One of China’s pioneering scientific institutions marks its 60th anniversary this year, celebrating a remarkable history of genetic research centered on strategic and pressing challenges in the world’s second-largest economy.

The Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences (CAS) was founded in 2001, through a merger of three institutes: the Institute of Genetics, the Institute of Developmental Biology, and the Shijiazhuang Institute of Agricultural Modernization.

In its freshly integrated form, IGDB uses research on plant and animal models to help solve relevant challenges in China, such as those of food security and human health, or crippling water shortages for its vast population of more than 1 billion people.

Putting down roots

The roots of the award-winning institute go back to 1959, when the Institute of Genetics was first established, which was founded to conduct research into plant molecules and cytogenetics, human and animal genetics, immunogenetics, and biotechnology. The Shijiazhuang Institute of Agricultural Modernization was established in 1978 to study the efficient use of farming resources, water-saving technology, and agricultural biology. The most recent of the group, the Institute of Developmental Biology, opened in 1980.

“After integration of the institutes, we have continued to attract high-level talent and to carry out research to solve the country’s major strategic needs, producing a number of important results,” says Weicai Yang, IGDB/CAS director, adding, “The institute is flourishing.”

The merger has created a modern, thriving center of scientific research, hosting 90 principal investigators and more than 360 researchers and technical staff. The institute now encompasses three state key laboratories, including the State Key Laboratory of Plant Genomics, the State Key Laboratory of Plant Cell and Chromosome Engineering, and the State Key Laboratory of Molecular Developmental Biology.

Reaping the rewards: Notable breakthroughs

Yang suggests that IGDB’s 60th anniversary is the perfect opportunity to review both the history and the future direction of the institute, which boasts an impressive staff of academic professionals. Among them is Zhensheng Li, who won the State Preeminent Science and Technology Award of China in 2006 for his contribution to the breeding and development of elite wheat cultivars, and Jiayang Li, who won first prize for the State Natural Science Award in 2017, and was named the Future Science Prize Life Science Prize Laureate in 2018 for his seminal work on rice molecular genetics and its application in rice genetic modification.

IGDB’s team includes scores of China’s high-flying scientists, including 42 recipients of the One Hundred Talents Program award from CAS and 30 winners of National Science Fund for Distinguished Young Scholars awards.

Researchers in the institute have achieved breakthroughs in crop genomics, wide hybridization, molecular breeding, and regenerative medicine. The institute has received 20 major national awards and its achievements have been selected as national or international top scientific breakthroughs in China on seven occasions, including the sequencing of the first 1% of the human genome in 2001 and the draft sequence of wheat A-genome in 2013. Many research results from the institute have also had broad societal impacts, such as tissue repair technology that has helped patients with uterine damage to have children. Furthermore, since 2011, the institute has bred 80 new wheat, rice, soybean, and corn cultivars.

Among IGDB’s long history of achievements over the past six decades, there are several which stand out, according to Yang.
"In 1973, the institute took the lead in carrying out embryo engineering research on mice, rabbits, sheep, and cattle, including in vitro immortalization and in vitro fertilization of eggs, cryopreservation of embryos, and embryo division and identification, and successfully completed the embryo transplantation of cattle and sheep in 1976," says Yang.

One key achievement in the area of food security is ongoing research that started in the 1960s and has led to the development of more than 80 wheat varieties—including Xiaoyan 6, which has become one of the most important founder parents for wheat breeding in China.

In work pioneered by Jiayang Li, researchers have also successfully defined the molecular genetic framework of tillering and the formation of ideal plant architecture in rice, as well as the role that plant hormone strigolactones play in rice growth. After more than 10 years of research, the institute has also created a new generation of rice supercultivation system solutions, and worked on creating new high-quality, high-yield, and multiresistance rice, using a new system of molecular module breeding technologies.

In 2015, the institute used nerve regeneration collagen scaffolds combined with cell transplantation to treat spinal cord injuries. Between 2013 and 2018, researchers successfully used stem cells combined with collagen scaffold material to treat endometrial damage and premature ovarian failure.

The institute's research into the Zika virus in 2016 also established the first animal model to confirm that infection by the virus can lead directly to the occurrence of microcephaly. It has also created vaccines that can be used for clinical treatment.

Although the pursuit of scientific knowledge is the institute's primary aim, its research direction is guided by the needs of the country, particularly as China has undergone sweeping economic growth and social change over the past six decades.

"While promoting the study of major scientific issues, we have actively carried out scientific research around the goal of solving major national strategic needs and have produced results that have both influenced the international scientific community and also played an important role in China's economic growth," says Yang.

Fostering collaboration

The institute has established several strategic partnerships with local governments and companies, including a nationwide agricultural R&D network focused on the breeding of crops and livestock.

It also has relationships with institutes and universities around the world, such as the CAS-JIC Centre of Excellence for Plant and Microbial Science, established with Britain's John Innes Centre (JIC), a joint center for research and training in plant and microbial science that focuses on studies of crop improvement and natural products. This is the most advanced partnership of its kind between China and the United Kingdom, with dedicated research space on three campuses, two in Beijing and Shanghai in China, and the third in Norwich in the United Kingdom. The center has launched 26 collaborative research projects between CAS and JIC since 2014. It is the most important international center for IGDB, bringing together UK and Chinese expertise in scientific research to tackle the global challenges of food security and sustainable health care.

The institute has a number of new projects and partnerships in the pipeline, all focused around key practical challenges in China's agricultural production and food security. Together with 10 other CAS institutes, in 2018 IGDB established the College of Advanced Agricultural Sciences at the University of CAS, and has also been working on the establishment of the Innovative Academy for Seed Design (INASEED) of CAS, which includes members from 19 other institutes of CAS, to support the national seed industry.

Looking beyond

With 60 years of breakthroughs and pioneering research behind them, IGDB's team of expert scientists and students are looking ahead to the next six decades and hoping to keep breaking new ground in biology.

"In the future, the institute will continue to serve China's major strategic agricultural and health care needs, working at the forefronts of life sciences and within the context of the national economy. We will do this through our focus on genomic structure and regulation, the molecular underpinnings of important agronomic traits, the molecular mechanisms of development and human diseases, and other cutting-edge disciplines," says Yang.

"I hope that in the next 60 years, while maintaining its overall high level of research and development, IGDB can make further major scientific breakthroughs as it strives to become a premier innovation research center for genetic and developmental biology."