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Blueprint into Action

Fields: From bare to bountiful

Left: Liu Xinwei (right), a professor at Qingdao Agricultural University, works with villagers on soil improvement trials at an experimental base in Dongying, Shandong province, on Nov 6. GAO XIAOLU / FOR CHINA DAILY

Right: Visitors take photos in a field after the rice harvest in Dongying on Wednesday. YANG YANG / FOR CHINA DAILY



Farmers gather harvested rice in a field in Dongying in early November. The once white, barren land has been transformed into high-yield fields. ZHENG XUDONG / FOR CHINA DAILY

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The fourth plenary session of the 20th Central Committee of the Communist Party of China in October called for enhancing overall agricultural production performance, quality and efficiency. Saline-alkaline land utilization is a crucial part of this effort, holding significant strategic importance for safeguarding national food security and ensuring China's food supply remains firmly in its own hands.

Shandong has integrated the comprehensive utilization of saline-alkaline land into the national strategy for developing the Yellow River Basin. The province is exploring a path characterized by ecological prioritization, adaptation to local conditions, compatibility between seeds and land, and technological support.

"The once white, barren land is now transforming into golden, high-yield fields," said Wang.

Harvesting hope

Li's farmland lies directly across the road from Huanghekou, or the Yellow River Estuary.

He started acquiring land from his fellow villagers in 2010 to carry out large-scale land management.

"At the beginning, I secured around 10 hectares of land. They leased the land to me at very low prices because the land had very low yields," he said.

He rehabilitated the land using methods such as irrigation and deep plowing. "It's very difficult to increase grain yield during the first three to five years, but later with the local government's support and also after accumulating some experience, the grain yield increased," he said.

Today, Li manages 66 hectares of saline-alkaline land, practicing the compound cultivation of wheat, corn and soybeans in the same fields.

"Now the government provides subsidies. In a normal year, 1 *mu* of land can create a gross revenue of over 2,000 yuan after two seasons," he said.

Business partners who joined him from the outset have all prospered enough to buy houses and cars. Li's son has also chosen to stay and continue the agricultural cooperative.

This year, Li started planting a new variety of wheat in some fields.

"Trial results showed that the new variety of wheat performs better," said Zhang Chengda, a staff member at Shandong Fengcai Seed Industry. "(It has) resistance to pests and diseases, while requiring less pesticide, adding new guarantees for stable and high yields on saline-alkaline land and bringing tangible hope for increasing farmers' incomes."

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Researchers keep developing salt-tolerant varieties, and I like to try the new ones.”

Li Dianquan, a farmer in Dongying, Shandong province

Li said: "Researchers keep developing salt-tolerant varieties, and I like to try the new ones."

Another piece of saline-alkaline land with about 100 hectares of selenium-rich rice in Wenhui subdistrict, Dongying, also saw a bumper harvest.

"I never imagined selenium-rich rice could grow from saline-alkaline land. After 180 days of growth, these grains are rich in selenium," said Song Xinye, a local farmer.

Yin Shenghui, director of the agricultural office in the subdistrict, said that through industrialization, standardized production, mechanized processing, and branded sales, the land has increased the village's collective income by 130,000 yuan.

"The once barren land has turned into a breadbasket," said Li.

Saline solutions

Managing saline-alkaline land is first and foremost a battle with the soil.

"(The soil was) white in spring, waterlogged in summer, and red in autumn, making grain harvesting extremely difficult," said Gai Junshan, chairman of Shandong Qian-shun Soil and Water Management Technology Co, voicing a shared memory of many Dongying natives.

In spring — when it's warm, dry and windy — water from deep in the soil is pulled to the surface and evaporates, leaving salt on the surface that forms a white crust on the ground, he said.

In autumn, the saline-alkaline soil makes it hard for most crops to grow. Only very tough, salt-loving plants like Suaeda salsa can survive. This plant turns a bright red color in the fall, covering the fields in a red blanket.

Born and raised in Dongying, Gai vowed to reclaim his hometown's saline-alkaline land when he was 17.

He traveled to countries including the Netherlands and Germany to study land rehabilitation techniques, eventually developing technologies suitable for the local conditions.

His company's core technology involves an integrated system. A physical barrier is erected around the

treatment area to effectively block external saline water intrusion.

Two sets of underground pipes are then laid, with the upper pipes draining salt from the soil, and the lower ones controlling and lowering the groundwater table to prevent salt from rising.

The entire system uses vacuum pumps to create negative pressure, functioning like a "respiratory system" for the land, allowing salt to be discharged in an orderly manner, said Gai.

"This technology successfully reduces the soil's salt content from 1.6 percent to 0.3 percent, reaching a standard suitable for various crops," he said.

"There's no one-size-fits-all model for managing saline-alkaline land. We must choose the right method based on the soil composition of different areas."

The system, involving 19 national invention patents held by his company, has now been applied in Dongying and other areas, such as the Inner Mongolia and the Xinjiang Uygur autonomous regions, providing technical support for crop harvest.

Green 'manure'

But this is merely the first step. Saline-alkaline land is not just salty, it's also barren.

At the Agricultural High-tech Industrial Demonstration Area of the Yellow River Delta of Shandong province, researchers from Qingdao Agricultural University have been focusing on making the soil healthy by increasing organic matter.

They promote the cultivation of "green manure" crops — plants grown to be chopped and turned back into the soil to add organic matter.

"As soil organic matter increases, the aggregate structure improves, enabling better water and fertilizer retention and suppressing salt rise, which naturally lowers surface salinity," said Liu Xinwei, a professor at Qingdao Agricultural University.

To verify the long-term effects of these measures, the researchers built 36 isolated cement pools at their experimental base in the demonstration zone. "This is to strictly control interference between different fertilizer treatment plots and ensure accurate and reliable data," said Liu.

This experiment is planned to last for decades, aiming to unravel the secrets of soil evolution and provide the most solid scientific basis for saline-alkaline land management.

This transformation, however, goes beyond soil texture, and it is also changing farmers' mindsets and capabilities.

At the base, Liu and several farmers, shovels in hand, discussed upcoming plowing and planting arrangements while checking soil moisture.

"After years of collaboration, farmers' expertise has also improved," Liu said. "Now they can not only accurately execute experimental plans but also assist in recording data. If you tell them how to set up the test plots, they can complete it quickly according to requirements."

Modifying the land, however, isn't enough as saline-alkaline land is very stubborn, the professor said. "So later, seed cultivation teams also got involved," said Liu.

They test existing varieties on saline-alkaline land to screen the best-performing ones, and then breed new salt-tolerant varieties.

The research teams at the demonstration base have made a number of major achievements in breeding new varieties that can grow in the saline-alkaline land.

The quinoa team has screened and cultivated over 60 high-quality, early-maturing, high-yield quinoa lines suitable for saline-alkaline land.

"The forage grass team has cultivated alfalfa varieties which have solved the problem of long-term reliance on imported alfalfa seeds in Shandong," said Liu.

To achieve precise and rapid breeding, the research teams have introduced a speed breeding facility and a phenotyping platform.

Inside the speed breeding facility, the environment is artificially controlled, drastically shortening crop growth cycles.

"Most crops in the north grow one cycle per year. Here, crop growth isn't affected by seasonal changes," said Ma Shumin, a staff member of the demonstration zone. This means the breeding cycle can be shortened from the traditional seven or eight years to three or four years.

The phenotyping platform operates like a plant CT room — a massive 25-meter wide, 300-meter long track system equipped with various hyperspectral, fluorescence, and radar cameras that perform comprehensive scans of plants growing in the field.

Through big data analysis, it can be quickly determined which variety is more salt-tolerant, greatly improving screening efficiency, Liu said.

"While the saline-alkaline land is a global challenge that is difficult to cure, technology and innovation enable its ingenious utilization. Seeing grain yields rise on this once-infertile land makes our work meaningful."

Gao Xiaolu, Dong Wenqiang and Yu Lichen contributed to this story.

Aquaculture reels in economic opportunities

By ZHAO RUIXUE
in Boxing, Shandong

In Boxing county, Shandong province, vast stretches of once-barren saline-alkaline land have been transformed into a thriving modern aquaculture base. Through coordinated development of low-lying areas along the Yellow River, the county has turned ecological challenges into economic opportunities.

In recent years, Boxing has accelerated the large-scale conversion of these unproductive lands, built standardized ponds, industrial aquaculture facilities, and supported infrastructure including water conservancy systems, roads and power supply networks to establish integrated modern fisheries zones.

A pioneer in this effort, Qiaozhuang town began experimenting with shrimp farming as early as 2001. By mixing Yellow River water with local saline groundwater, farmers gradually adapted the shrimp to the local conditions.

"Our village sits on reclaimed coastal land which is highly saline, where only weeds grew and crops barely survived. We were once known for poverty," said Song Chun, Party secretary of Wangping village in Qiaozhuang.

"Now, nearly every household raises shrimp, and lives have improved dramatically," he said.

Over the past two decades, Qiaozhuang has established a complete industrial chain from seedling acclimation, feed supply, and disease control to cold storage, processing, and sales.

"On average, each household in our village manages two or three shrimp ponds, with annual earnings exceeding 100,000 yuan (\$14,055)," Song added.

The town continues to innovate. It has introduced an intelligent recirculating aquaculture system that automates feeding, waste removal, and harvesting. An online water-quality monitoring system tracks key indicators, such as water temperature and dissolved oxygen in real time, ensuring a healthy aquatic environment.

Today, Qiaozhuang boasts 38,000 *mu* (about 2,533 hectares) of shrimp ponds, generating an average annual income of 17,000 yuan per *mu*, according to statistics from the town government.

Wang Jingdong, deputy director of the Shandong Provincial Department of Agriculture and Rural Affairs, highlighted the provincial strategy: "We adhere to a coordinated approach that balances grain, economic crops, and forage production, while promoting agriculture, animal husbandry, and fisheries in parallel. By developing distinctive saline-alkaline agriculture, we are turning a 'barren crust' into 'golden nuggets'."

Gao Xiaolu contributed to this story.



Villagers collect shrimp cultivated in a saline-alkaline pond in Boxing county, Shandong. PROVIDED TO CHINA DAILY