Introduction

New quality productive forces represent the central concept in China's ongoing push for high-quality development. In essence, they denote an advanced form of productive forces that is innovation-driven and has moved beyond conventional growth trajectories. These forces are marked by high-tech, high-efficiency, and high-quality features, aligning with the country's new development philosophy^[1–2]. Strengthening breakthroughs in key and core agricultural technologies and the efficient transformation and application of scientific and technological achievements, reshaping agricultural production methods through frontier technologies such as intelligent technology and biotechnology as well as innovative management concepts, and developing agricultural new quality productive forces according to local conditions will help achieve the improvement of total factor productivity across the industry, the expansion of the value space of agricultural products, and the enhancement of agricultural development resilience, thereby empowering rural revitalization and the building of a strong agricultural nation^[3–5]. Agricultural intellectual property rights^[6–7], especially sci-tech innovation-related intellectual property (IP) rights such as new plant and animal varieties, invention patents, utility model patents, and design patents for the product itself, play an

important role in supporting the development of agricultural new quality productive forces.

Covering roughly one-sixth of China's territory, Xinjiang is a pivotal region for putting the all-encompassing approach to food into practice, establishing a diversified food supply system, and fostering agricultural new quality productive forces; it also constitutes a primary front for comprehensive rural revitalization and the building of an agricultural powerhouse. The author's prior research has addressed Xinjiang's advantageous and characteristic industries, brand and logo-related IP, traditional knowledge, and cultural heritage^[8–9]. Building on this work, the present paper takes agricultural new quality productive forces and sci-tech innovation intellectual property as its lens to examine the agricultural implementation strategies of the Party's governance strategy for Xinjiang in the new era.

1 New quality productivity and its performance

1.1 Crop farming

1.1.1 Crop Resource Base. Xinjiang is one of the world's core production areas for long-staple cotton, naturally colored cotton, tomatoes, lavender, *etc.*, and an important producing area for crops such as melons, watermelons, fragrant pears, red dates, grapes, apples, figs, walnuts, almonds, chili peppers, fennel, sugar beets, hops, sea buckthorn, apocynum, goji berries, safflower, and snow lotus.

1.1.2 Main performance. (i) Reaching new heights of scale and high standardization. Xinjiang currently has a cultivated land area of approximately 6.666 7 million ha, with about 3.992 7 million ha of high-standard farmland built, laying a solid foundation

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for large-scale operations. By promoting water-fertilizer integration intelligent fertilization technology and building digital standard farmland, smart drip irrigation with water-fertilizer integration has been realized, effectively improving the effective utilization coefficient of farmland irrigation water. A series of locally innovated technological combinations such as "dry sowing and wet emergence" and "drip irrigation salt removal" have been formed. Through the coordinated efforts of "engineering-agronomy-biology-ecology," a saline-alkali land comprehensive utilization model featuring mutual promotion between cropping and land improvement has been established. (ii) Transitioning from labor-intensive farming (sweating farming) to smart agriculture. New technologies, including smart agricultural machinery and digital management, are increasingly permeating all stages of crop production, propelling a deep-seated shift from traditional farming to a smart agriculture. (iii) Breeding new varieties and promoting superior varieties. The successful breeding of a number of breakthrough new varieties has provided core support for the large-scale increase in crop yields per unit area. For example, "Jinnian 2" achieved a lint cotton yield exceeding 8 250 kg/ha under the extreme environment of the Tarim Basin, effectively overcoming the worldwide challenge of yield reduction caused by high temperatures and drought. Currently, the coverage rate of improved varieties for major crops across Xinjiang has surpassed 95%.

1.2 Animal husbandry

1.2.1 Animal husbandry resource base. Xinjiang is one of China's five major pastoral regions, rich in grassland resources, with famous grasslands such as Nalati Grassland, Bayanbulak Grassland, and Kalajun Grassland. In addition, it is home to national-level standardized demonstration farms for livestock and poultry breeding, including Zhaosu Horse Farm in Ili Kazakh Autonomous Prefecture, Tianshan Meat-type Breeding Sheep Co., Ltd. in Aksu Prefecture, and Jinken Animal Husbandry Technology Co., Ltd. in Hotan Prefecture.

1.2.2 Main performance. (i) A development pattern that simultaneously emphasizes grassland, farming, and suburban areas. The vast natural grasslands and long history of grassland animal husbandry form the foundation of Xinjiang's traditional livestock industry. Farming-area animal husbandry, relying on abundant crop straw and agricultural by-product resources, has developed rapidly in recent years. Suburban animal husbandry, centered on the urban "vegetable basket" supply demand, is characterized mainly by large-scale and intensive farming. (ii) Seed industry revitalization and improved variety breeding. The successful breeding and commercial transformation of the new "Junkun Meat Sheep" variety represents one of the landmark achievements. Technologies for the purification and rejuvenation of local varieties and high-efficiency reproduction are also being promoted at an accelerated pace. A research team from Xinjiang Agricultural University introduced 58 forage varieties from home and abroad featuring high yield, drought resistance, and salt-alkali tolerance, and through localized trials, selected 15 forage varieties suitable for re-

gional cultivation. (iii) Artificial intelligence and smart animal husbandry. New-generation information technologies, represented by artificial intelligence, the Internet of Things (IoT), and big data, are accelerating their penetration and integration into animal husbandry. The development of "AI + animal husbandry" smart farming is profoundly transforming traditional farming practices. (iv) Ecological cycling and resource utilization. Recent local developments include the conversion of crop straw into animal feed, technological breakthroughs in desert forage cultivation, genetic improvement of salinity-tolerant forage varieties, and a novel green production cycle integrating livestock operations, waste-to-resource utilization, and crop farming.

1.3 Aquaculture

1.3.1 Aquaculture resource foundations. Xinjiang ranks as the top aquaculture-producing province in Northwest China. It possesses 57 national wetland parks, 3 355 rivers, and over 130 lakes, whose combined surface area surpasses 10 000 km², the fourth largest in the country. The region also houses national-level demonstration areas for environmentally sound and healthy aquaculture, represented by Fuhai County and the joint venture between Ili Tianyun Organic Agriculture Co., Ltd. and Xinjiang Sanwen Fishery Co., Ltd.

1.3.2 Main performance. (i) Diversification of aquaculture models. From traditional farming models such as freshwater ponds and open freshwater waters, it has expanded to emerging models such as freshwater industrialized farming, cold-water pond farming, cold-water industrialized farming, artificial marine environment pond farming, and artificial seawater industrialized farming. (ii) Utilizing cold water resources for high-quality cold-water fish farming. The water bodies formed by alpine snow and ice melt maintain temperatures below 20 °C year-round, featuring high purity and abundant dissolved oxygen, making them ideal habitats for cold-water fish such as salmon and trout. In particular, Tianshan glacial water exhibits unique physicochemical properties, such as low deuterium content and high selenium enrichment, which confer distinctive quality advantages to farmed fish. Leveraging this natural endowment, Xinjiang salmon meets international quality standards and has obtained multiple professional certifications, including those from the Global Aquaculture Alliance and global food safety programs. (iii) Utilizing saline-alkali water resources for land-based mariculture. By means of ion regulation technology, the effects of the eight major ions in saline-alkali water on cultured organisms have been precisely studied, and water hardness and calcium-magnesium content have been adjusted accordingly, successfully achieving inland farming of marine products such as Pacific white shrimp, mud crabs, and Australian lobsters. On the edge of the Taklimakan Desert, the saline-alkali flats once "barren and devoid of any grass" have now become a paradise teeming with "shrimp soldiers and crab generals". (iv) Forming a resource utilization pattern of "cold in the north, saline in the south, and region-wide coordination." Xinjiang's aquaculture space has extended from traditional freshwater lakes to diverse wa-

ter bodies, with reservoirs, saline-alkali flats, and irrigation canals all convertible into farming areas. Northern Xinjiang, leveraging the cold water resources of the Ili River Valley and the Irtysh River Basin, focuses on developing characteristic cold-water fisheries featuring salmon, peled whitefish, and northern pike; southern Xinjiang, drawing on the saline-alkali water resources of the Tarim River Basin, emphasizes "imitation seawater" aquaculture for Pacific white shrimp and crabs. In addition, peri-urban areas utilize factory-based recirculating water systems to culture marine fish such as grouper and barramundi.

2 Seed industry

The seed industry is the "chip" of agriculture and a key link in developing agricultural new quality productive forces. Since 2021, China has implemented a major strategic deployment in the agricultural field, namely, the Seed Industry Revitalization Action, aimed at strengthening the agricultural "chip," ensuring independent and controllable seed sources, and achieving self-reliance and self-strengthening in seed industry science and technology. In July of the same year, the Central Commission for Deepening Reform deliberated and approved the *Action Plan for Seed Industry Revitalization*, elevating seed source security to the height of a national strategy.

2.1 National seed enterprise array In 2022, China's Ministry of Agriculture and Rural Affairs evaluated over 30 000 seed companies across the country and identified 69 crop, 86 livestock and poultry, and 121 aquaculture seed enterprises and institutions according to criteria such as business scale, innovation capacity, and growth potential. These were assembled into a national strategic array specifically tasked with "overcoming critical bottlenecks, shoring up weaknesses, and reinforcing competitive strengths," with the goal of rapidly fostering a core force for the revitalization of the seed industry. Seven of the selected entities are based in Xinjiang.

2.1.1 National crop seed industry array enterprises. In the *National List of Crop Seed Industry Array Enterprises*, the problem-solving array covers vegetables, edible fungi, and sugar crops, among which the vegetable category includes Xinjiang Nongle Agricultural Development Co., Ltd. The "shoring up weaknesses" array covers corn, soybeans, potato and coarse grains, oil crops, and cotton, among which the corn category includes Jiushenghe Seed Industry Co., Ltd., and the cotton category includes Xinjiang Jinfengyuan Seed Co., Ltd. and Xinjiang Tarim River Seed Co., Ltd. The "strengthening advantages" array covers rice and wheat but does not involve Xinjiang. The specialized platforms involve investment institutions and technical support, and also do not involve Xinjiang.

2.1.2 National livestock and poultry seed industry array enterprises. In the *National List of Livestock and Poultry Seed Industry Array Enterprises*, the problem-solving array covers white-feather broiler chickens but does not involve Xinjiang. The "shoring up weaknesses" array covers pigs, beef cattle, dairy cattle, and

sheep, among which the beef cattle category includes Xinjiang Hutubi Breeding Farm Co., Ltd., and the dairy cattle category includes Xinjiang Tianshan Animal Husbandry Bio-Breeding Co., Ltd. The "strengthening advantages" array covers yellow-feather broiler chickens, laying hens, meat ducks, and laying ducks, but does not involve Xinjiang. The specialized platforms involve investment institutions, breeding services, technical support, and testing institutions, and also do not involve Xinjiang.

2.1.3 National aquaculture seed industry array enterprises. According to the *National List of Aquaculture Seed Industry Array Enterprises*, the problem-solving array targets species such as the four major Chinese carps, swamp eel, rainbow trout, freshwater pufferfish, red swamp crayfish, Pacific white shrimp, frogs, eel, Chinese sea bass, marine pufferfish, golden pompano, silver pomfret, and mud crab; Xinjiang Tianyun Organic Agriculture Co., Ltd. is listed under rainbow trout. The weakness-shoring-up array encompasses bream, mandarin fish, snakehead, yellow catfish, catfishes, sturgeon, Chinese mitten crab, turtles and softshell turtles, large yellow croaker, flatfishes, grouper, Chinese white shrimp, kuruma shrimp, giant tiger prawn, swimming crab, oysters, scallops, clams/cockles/razor clams, and laver, none of which include Xinjiang entities. The strength-enhancing array (common carp, crucian carp, tilapia, largemouth bass, giant freshwater prawn, abalone, sea cucumber, kelp, and wakame) and the specialized platforms (investment institutions and technical support) similarly feature no Xinjiang presence.

2.2 National-level breeding and seed production bases National-level breeding and seed production bases cover crops, livestock and poultry, and aquaculture, including national-level major seed production counties, national-level regional elite seed propagation bases, national core livestock and poultry breeding farms and elite breed multiplication and extension farms, national core stud stations, and national-level aquatic original and improved seed farms.

2.2.1 Crops. National-level crop breeding and seed production bases consist of four core areas, namely Sichuan for rice, Gansu for corn, Heilongjiang for soybean, and Hainan Nanfan. Through policies such as the Modern Seed Industry Enhancement Project, an improved seed supply network covering 216 base counties has been established.

These national-level major seed production counties and national-level regional elite seed propagation bases involve a wide range of crops, including rice, wheat, highland barley, corn, soybean, coarse grains and miscellaneous beans, sweet potato, potato, oilseed rape, peanut, watermelon and melon, apple, pear, citrus, grape, kiwifruit, banana, vegetables, edible fungi, sugarcane, tea, Chinese medicinal plants, cotton, and off-season (winter and summer) breeding in Nanfan.

Among them, Xinjiang mainly involves wheat, corn, watermelons and melons, vegetables, and cotton. Wheat includes Qitai County and Baicheng County. Corn includes Changji City, Hutubi County, Manas County, Gongliu County, and the 4th, 5th, 6th,

8th, and 9th Divisions of the Xinjiang Production and Construction Corps (XPCC). Watermelons and melons include Changji Prefecture and Shanshan County. Vegetables include Bayingolin Prefecture and Changji Prefecture. Cotton includes Awat County, Bayingolin Prefecture, Korla City, and the 1st, 7th, and 8th Divisions of the XPCC.

2.2.2 Livestock and Poultry. Since the first batch of national core pig breeding farms were designated in 2010, China has established a national livestock and poultry genetic improvement system, encompassing core breeding farms for livestock and poultry, elite breed multiplication and extension farms, core stud stations, and so forth. The system covers pigs, beef cattle, dairy cattle, sheep, broiler chickens, layer chickens, and waterfowl, but does not cover yaks, horses, donkeys, camels, red deer, bees, silkworms, and the like.

Among them, Xinjiang has one national core pig breeding farm: Xinjiang Tiankang Animal Husbandry Technology Co., Ltd. Jiamei Breeding Branch (Duroc pigs, Xinjiang White pigs). It has four national core beef cattle breeding farms: Yili Xinhe Breeding Cattle Co., Ltd. (Xinjiang Brown cattle), Yili Chuangjin Benniu Animal Husbandry Co., Ltd. Huaxi cattle breeding farm (Huaxi cattle), Xinjiang Hutubi Breeding Farm Co., Ltd. (Chinese Simmental cattle), and Xinjiang Hanting Muyuan Breeding Technology Co., Ltd. (Angus cattle). There are two national core dairy cattle breeding farms: Tacheng Prefecture Breeding Farm (Xinjiang Brown cattle) and Changji Jiyuan Animal Husbandry Co., Ltd. (Chinese Holstein cattle). There are three national core sheep breeding farms: Xinjiang Gonnais Breeding Sheep Co., Ltd. (Xinjiang Fine-wool sheep), Baicheng County Breeding Sheep Farm (Chinese Merino sheep), and Xinjiang Xiyu Muyangren Agricultural and Animal Husbandry Technology Co., Ltd. (Pishan Red sheep). An enterprise that had its national core beef cattle breeding farm status revoked is Zhongao Derun Animal Husbandry Co., Ltd. (Angus cattle).

2.2.3 Aquaculture. In recent years, China has established 104 national-level aquatic original and improved seed farms, covering many species such as black carp, grass carp, silver carp, bighead carp, common carp, crucian carp, mandarin fish, blunt-snout bream, topmouth culter, naked carp, loach, Pacific white shrimp, tilapia, channel catfish, rainbow trout, paddlefish, giant freshwater prawn, Chinese mitten crab, turtle, softshell turtle, ornamental fish, mullet, flounder, tongue sole, large yellow croaker, grouper, pufferfish, Chinese white shrimp, vannamei shrimp, swimming crab, sea urchin, abalone, scallop, sea cucumber, laver, kelp, and many others. However, Xinjiang currently has no national-level aquatic original and improved seed farm.

2.3 Registration of crop varieties According to the China Seed Industry Big Data Platform, since 2017, Xinjiang has effectively registered 802 crop varieties, covering 13 types of crops, including barley (highland barley), foxtail millet, sorghum, potato, sunflower, oilseed rape, melon, watermelon, grape, tomato, chili pepper, Chinese cabbage, and sugar beet.

Among them, the Qitai Wheat Experimental Station of Xinjiang Academy of Agricultural Sciences registered three barley (highland barley) varieties: "Xinpi 12119," "Xinpi 13003," and "Xinpi 14099." The Institute of Food Crops of Xinjiang Academy of Agricultural Sciences, the Agricultural Science Research Institute of the 6th Division of XPCC, and others registered six foxtail millet varieties, including "Xingu 1," "Xingu 8," and "Taixuangu 30." The Agricultural Science Research Institute of the 4th Division of XPCC, Xinjiang Jiufeng Seed Industry Co., Ltd., Shihezi University, and others registered six sorghum varieties, including "Xinliang N6VA," "Xinnuo 9," and "Zhongketian 2." The Comprehensive Experimental Station of Xinjiang Academy of Agricultural Sciences registered three potato varieties: "Jiangshu 1," "Jiangshu 2," and "Jiangshu 3."

Thirteen entities, including the Xinjiang Academy of Agricultural Reclamation Sciences, Changji Prefecture Xiya Seed Co., Ltd., and Xinjiang Zhongfuyuan Agricultural Science and Technology Development Co., Ltd., registered 56 sunflower varieties, such as "YJK709," "Xiya 588," and "Zhongfuyuan 9." The Institute of Industrial Crops of Xinjiang Academy of Agricultural Sciences and Changji Jiusheng Seed Science and Technology Co., Ltd. registered eight rapeseed varieties, including "Xinyou 17," "Xinyou 26," and "Shengyou 998."

Forty-two entities, including the Hami Melon Research Center of Xinjiang Academy of Agricultural Sciences, the Grape and Melon Research Institute of Xinjiang Uygur Autonomous Region, and Xinjiang Shuangquan Agricultural Science and Technology Co., Ltd., registered 343 melon varieties, such as "Huangpi 9818," "Xizhoumi 25," and "Shuangtian 53." Thirty-four entities, including Xinjiang Nongle Agricultural Development Co., Ltd., Xinjiang Shuangquan Agricultural Science and Technology Co., Ltd., and Xinjiang Xiyu Seed Industry Co., Ltd., registered 188 watermelon varieties, such as "Detian Zaochun Hongyu," "Shuangquan 24," and "Xiyu Heibao." The Turpan Agricultural Science Research Institute of Xinjiang Academy of Agricultural Sciences registered one grape variety, "Bolaite."

Seventeen entities, including Xinjiang Jinzhong Nongle Agricultural Science and Technology Development Co., Ltd., COFCO Tunhe Seed Co., Ltd., and the Institute of Horticultural Crops of Xinjiang Academy of Agricultural Sciences, registered 107 tomato varieties, such as "Jinfan 6366," "Tianhong 2272," and "Xinhong 71." Eighteen entities, including Xinjiang Tianjiao Hong'an Agricultural Science and Technology Co., Ltd., the Institute of Horticultural Crops of Xinjiang Academy of Agricultural Sciences, and Shihezi Development Zone Tianyuan Agricultural Science and Technology Co., Ltd., registered 67 pepper varieties, such as "Honglong 31," "Yuanjiao 35," and "Shiyan Tianjiao 38." The Agricultural Science Research Institute of the 6th Division of XPCC registered three Chinese cabbage varieties: "Xinkuai 2," "Zaokuai 25," and "Cuili 30."

The Institute of Industrial Crops of Xinjiang Academy of Agricultural Sciences, Shihezi Academy of Agricultural Sciences,

and others registered 11 sugar beet varieties, including "Xintian 15," "XJT9908," and "STM1512."

2.4 National superior crop varieties The *National Catalogue for the Extension of Superior Crop Varieties (2025)* covers 21 crops, including rice, wheat, corn, foxtail millet, sorghum, soybean, potato, sweet potato, rapeseed, peanut, cotton, melon, watermelon, apple, pear, peach, Chinese cabbage, heading cabbage, cucumber, sugarcane, and tea. It categorizes varieties into four types (backbone, growing, promising, and specialized) and recommends a total of 326 superior varieties.

Among them, Xinjiang has participated in the breeding of 14 varieties, covering four crops: wheat, corn, cotton, and melon. Specifically, they include the wheat growing-type variety Xindong 55; the corn promising-type variety Dongke 1188; cotton backbone-type varieties Tahe 2 and Xinluzao 84, growing-type varieties J8031 and H33-1-4, promising-type varieties Guoxinmian 37, Jimian 30, Xintamian 3, and Jinken 1402, and the special-purpose variety Yuanmian 8; and melon backbone-type varieties Xizhoumi 17, Xinmi 11, and Jinse Nianhua.

Xindong 55 is characterized by high resistance to powdery mildew and leaf rust, cold tolerance and lodging resistance, salt-alkali tolerance, and tolerance to close planting. Its breeders are the Agricultural Science Research Institute of the 1st Division of XPCC and Xinjiang Tarim River Seed Industry Co., Ltd. The development and extension units are Xinjiang Tarim River Seed Industry Co., Ltd. and Xinjiang Jinfengyuan Seed Co., Ltd.

Dongke 1188 is characterized by excellent comprehensive resistance, high and stable yield, good grain marketability, fast dehydration at the late stage, and suitability for mechanical grain harvesting. Its breeders are Liaoning Dongya Seed Co., Ltd. and Xinjiang Haorizi Seed Co., Ltd. The development and extension unit is Liaoning Dongya Seed Co., Ltd.

Tahe 2 is characterized by high yield potential, excellent fiber quality, resistance to Fusarium wilt, and tolerance to Verticillium wilt. Its breeder and development and extension unit is Xinjiang Tarim River Seed Industry Co., Ltd.

Xinluzao 84 is characterized by good early maturity, high yield potential, strong boll-setting ability, concentrated boll opening, and suitability for mechanical harvesting. Its breeder and development and extension unit is Xinjiang Hexin Technology Development Co., Ltd.

J8031 is characterized by strong growth vigor, high yield potential, excellent quality, good boll-setting performance, thin boll shells with large bolls, high lint percentage, good lint cohesion, and suitability for mechanical harvesting. Its breeder and development and extension unit is Xinjiang Jinfengyuan Seed Co., Ltd.

H33-1-4 is characterized by early maturity, high yield, good quality and multi-resistance, and suitability for mechanical harvesting. Its breeder and development and extension unit is Xinjiang Hexin Technology Development Co., Ltd.

Guoxinmian 37 is characterized by strong growth vigor, high yield, suitability for mechanical harvesting, and superior

quality. Its breeders are Hejian Guoxin Rural Technical Service Association and Xinjiang Guoxin Seed Co., Ltd. The development and extension unit is Hejian Guoxin Rural Technical Service Association.

Jimian 30 is characterized by early maturity, large and numerous bolls, high yield potential, strong stress resistance, wide adaptability, yield increase across multiple regions, suitability for various planting patterns, and suitability for mechanized management. Its breeders are the Institute of Cotton, Hebei Academy of Agriculture and Forestry Sciences, Hebei Xinniu Agricultural Science and Technology Co., Ltd., and Xinjiang Hexin Agricultural Science and Technology Development Co., Ltd. The development and extension unit is the Institute of Cotton, Hebei Academy of Agriculture and Forestry Sciences.

Xintamian 3 is characterized by strong boll-setting ability, high yield potential, a clean plant architecture, suitability for dense planting, vigorous growth without premature senescence, smooth and concentrated boll opening, and Type I fiber quality. Its breeder and development and extension unit is Xinjiang Tarim River Seed Industry Co., Ltd.

Jinken 1402 is characterized by good early maturity, high yield, excellent fiber quality, good disease resistance, concentrated and smooth boll opening, and suitability for mechanical harvesting. Its breeder and development and extension unit is the Cotton Research Institute of Xinjiang Academy of Agricultural Reclamation Sciences.

Yuanmian 8 is characterized by high yield, good quality, large bolls, fairly good disease resistance, and good trait coordination. Its breeder is the Institute of Industrial Crops, Xinjiang Academy of Agricultural Sciences, and the development and extension unit is Xinjiang Academy of Agricultural Sciences.

Xizhoumi 17 is characterized by heat and humidity tolerance, resistance to Fusarium wilt, resistance to aphids, moderate resistance to powdery mildew and downy mildew, and good storage and transport tolerance. Its breeder and development and extension unit is Xinjiang Grape and Melon Research Institute.

Xinmi 11 is characterized by storage and transport tolerance, moderate resistance to powdery mildew, and low resistance to downy mildew. Its breeder is the Institute of Horticultural Crops, Xinjiang Academy of Agricultural Sciences, and the development and extension unit is Xinjiang Hami Melon Seed Co., Ltd.

Jinse Nianhua is characterized by relatively strong plant vigor, easy fruit setting, strong marketable appearance, and superior quality. Its breeder and development and extension unit is Xinjiang Tianhao Seed Co., Ltd.

2.5 Seed production and operation licenses A total of 104 enterprises in Xinjiang hold 110 valid crop seed production and operation licenses. Their production and operation scope covers rice, sorghum, wheat, corn, soybean, sunflower, rapeseed, tiger nut, melon, watermelon, vegetables (tomato, pepper, eggplant, cowpea, sword bean, carrot, radish, qiamagu, leafy vegetables, spinach, pakchoi, coriander, pumpkin, zucchini, *etc.*), edible

fungi, cotton, and other crops.

3 Sci-tech innovation-related intellectual property rights

Xinjiang is rich in agricultural intellectual property resources, including brand and logo-related types^[8], cultural heritage-related types^[9], and sci-tech innovation-related types. Among them, the sci-tech innovation-related types mainly consist of new agricultural plant varieties, new forest and grass plant varieties, new livestock and poultry varieties, new bee and silkworm varieties, new aquatic animal and plant varieties, invention patents, utility model patents, and design patents for the product itself.

3.1 New agricultural plant varieties Since 1999, China has promulgated the *List of Protected New Agricultural Plant Varieties of the People's Republic of China* in 11 batches, including 61 genera, 2 groups (the Tea Group and the Peony Group), and 128 species. The *Draft List of Protected Agricultural Plant Varieties (12th Batch)* (2025 Exposure Draft) proposes to add a further 39 genera and 73 species.

To date, Xinjiang has been granted rights for 521 new agricultural plant varieties. These span seven genera and thirteen species, including *Gossypium* (cotton); grain crops such as rice, common wheat, maize, *Hordeum* (barley), sorghum, and soybean; oil crops such as sunflower, peanut, and *Brassica napus* (rapeseed); fruit crops such as melon, watermelon, *Malus* (apple), and *Vitis* (grape); vegetables such as *Capsicum* (pepper), tomato, and zucchini; as well as other plants including sugar beet, *Lavandula* (lavender), and *Phalaenopsis* (moth orchid).

3.1.1 *Gossypium* L. There are 218 new agricultural plant varieties in the genus *Gossypium* L., held by a total of 40 variety rights holders. Among them, Xinjiang Jinfengyuan Seed Co., Ltd. holds 43 varieties: F01505, H33687, H5161, J202, J20605, J8031, JFY266, JFY288, JK621, JK622, Jinfeng 22, Jinfeng 27, Jinfeng 2, Jinhai 1, Jinhai 6, Jinhai 7, Jinhai 8, Jinhai 9, Jinmian 1001, Jinmian 1002, Jinmian 1003, Jinmian 1004, Jinmian 1005, Jinmian 1006, Jinmian 1007, Jinmian 244, Jinmian 248, Jinmian 249, Jinmian 259, Jinmian 271, Jinzao 22, Xinluzhong 47, Changfeng 10, Changjin 11, Changjin 14, Changjin 17, Changjin 18, Changjin 1, Changjin 20, Changjin 21, Changjin 2, Changjin 3, and Changjin 4. The Institute of Industrial Crops, Xinjiang Academy of Agricultural Sciences holds 40 varieties: K418, K426, K432, Huamian 2, Xinshi 518, Xin 163011, Xin 19075, Xin 6015, Xin 78, Xin 825, Xinhai 24, Xinhai 35, Xinhai 39, Xinhai 60, Xinhai 61, Xinluzao 50, Xinluzao 57, Xinluzhong 54, Xinluzhong 73, Xinluzhong 76, Xinluzhong 77, Xinluzhong 78, Xinluzhong 80, Xinluzhong 83, Xinluzhong 84, Xinluzhong 88, Xinmian 1, Xinnmian 2, Xinnongmian 1, Xinnongzao 112, Yuanmian 15018, Yuanmian 1, Yuanmian 21, Yuanmian 2, Yuanmian 34, Yuanmian 5, Yuanmian 8, Yuanmian Xin 13305, Zong 620, and Zong 928.

Shihezi Academy of Agricultural Sciences holds 16 new *Gossypium* varieties: Shi A2, Shicai 17, Shicai 19, Shicai 22, Shi-

nong 1, Shixuan 131, Xinshi H16, Xinshi K24, Xinshi K27, Xinshi K33, Xinshi K34, Xinshi K35, Xinshi K37, Xinshi K38, Xinshixuan 162, and Xinshixuan 172. China Colored Cotton (Group) Co., Ltd. holds 14 varieties: Caichang 6006, Caichang 6115, Xincaimian 11, Xincaimian 12, Xincaimian 16, Xincaimian 17, Xincaimian 19, Xincaimian 25, Zong 1192, Zong 1342, Zong 1496, Zong 234, Zong 2395, and Zong 2478. Xinjiang Academy of Agricultural Reclamation Sciences holds 12 varieties: Jinken 1441, Jinken 1442, Jinken 1643, Jinken 1746, Jinken Zong 11, Xinluzao 33, Xinluzao 40, Xinluzao 42, Xinluzao 44, Xinluzao 45, Xinluzao 53, and Xinluzao 68. The Cotton Research Institute of Xinjiang Academy of Agricultural Reclamation Sciences holds 11 varieties: Jinken 11523, Jinken 1161, Jinken 1402, Jinken 1565, Jinken 1678, Jinken 1775, Jinken 5339, Jinken 6217, Jinken 6464, Jinken 717, and Jinken Za 1062. Xinjiang Hexin Technology Development Co., Ltd. holds 10 varieties: H1594, H216, H219, K2725, T115, X19075, Hexin 1693, Xinlumian 3, Xinnmian 91, and Xinnmian 92.

The Agricultural Science Research Institute of the 7th Division of XPCC holds 8 new *Gossypium* varieties: Xinluzao 25, Xinluzao 35, Xinluzao 38, Xinluzao 47, Xinluzao 49, Z1112, Z1146, and Xinluzao 58. The Agricultural Science Research Institute of the 1st Division of XPCC holds 7 varieties: Xinhai 25, Xinhai 36, Xinluzhong 48, Xinluzhong 60, Anonghai 1, Anonghai 2, and Anonglu 1. Jiushenghe Seed Industry Co., Ltd. holds 4 varieties: Jiumian 27, Jiumian 35, Jiushenghe M123, and Jiushenghe M1812. Xinjiang Tarim River Seed Industry Co., Ltd. holds 4 varieties: Xinhai 28, Xinhai 63, Xinluzhong 37, and Xintamian 102. Bazhou Fuquan Xinke Seed Industry Co., Ltd. holds 3 varieties: Fuquan 10, Xinluzhong 26, and Xinluzhong 33. Kuytun Wanshi Cotton Seed Industry Co., Ltd. holds 3 varieties: Xinluzao 31, Xinluzao 39, and Xinluzao 66. The Agricultural Science Research Institute of Bayingolin Mongol Autonomous Prefecture holds 3 varieties: H163, Ba 43541, and Jinxu 5. Xinjiang Fuquan Xinke Seed Industry Co., Ltd. holds 3 varieties: Fuquan 17, Xinluzhong 44, and Xinluzhong 56. Xinjiang Huatian Seed Co., Ltd. holds 3 varieties: HT139, HT2012, and Yiluzao 6. Xinjiang Esquel Textile Co., Ltd. holds 3 varieties: Yuanlong 30, Yuanlong 42, and Yuanlong 37. Xinjiang Zhongmian Seed Co., Ltd. holds 3 varieties: Zhongmian 218, Zhongmian 259, and Zhongmian 698. Shihezi University holds 2 varieties: Shidamian 192 and Shidamian 268. Shihezi Agricultural Science and Technology Development Research Center holds 2 varieties: Xinluzao 36 and Xinluzao 43. Shihezi Zhuangjiahan Agricultural Science and Technology Co., Ltd. holds 2 varieties: Zhuangjiahan 201 and Zhuangjiahan 701. Xinjiang Huiyuan Seed Co., Ltd. holds 2 varieties: Huiyuan 710 and Xinluzao 72. Xinjiang Jinbo Seed Center holds 2 varieties: Xinluzao 29 and Xinluzao 30. Xinjiang Agricultural University holds 2 varieties: Xinnmian 144 and Xinnongdamian 4.

Korla Kangshengda Agricultural Technology Extension Service Center, Li Qin, Shihezi Xinniao Agricultural Science and Technology Co., Ltd., Xinjiang Dejia Science and Technology

Seed Co. , Ltd. , Xinjiang Guoxin Seed Co. , Ltd. , Xinjiang Huiyuan Agricultural Science and Technology Development Co. , Ltd. , Xinjiang Jinhongxiang High-Tech Agriculture Co. , Ltd. , Xinjiang Jinghua Seed Co. , Ltd. , the Agricultural Science Research Institute of the 5th Division of XPCC, Xinjiang Shida Science and Technology Co. , Ltd. , Xinjiang Shuofeng Seed Co. , Ltd. , Xinjiang Shihezi Academy of Agricultural Sciences, Xinjiang Shihezi Xiayedi Experimental Station, Xinjiang Tianhe Seed Co. , Ltd. , Zhang Zhaohui, and Zhang Haijun each hold one new *Gossypium* variety, namely Kangsheng 1, Xinhai 38, Xinmiao 3, Xinhai 34, Xinmian 8, Xinluzao 28, Xinluzao 54, Xingjinhua 198, Wushi 1615, Xinluzhong 36, Xinluzao 52, Xinluzao 70, Tianyun Za 1, Xinluzao 26, Xinluzhong 62, and Hai 14-9.

3.1.2 Grain crops. There are 14 new varieties of rice (*Oryza sativa* L.), held by 4 variety rights holders. Among them, Xinjiang Jinfengyuan Seed Co. , Ltd. holds 6 varieties: Jindao 77, Jindao 89, Jindao 95, Jindao 112, Jindao 1227, and Jindao 3314. The Institute of Nuclear Technology and Biotechnology, Xinjiang Academy of Agricultural Sciences holds 4 varieties: Hejing 1, Xindao 36, Xinnongjingyi 4, and Zhuguang. Xinjiang Tarim River Seed Industry Co. , Ltd. holds 2 varieties: Tadao 1 and Tadao 3. The Institute of Food Crops, Xinjiang Academy of Agricultural Sciences holds 2 varieties: Liangjing 5 and Liangjing Za 1.

Common wheat (*Triticum aestivum* L.) has 83 new varieties, held by 17 variety rights holders. Among them, the Institute of Food Crops, Xinjiang Academy of Agricultural Sciences holds 17 varieties: 12N6166, Liangchun 1201, Liangchun 1242, Liangchun 1354, Liangchun 1511, Liangchun 1522, Xinchun 29, Xinchun 34, Xinchun 48, Xinliang 1451, Xinliang 169, Xinliang 201, Xinliang 603, Xinliang 802, Xinliang 803, Xinliang 804, and Xinliang 806. The Institute of Nuclear Technology and Biotechnology, Xinjiang Academy of Agricultural Sciences holds 12 varieties: Hechun 1, Hechun 3, Xinchun 30, Xinchun 37, Xinchun 46, Xinchun 47, Hechun 115, Hechun 121, Hechun 137, Hechun 213, Hechun 415, and Hechun 514. Jiushenghe Seed Industry Co. , Ltd. holds 11 varieties: YND03102, Jiuchun 424, Jiushenghe C1809, Jiushenghe C983, Jiushenghe D09, Jiushenghe D1508, Jiushenghe D606, Liangchun 1571, Qichun 12136, Xindong 61, and Xinliang 157. Shihezi Academy of Agricultural Sciences holds 11 varieties: Shidong 01162, Shidong 031921, Shidong 0349, Shidong 0358, Shidong 06510, Shidong 0711, Shidong 1290, Xindong 33, Xindong 41, Xindong 48, and Xindong 52.

Xinjiang Xingmu Seed Co. , Ltd. holds 8 new common wheat varieties: XM1803, XM1813, XM1820, Xingmu 1602, Xingmu 1603, Xingmu 1804, Xingmu 1807, and Xingmu 1909. The Qitai Wheat Experimental Station of Xinjiang Academy of Agricultural Sciences holds 7 varieties: 2012J176, SYZ14206, Qichun 13162, Qichun 18178, Qidong 1636, Qidong 3, and Xinhai 688. Xinjiang Academy of Agricultural Reclamation Sciences holds 5 varieties: AL36A, Kenchu 1801, Kenchu 1803, Kendong 157, and Xinchun 50. Xinjiang Huaxia Agriculture Co. , Ltd. holds 2 vari-

eties: Zhongxia 168 and Zhongxia 169. The Agricultural Science Research Institute of the 1st Division of XPCC holds 2 varieties: Anongdong 5 and Anongdong 6.

Bazhou Xufeng Agricultural Science and Technology Development Co. , Ltd. , Shihezi University, Tacheng Prefecture Fengyuan Agricultural Science and Technology Co. , Ltd. , Xinjiang Jinfengyuan Seed Co. , Ltd. , Xinjiang Jintianshan Agricultural Science and Technology Co. , Ltd. , Xinjiang Kenfeng Seed Co. , Ltd. , the Institute of Crop Germplasm Resources of Xinjiang Academy of Agricultural Sciences, and the Agricultural Science Research Institute of Ili Kazakh Autonomous Prefecture each hold one new common wheat variety, namely Xumai 1, Xinchun 39, Fengyuanchun 3, Xindong 50, Jinmai 3, Lüxiang 1, Yinong 26, and Yinong 22, respectively.

Maize (*Zea mays* L.) has 131 new varieties, held by 28 variety rights holders. Among them, Xinjiang Xiangfeng Biotechnology Co. , Ltd. holds 28 varieties: XF16, XFB02, XFB03, XFD2, XFxD03F, XFxF1, XFxFJ007, XFxFJ019, XFxFJ033, XFxFJ036, XFxFJ11, XFxFJ18, XFxFJ424, XFxFJ622, XFxFJ701, XFxFJ710, XFxFJ711, XFxFJ719, XFxFJ721, XFxFJ726, XFxFJ8A, XFxFJF2, XFxFJH7, XFxFJM2, XFxFJV7, XFxFM1, XFxFQ04M, and Xiangfeng 919. The Institute of Food Crops, Xinjiang Academy of Agricultural Sciences holds 28 varieties: CX3062, CX-313, CX3221, CX5001, CX503, CX504, CX7001, CX7002, CX7010, Xinnongyu 6328, Xinnongyu 5007, Xinqing 1, Xinyu 29, Xinyu 34, Xinyu 35, Xinyu 41, Xinyu 54, Xinzi 2121, Xinzi 2138, Xinzi 275B, Xinzi 3194, Xinzi 349, Xinzi 42311, Xinzi 618, Xinzi 6233, Xinzi 6423, Zao 314L, and Zao 314S.

Xinjiang Meiya Lianda Seed Industry Co. , Ltd. holds 7 new maize varieties: 72B, D17, T19, T44A, Meilian 72, Meilian 6500, and Meiya 81. Xinjiang Huaxi Seed Co. , Ltd. holds 6 varieties: X003, X008, Huaxi 703, Huaxi 707, Huaxi 709, and Huaxi 716. Xinjiang Qicai Agriculture Co. , Ltd. holds 6 varieties: QZ5002, Haole 616, Jinyu 101, Qicai 184, Qicai 808, and Qicai 857. Xinjiang Jienong Seed Co. , Ltd. holds 5 varieties: JN28, Jienong 1650, Jienong 4617, Jienong 624, and Jienong 628. Xinjiang Rongfeng Seed Co. , Ltd. holds 5 varieties: Rongfeng 620, Rongfeng 701, Rongfeng 711, Rongfeng 901, and Xianke 602. Shang Xingang holds 4 varieties: SN160, Jinxu 101, Xinrui 516, and Jinxu 708; Xinjiang Huaxia Agriculture Co. , Ltd. holds 4 varieties: H100, Huaxia 569, Huaxia 688, and Huaxia 813.

Xinjiang Guangyu Science and Technology Development Co. , Ltd. holds 3 new maize varieties: GY519, Guangyu 568, and Guangyu 902. Xinjiang Jinfengyuan Seed Co. , Ltd. holds 3 varieties: JFY5380, JFY5398, and Jinyu 1541. Xinjiang Jiufeng Seed Co. , Ltd. holds 3 varieties: Fengyu 33, Fengyu 598, and Fengyu 3198. Xinjiang Lilijin Seed Co. , Ltd. holds 3 varieties: Jinli 1701, Jinli 1702, and Jinli 1926. Xinjiang Academy of Agricultural Reclamation Sciences holds 3 varieties: XS9056, Kenyu 4140, and Kenyu 4606. Xinjiang Nongrun Seed Co. , Ltd. holds 3 varieties: Dade 2151, Dade 2152, and Dade 2161. Xinjiang

Tianyu Seed Co., Ltd. holds 3 varieties: Tianyu 808, Tianyu 818, and Tianyu 1885. Xinjiang Xiannong Kechuang Seed Co., Ltd. holds 3 varieties: Kechuang 9, Keyu 505, and Linkeyu 930. Changji Denghai Seed Co., Ltd. holds 2 varieties: Denghai 550 and Denghai 1119. Shang Jing holds 2 varieties: YS81 and Xian-nong 3. Xinjiang Kangdi Seed Science and Technology Co., Ltd. holds 2 varieties: Xinyu 45 and Xinyu 49.

Changji Prefecture Xiya Seed Co., Ltd., Ding Jirui, Jiushenghe Seed Industry Co., Ltd., Xinjiang Kangdi Agricultural Science and Technology Development Co., Ltd., Xinjiang Hongjing Agricultural Science and Technology Development Co., Ltd., Xinjiang Jintianshan Agricultural Science and Technology Co., Ltd., Xinjiang Xinshi Improved Seed Co., Ltd., and Xinjiang Zhongyu Agricultural Science and Technology Co., Ltd. each hold one new maize variety, namely Hengtian 902, DR21, Jiushenghe 593, Kangdi 5035, Hongjing 225, Jinshan 1578, Jiaer 336, and Zhongyan 2004.

Barley (*Hordeum* L.) has only 5 new varieties, all held by the Qitai Wheat Experimental Station of Xinjiang Academy of Agricultural Sciences: Xinliangpi 1, Xinpi 12119, Xinpi 13003, Xinpi 14057, and Xinpi 14099.

Sorghum (*Sorghum bicolor* (L.) Moench) has only 1 new variety, held by the Turpan Agricultural Science Research Institute: Xingao-liang 2.

Soybean (*Glycine max* (L.) Merrill) has only 1 new variety, held by the Xinjiang Academy of Agricultural Reclamation Sciences: Xinzhendou 1.

3.1.3 Oil crops. Sunflower (*Helianthus annuus* L.) has 5 new varieties, held by 2 variety rights holders. Among them, the Institute of Industrial Crops, Xinjiang Academy of Agricultural Sciences holds 3 varieties: 15S7079, HZ147, and HZ2399. Xinjiang Academy of Agricultural Reclamation Sciences holds 2 varieties: XKSI861 and XKY1612.

Peanut (*Arachis hypogaea* L.) has only 1 new variety, held by the Institute of Industrial Crops, Xinjiang Academy of Agricultural Sciences: Jianghua 211.

Oilseed rape (*Brassica napus* L.) has only 2 new varieties, both held by the Institute of Industrial Crops, Xinjiang Academy of Agricultural Sciences: Xinyou 24 and Xinyou 26.

3.1.4 Fruit plants. Melon (*Cucumis melo* L.) has 7 new varieties, held by 5 variety rights holders. Among them, the Hami Melon Research Center of Xinjiang Academy of Agricultural Sciences holds 2 varieties: Fengwei 4 and Fengwei 5; Chen Yuanliang holds 2 varieties: Nongtian 2 and Nongtian 3; while Liu Xiaoyong, Xinjiang Nongren Seed Science and Technology Co., Ltd., and the Institute of Crop Germplasm Resources of Xinjiang Academy of Agricultural Sciences each hold one variety, namely Tianmi 9, Shengkang 25, and Kuogun 1, respectively.

Common watermelon (*Citrullus lanatus* (Thunb.) Matsum et Nakai) has 7 new varieties, held by 7 variety rights holders. Changji Prefecture Yifeng Agricultural Science and Technology Co., Ltd., Xinjiang Annong Seed Co., Ltd., Xinjiang

Changnong Seed Industry (Group) Co., Ltd., Xinjiang Changnong Seed Industry Co., Ltd., the Institute of Crop Germplasm Resources of Xinjiang Academy of Agricultural Sciences, the Institute of Horticultural Crops of Xinjiang Academy of Agricultural Sciences, and Xinjiang Shuangquan Agricultural Science and Technology Co., Ltd. each hold one variety, namely Jiajiamei 2, Annong Zhentian 1, Boyuan Meidai, Boyuan Huaguan, Tawuzi 1, Huozhou 3, and C3078, respectively.

Apple (*Malus* Mill.) has 4 new varieties, held by 2 variety rights holders. Among them, Yili Maoxing Agriculture and Forestry Development Co., Ltd. holds 3 varieties: Hongxun 3, Hongxun 6, and Luhong. Wang Hongxun holds 1 variety: Hongxun 1.

Grape (*Vitis* L.) has only 2 new varieties, both held by the Grape and Melon Research Institute of Xinjiang Uygur Autonomous Region: Huozhou Cuiyu and Luzhou Baoshi.

3.1.5 Vegetables. Pepper (*Capsicum* L.) has 18 new varieties, held by 4 variety rights holders. Among them, Xinjiang Tianjiao Hong'an Agricultural Science and Technology Co., Ltd. holds 13 varieties: HB289, HB4054, HT40, Fugui Hong, Honglong 12, Honglong 16, Honglong 18, Honglong 23, Honglong 8488, Tianjiao Hongfu, CL189, FL114, and Tianjiao Hongxi. Chen Yuanliang holds 2 varieties: Nongjiao 4 and Nongjiao 5. The Institute of Horticultural Crops, Xinjiang Academy of Agricultural Sciences holds 2 varieties: Yuanjiao 32 and Yuanjiao 35. The Institute of Crop Germplasm Resources, Xinjiang Academy of Agricultural Sciences holds 1 variety: Ajike.

Tomato (*Lycopersicon esculentum* Mill.) has 9 new varieties, held by 4 variety rights holders. Among them, the Institute of Horticultural Crops, Xinjiang Academy of Agricultural Sciences holds 3 varieties: Yuanfan 56, Yuanfan 70, and Changhong. Xinjiang Academy of Agricultural Reclamation Sciences holds 3 varieties: KF1501, KF1502, and KF1503. The Agricultural Science Research Institute of the 6th Division of XPCC holds 2 varieties: Xiyuhong 201 and Xiyuhong 202. The Agricultural Science Research Institute of the 7th Division of XPCC holds 1 variety: Xinfan 15.

Zucchini (*Cucurbita pepo* L.) has only 4 new varieties, all held by Xinjiang Sanrui Agricultural Science and Technology Co., Ltd.: Haojie 1, Haojie 9, Sanrui Shuoguo, and Sanrui Yuguo.

3.1.6 Other plants. Sugar beet (*Beta vulgaris* L.) has only 4 new varieties, all held by Shihezi Academy of Agricultural Sciences: STC1211, STD1507, STD1812, and STm1512. Lavender (*Lavandula* L.) has 4 new varieties, held by 3 variety rights holders. Among them, Xinjiang Agricultural University holds 2 varieties: Xinnongxun 1 and Xinnongxun 2. The Agricultural Science Research Institute of the 4th Division of XPCC holds 1 variety: Xinxun 5. The Agricultural Science Research Institute of Ili Kazakh Autonomous Prefecture holds 1 variety: Yixun 1. Moth orchid (*Phalaenopsis* Bl.) has only 1 new variety, held by Changji Meichuangmei Agricultural Science and Technology Co., Ltd.: Jubao Xiaohuangya 2.

3.2 New forest and grass plant varieties Since 1999, the *Catalogue of Protected New Plant Varieties of the People's Republic of China (Forest and Grass Section)* has been published in 10 batches, covering a total of 311 genera and 32 species.

Among them, Xinjiang has obtained 35 new forest and grass plant varieties, involving the genera *Juglans* (walnut), *Prunus* (plum), *Ziziphus* (jujube), *Elaeagnus* (oleaster), *Populus* (poplar), *Rosa* (rose), *Ulmus* (elm), and *Pistacia* (pistachio), as well as the species jujube and apricot, covering a total of 8 genera and 2 species.

Walnut (*Juglans*) has 8 new forest and grass plant varieties, held by 4 variety rights holders. Among them, Xinjiang Academy of Forestry Sciences holds 3 varieties: Xinye 1, Xinhe 1, and Xinxiong. The Institute of Non-timber Forestry, Xinjiang Academy of Forestry Sciences holds 3 varieties: Mobao, Xinhui, and Xinsheng. Xinjiang Academy of Agricultural Sciences and the Institute of Horticultural Crops, Xinjiang Academy of Agricultural Sciences each hold 1 variety, namely Xinyuanfeng and Xinhe 1, respectively.

Plum (*Prunus*) has 7 new forest and grass plant varieties, held by 3 variety rights holders. Among them, the Institute of Non-timber Forestry, Xinjiang Academy of Forestry Sciences holds 4 varieties: Huangxin, Shengmei, Xinlu, and Xinrui. Kashi Prefecture Forestry Workstation holds 2 varieties: Zhenzhu and Huanghou. Xinjiang Academy of Agricultural Sciences holds 1 variety: Jiangbianfeng.

Jujube (*Ziziphus*) has 2 new forest and grass plant varieties: Sa Misu 2 and Qiang Hui 3, both held by Xinjiang Academy of Agricultural Sciences.

Oleaster (*Elaeagnus*) has 9 new forest and grass plant varieties: Baishatian, Hongling, Hongyu, Jinhuanhou, Jinsha, Qiahuang, Xinchu, Xinmai, and Yafeng. The variety rights holder for all of them is Xinjiang Academy of Forestry Sciences.

Poplar (*Populus*) has 3 new forest and grass plant varieties: Tianyan 98 Yang, Tianyan 99 Yang, and Tianyan 2000 Yang. The variety rights holder for all of them is Xinjiang Tianyan Biotechnology Co., Ltd.

Rose (*Rosa*) has 2 new varieties: Caoyuan Muge and Tianshan Xiaguang. Their variety rights holders are Xinjiang Applied Vocational Technical College and Kuitun Campus of Yili Normal University, respectively.

Elm (*Ulmus*) and pistachio (*Pistacia*) each have one new forest and grass plant variety: Tianrui, held by Xinjiang Ruiyixin Ecological Garden Technology Co., Ltd., and Xinkaizhen 1, held by Xinjiang Tianyi Shenghe Forestry Technology Co., Ltd., respectively.

Jujube (*Ziziphus jujuba*) and apricot (*Prunus armeniaca*) each have one new forest and grass plant variety: Pan Zao, held by the Xinjiang Red Date Association, and Deyuan 1, held by Turpan Deyuan Winery Co., Ltd., respectively.

3.3 New livestock and poultry varieties According to the *National Catalogue of Livestock and Poultry Genetic Resources and*

Varieties (2024 Edition), China has 32 cultivated pig breeds (including hybrids of domestic and wild pigs) and 18 cultivated pig synthetic lines. Among them, Xinjiang has participated in the breeding of the Ili white pig.

There are 11 cultivated breeds of ordinary cattle and 2 cultivated breeds of yak, and no cultivated breeds of zebu, buffalo, or gaur. Among them, Xinjiang has participated in the breeding of Xinjiang Brown cattle, Chinese Holstein cattle, and Chinese Simmental cattle.

There are 38 cultivated breeds of sheep and 15 cultivated breeds of goats. Among them, Xinjiang has participated in the breeding of Xinjiang Fine-wool sheep, Xinji Fine-wool sheep, Dexin Mutton Fine-wool sheep, Chinese Merino sheep, Subo Merino sheep, Chinese Karakul sheep, and Jiangnan Cashmere goat.

There are 14 cultivated breeds of horse and 13 cultivated breeds of rabbit, as well as 5 cultivated rabbit synthetic lines; there are no cultivated breeds of donkey or camel. Among them, Xinjiang has participated in the breeding of Yiwu horse and Ili horse.

There are 7 cultivated breeds of sika deer, 3 of red deer, 8 of mink (non-food), and 2 of raccoon dog, while there are no new breeds of reindeer, alpaca, silver fox (non-food), or arctic fox (non-food). Among them, Xinjiang has participated in the breeding of Yiha red deer and Tahe red deer.

There are 5 cultivated chicken breeds and 1 cultivated goose breed, as well as 104 chicken, 16 duck, 4 goose, 3 pigeon, and 1 quail cultivated commercial lines. However, Xinjiang has not participated in the breeding of these new varieties.

There are 2 cultivated breeds of pheasant and 2 cultivated commercial lines of Muscovy duck, while there are no new varieties of turkey, guinea fowl, partridge, mallard, ostrich, or emu. However, Xinjiang has not participated in the breeding of these new varieties.

3.4 New varieties of bees and silkworms According to the *National Catalogue of Bee Genetic Resources and Varieties (2024 Edition)*, China has 7 cultivated bee varieties (strains, commercial lines). However, Xinjiang has not participated in the breeding of these new bee varieties.

According to the *National Catalogue of Silkworm Genetic Resources and Varieties (2024 Edition)*, China has 65 cultivated varieties of silkworm (*Bombyx mori*) and 44 cultivated varieties of tussah silkworm (*Antheraea pernyi*). However, Xinjiang has not participated in the breeding of these new silkworm varieties.

3.5 New aquatic animal and plant varieties New aquatic varieties refer to new aquatic animal and plant varieties bred through selection, hybridization, introduction, and other methods, approved by the National Aquatic Original and Improved Seed Approval Committee, and authorized for extension by the Ministry of Agriculture and Rural Affairs. China currently has 306 new aquatic varieties, covering fish, shrimp, crabs, shellfish, frogs, alligator snapping turtles, softshell turtles, algae, and more.

Among them, Xinjiang has participated in the breeding of on-

ly one variety, the peled whitefish (variety registration number GS-03-002-2005), which was bred through introduction and other methods. Its breeding units are the National Fisheries Technology Extension Center (introduction) and Xinjiang Tianrun Sailimu Lake Fishery Science and Technology Development Co. , Ltd.

3.6 Invention patents and utility model patents According to the *International Patent Classification (2025 Edition)* , the IPC classification number for plant breeding is A01H (new plants or methods for obtaining new plants, etc.), the IPC classification number for invertebrate breeding is A01K67/60 to A01K67/68 (new or improved invertebrate varieties, etc.), the IPC classification number for vertebrate breeding is A01K67/027 (new or improved vertebrate varieties, etc.), and the IPC classification number for agriculture is A01 (agriculture, forestry, animal husbandry, hunting, trapping, fishing, etc.).

As shown in Table 1 , in the field of plant breeding, the number of valid patents in Xinjiang is limited, with only 69 national invention patents and 45 national utility model patents. In the field

of invertebrate breeding, valid patents in Xinjiang are extremely rare, with only one national invention patent, *A Breeding Method for Cotton Aphid Parasitoid Aphidius gifuensis* (publication number CN119257077A), and no national utility model patents. In the field of vertebrate breeding, valid patents in Xinjiang are also very few, with only four national invention patents: *Method for Obtaining Sheep of Different Coat Colors Based on CRISPR/Cas9 and sgRNA Targeting the ASIP Gene* (publication number CN105950626A), *Nucleic Acid Molecules, Kit, Method and Application for Breeding Short-Tailed Sheep Based on HDR Gene Editing* (publication number CN112779254A), *sgRNA, Kit and Application for Achieving Precise Mutation of the FGF5 Gene in Sheep* (CN112553207A), and *RNAi Interference Fragment, Interference Vector, Preparation Method and Application Thereof* (CN107267511A), and likewise no national utility model patents. In the field of agriculture, Xinjiang has comparatively more valid patents, with 1 347 national invention patents and 5 310 national utility model patents.

Table 1 Number of valid national invention and utility model patents in Xinjiang

Region	Breeding field						Agricultural field	
	Plants		Invertebrates		Vertebrate			
	Patent	Utility model	Patent	Utility model	Patent	Utility model	Patent	Utility model
Hami City	9	9	0	0	0	0	12	66
Turpan City	0	1	0	0	0	0	7	61
Bayingolin Prefecture	1	9	1	0	0	0	55	361
Hotan region	0	0	0	0	0	0	11	200
Kashgar region	0	0	0	0	0	0	18	241
Kizilsu Prefecture	0	1	0	0	0	0	1	63
Aksu region	2	3	0	0	0	0	81	367
Counties directly under Ili Prefecture	1	6	0	0	0	0	28	437
Bortala Prefecture	0	1	0	0	0	0	20	113
Tacheng region	1	0	0	0	0	0	29	242
Altay region	0	0	0	0	0	0	14	152
Karamay City	0	0	0	0	0	0	18	73
Changji Prefecture	8	6	0	0	0	0	59	676
Urumqi City	47	13	0	0	3	0	598	1 742
Counties directly under the autonomous region	19	9	0	0	1	0	396	516
Total	69	45	1	0	4	0	1 347	5 310

3.7 Product design patents Design patents related to agricultural products (especially primary agricultural products) are primarily used for packaging and containers that facilitate the transportation or loading/unloading of goods, and are national design patents for packaging and containers^[8]. National design patents for the product itself are mainly used for the appearance design of the product itself, and do not involve packaging or containers.

As a key national production base for a wide variety of foods, natural textile fibers, and livestock products, Xinjiang occupies a distinctive position in the design patent landscape. Drawing on the *Locarno Classification entries of the International Classification for Industrial Designs (15th Edition)* that pertain to foodstuffs (cover-

ing food for humans, animal feed, and dietetic preparations), textiles (including all textiles and similar products sold as yarns or in unfinished form), clothing (including garments, fashion accessories, and haberdashery), household textiles, and articles for animal care and training, this study retrieved the valid national design patents for products themselves across these five categories in the autonomous region, as summarized in Table 2.

As shown in Table 2 , after excluding national design patents for packaging and containers, the number of valid national product design patents in Xinjiang is limited across the five major fields of foodstuffs, textiles, clothing, household textiles, and animal farming, with 23 , 27 , 124 , 51 , and 38 patents, respectively.

Table 2 Number of valid national product design patents in Xinjiang

Region	Foodstuffs	Textiles	Clothing	Household textiles	Animal farming
Hami City	4	0	1	0	0
Turpan City	0	0	8	0	1
Bayingolin Prefecture	0	3	11	2	2
Hotan region	1	1	15	0	1
Kashgar region	2	5	10	0	4
Kizilsu Prefecture	0	0	2	0	0
Aksu region	3	1	10	2	1
Counties directly under Ili Prefecture	0	4	1	4	2
Bortala Prefecture	0	0	1	0	2
Tacheng region	0	2	0	0	11
Altay region	0	0	3	0	1
Karamay City	0	1	0	1	0
Changji Prefecture	1	0	7	0	2
Urumqi City	12	10	50	41	11
Counties directly under the autonomous region	0	0	5	1	0
Total	23	27	124	51	38

4 Main problems of new quality productivity and sci-tech innovation

4.1 Agricultural ecological environment needs to be further improved Desert control, saline-alkali land development and water resources utilization have been greatly improved, which need to be further developed, and the standardization construction of farmland, pasture and pond needs to be strengthened.

4.2 Facility agriculture and smart agriculture need to be developed according to local conditions It is necessary to further develop facility planting and breeding, and promote the industrial development of agriculture, animal husbandry and aquatic products, especially in extreme environmental areas such as desert, saline-alkali land and alpine mountainous areas. Besides, it is necessary to further promote the application of big data, cloud computing, AI, IoT and other technologies under the guidance of standardization, digitalization and intellectualization, establish a smart agricultural system, build a smart agricultural operation and management network, and realize automation and precision management of production process.

4.3 Bottlenecks in the purification and rejuvenation of traditional varieties and the screening and domestication of introduced new varieties The region's traditional crop and live-stock varieties have undergone significant genetic deterioration, necessitating systematic purification and selective propagation so that the non-degenerated individuals can be multiplied and rejuvenated into genetically uniform, vigorous populations. Introduced salt-alkali tolerant germplasm requires additional rounds of screening and adaptive cultivation. In aquaculture, the dominant species are largely dependent on stock introduced from outside the region; these introductions often show poor suitability to local aquatic conditions, resulting in extremely low survival rates.

4.4 Insufficient capacity to cultivate new varieties of animals and plants The capacity for breeding new varieties of agricultural plants, forest and grass plants, livestock, poultry, bees, silkworms, and aquatic animals and plants is insufficient. The

whole region has obtained only 521 new agricultural plant varieties, involving only 7 genera and 13 species. It has obtained only 35 new forest and grass plant varieties, involving only 8 genera and 2 species. It has participated in breeding only 15 new live-stock varieties, involving only pigs, cattle, sheep, horses, and red deer, but not poultry, bees, or silkworms. As for new aquatic animal and plant varieties, only the peled whitefish has been introduced and bred.

4.5 Scarcity of invention patents and utility model patents Agri-cultural sci-tech innovation capacity remains weak. While a relatively large number of valid national invention and utility model patents exist in the broader agricultural sector, they are notably sparse in the specialized breeding fields of plants, invertebrates, and vertebrates.

4.6 Scarcity of product design patents Design innovation capacity remains weak, and valid national product design patents are limited in number across all five categories examined, namely, foodstuffs, textiles, clothing, household textiles, and animal farming.

5 Strategies for the development of new quality productivity and the empowerment of intellectual property rights

5.1 Managing the agricultural ecological environment according to local conditions and establishing standardized agricultural production infrastructure It is recommended to strengthen desert control, saline-alkali land development, and water resource utilization according to local conditions, continuously improve the agricultural ecological environment in Xinjiang, promote the standardization of farmland, pastures, and ponds, and build high-standard farmland, pastures, ponds, and logistics networks, thereby establishing standardized agricultural production infrastructure.

5.2 Developing facility agriculture and smart agriculture, and building a modern agricultural production system It is

recommended to vigorously develop facility agriculture in Xinjiang, with particular emphasis on extreme environments such as deserts, saline-alkali areas, and frigid alpine zones, so as to accelerate the industrial-scale production of crops, livestock, and aquatic products.

A new agricultural paradigm driven by the IoT, big data, and artificial intelligence should be fostered; precision operations should be realized through intelligent agricultural machinery, agricultural sensors, and the BeiDou Navigation Satellite System. Priorities include establishing a province-wide agricultural and rural big data platform, jointly developing a "single map" of agricultural and rural land, creating foundational models for smart agriculture, facilitating large-area yield improvements of staple crops, incubating a suite of smart farms (including livestock and aquaculture operations), promoting the digital transformation of entire agricultural value chains, and implementing early-stage pilot and demonstration projects for smart agriculture.

Agriculture must continue to be equipped with modern science, technology, and industry, served by modern scientific advances, and transformed through modern production modes. This will establish a modern agricultural production system and progressively shift agriculture away from its traditional dependence on favorable weather.

5.3 Enhancing the purification and rejuvenation of traditional varieties and the introduction and acclimatization of new germplasm to strengthen the agricultural "chip" Efforts should be intensified to develop national- and autonomous region-level crop germplasm repositories (and field genebanks), forest germplasm banks, grass germplasm nurseries, national livestock and poultry gene banks (including conservation zones and breed preservation farms), and national aquatic germplasm conservation zones, thereby safeguarding agricultural bio-genetic resources and preserving their diversity.

It is necessary to build national-level and autonomous region-level seed industry enterprise arrays by drawing on the problem-solving array, weakness-shoring-up array, strength-enhancing array, investment institutions, and technical support.

In addition, it is recommended to enhance the purification and rejuvenation of traditional varieties in crop farming, animal husbandry, and aquaculture, strengthen the introduction, screening, and acclimatization of new varieties (especially marine aquatic animals), thereby fortifying, enhancing, and expanding the agricultural "chip."

5.4 Creating new plant and animal varieties and cultivating biological varieties with independent intellectual property rights Greater efforts should be directed toward the development of new plant and animal varieties, including the generation of new variety rights for agricultural plants, forest and grass plants, livestock and poultry, bees and silkworms, and aquatic organisms. Priority should be given to breeding salt- and alkali-tolerant, drought-resistant, and cold-hardy crops and forages, as well as aquatic animals adapted to artificial seawater environments, with the ultimate goal of cultivating proprietary biological varieties protected by independent intellectual property rights.

5.5 Protecting invention patents and utility model patents to safeguard agricultural sci-tech innovation It is recommended

to advance the strategy of building a strong intellectual property nation and implement patent strategies for leading agricultural enterprises, and strengthen the creation, application, protection, management, and services of national invention patents and national utility model patents in crop farming, animal husbandry, aquaculture, and their deep-processing sectors, especially in the field of plant and animal seed industries, so as to effectively safeguard agricultural sci-tech innovation.

5.6 Creating product design patents to promote equipment-based agriculture and deep processing of agricultural products It is recommended to create national design patents for the product itself for items such as agricultural machinery, equipment, and textiles, and combine them with national utility model patents to promote the development of equipment-based agriculture and the deep processing of agricultural products. At the same time, integrate packaging and container design patents to strengthen the intellectual property protection of design innovations.

5.7 Employing sci-tech innovation-related intellectual property to empower the development of agricultural new quality productive forces (i) It is necessary to strengthen the creation, application, protection, management, and services of sci-tech innovation-related intellectual property rights, including new agricultural plant and animal varieties, invention patents, utility model patents, and product design patents, and integrate them with brand and logo-related IP and cultural heritage-related IP to connect the entire intellectual property chain. Fully leverage the role of IP in institutional supply and technology supply to empower the development of agricultural new quality productive forces.

(ii) It is recommended to develop agricultural new quality productive forces according to local conditions, striving to achieve new breakthroughs in strengthening original innovation and tackling key and core technologies to seize the commanding heights of science and technology; explore new pathways in promoting the deep integration of the innovation chain, industrial chain, capital chain, and talent chain, and in driving the efficient transformation and application of scientific and technological achievements; create new prospects in optimizing and upgrading traditional industries, cultivating and strengthening emerging industries, and proactively laying out future industries; and achieve new results in further deepening reform and removing institutional and mechanistic obstacles that constrain the development of new quality productive forces.

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The regression results clearly demonstrated that in core grain production areas, where the primary industry constitutes a relatively high proportion, the coefficient for returning entrepreneurial vitality was significantly higher than in non-core areas and was positive at the 1% statistical significance level, confirming **H3**. This suggests that the issue of idle factors is more pronounced in core grain-producing counties, and the marginal effect of returning entrepreneurship is stronger.

4 Conclusions and policy implications

4.1 Conclusions This paper analyzed balanced panel data from 178 national-level major grain-producing counties across six central provinces between 2011 and 2022. It developed an evaluation system and a factor integration index to assess the level of common prosperity in these counties. The study draws three key conclusions: first, returning entrepreneurial vitality significantly and positively influences the common prosperity of major grain-producing counties in the six central provinces. This vitality not only boosts the overall economic output but also helps narrow the income gap between urban and rural areas and enhances the sharing of public services. Second, factor integration serves as the core transmission pathway. Returning entrepreneurship partially mediates this effect by improving the efficiency of aggregation and allocation of capital, labor, land, and technology. Third, this impact exhibits regional heterogeneity, being more pronounced in core grain-producing areas and counties with a relatively high proportion of primary industry.

4.2 Policy implications The research conclusions of this article offer clear policy guidance for dismantling the urban-rural dual structure, enhancing support policies for returning entrepreneurship, and promoting common prosperity in the major grain-producing counties of six central provinces during the 15th Five-Year Plan period.

4.2.1 Dismantling the institutional barriers between urban and rural factors. During the 15th Five-Year Plan period, efforts will focus on major grain-producing counties to improve the land transfer system, establish specialized credit products to support returning entrepreneurship, and enhance the technology promotion system, thereby providing institutional guarantees for factor integration.

4.2.2 Improving the support system for factor integration. It is essential to closely integrate policies supporting returning entrepreneurship with food security strategies, enhance fiscal subsidies,

tax incentives, and credit interest subsidies, establish business incubation centers and industrial parks, and promote the coordinated development of the primary, secondary, and tertiary industries.

4.2.3 Implementing differentiated support policies. Priority should be given to launching pilot programs that encourage returning entrepreneurship in key grain-producing areas and economically underdeveloped counties. Support for large-scale households and family farms should emphasize the integration of land and technology, while support for businesses in the processing and tourism sectors should focus on combining capital and labor. This targeted approach will help prevent resource waste caused by a "one-size-fits-all" policy.

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