In China, a Plan to Turn Rice Into Carbon Credits

Biotech Firm Pushes Using Less Fertilizer; Ban on Altered Seeds

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YINCHUAN, China—Agriculture contributes more to total global greenhouse-gas emissions than the entire world transportation sector, according to a United Nations-sponsored panel. To Eric Rey, that sounds like the makings of a business plan.

On a recent day, Mr. Rey pulled on a pair of rubber boots and waded into a muddy rice paddy—the place where he hopes to battle global warming and earn a fortune for his budding biotech company.

In rural northern China, a rice paddy is dotted with yellow metal boxes. Plastic tubes trap emissions of nitrous oxide for measurements.

Mr. Rey, president and chief executive of Arcadia Biosciences of Davis, Calif., has ventured to this remote corner of northern China—a patchwork of flower fields and emerald rice paddies punctuated by ornamented mosques—to sell farmers a genetically engineered rice seed. He says the seed, still in development, will cut their need for nitrogen fertilizer, which is among their biggest costs—and a huge source of greenhouse gases. He then aims to sell the resulting carbon credits on a growing global exchange.

"Here's an opportunity for farmers to make more money, for us to be more profitable and for the environment to benefit," said Mr. Rey, a lanky 51-year old, beaming as he brushed his hand across the tips of the rice grains. "It's a triple win."

Entrepreneurs around the globe are racing to feed a $30 billion market for carbon credits, which offer companies a way to comply with emissions-reduction requirements without actually cutting their own output of greenhouse gases. The market arose in the wake of the 1997 Kyoto Protocol, in which most industrial countries except the U.S. agreed to a collective 5% reduction in their greenhouse-gas emissions by 2012.

Tapping Agriculture

In a typical transaction, an industrial company that is having trouble reducing emissions can buy credits from another company that has figured out a cost-efficient way to cut its own carbon output beyond what is required. Many early carbon-credit projects focused on curbing emissions at industrial facilities, including reducing methane emissions at landfills. But entrepreneurs like Mr. Rey see huge potential in tapping into agriculture—the No. 4 producer of global-warming gas.
GROWING CONCERN

• The Situation: Eric Rey has a plan to profit from the vast amount of global-warming gases created by the fertilizer used in growing rice in China.

• The Background: He is trying to sell a gene his company owns that he says allows rice plants to use less fertilizer. He plans to sell the reduced emissions on the growing global market for carbon credits.

• What's Next: He is testing Chinese rice fields to get a base line for how much gas is emitted and is working with Chinese researchers on developing local rice that contains his company's gene.

Agriculture contributes about 14% of global greenhouse-gas emissions, according to the U.N.-sponsored Intergovernmental Panel on Climate Change. That is smaller than emissions from energy use, forestry and industry, but larger than transportation.

By focusing on rice in China, Mr. Rey may be tapping into a treasure trove. Much of the greenhouse-gas emissions from agriculture come from nitrogen fertilizer. China is the biggest user of fertilizer and the world's largest rice producer.

But his quest to turn Chinese rice into carbon credits faces big hurdles. His company needs to do field tests in China to prove that its genetically modified seeds can thrive there. China's intellectual-property laws are weak and its farmers are set in their ways, leaving biotech firms stumped over how to make money from its vast agriculture sector. Monsanto Co., a pioneer in the Chinese market, has retreated in frustration.

Most daunting, he must persuade the Chinese government to allow companies to sell staple food crops, like rice, that have been bioengineered. Though genetically modified seeds are common in the U.S., European and Asian countries have been more cautious about their use.

Mr. Rey, a biotech veteran who enjoys adventures such as flying aerobatic planes or tracking baboons in Tanzania, isn't deterred by the odds. "A set of rules is something that somebody made up in their mind," he says.

He spent 15 years at Calgene, developer of the "Flavr Savr" tomato, the first genetically modified whole food approved by the Food and Drug Administration. Calgene was acquired by Monsanto in 1997 and that year, Mr. Rey set up his own consulting firm.

One day in 2000, he got a call from John Sperling, a billionaire who made a fortune creating University of Phoenix, an online college. Mr. Sperling, an investor in biotech projects including cloning and human longevity, was seeking help on a project in Eritrea trying to raise plants that could grow in salt water to aid poor farmers. The project wasn't successful, but the two found a common interest in using biotechnology to solve hunger and help farmers.

"The grand design is someday to create plants that are salt-tolerant, nitrogen-efficient and drought-resistant," says Mr. Sperling. "That is the nirvana of agricultural engineering."

In 2002, Mr. Rey, with funding from Mr. Sperling, formed Arcadia. Today, the company's staff of 75 scouts research institutions for new technologies, hoping to develop and eventually license them. So far, it has nine technologies in the pipeline, including salt-tolerant plants, safflower oil enhanced with omega-6 fatty acids and tomatoes with a longer shelf life. The company expects to commercialize its first product in 2008.

Forgot to Fertilize

The year Arcadia was formed, its researchers came across work at the University of Alberta in the field of nitrogen-use efficiency. The Canadian researchers had been trying to create a plant that could thrive in salty soils. Instead they stumbled upon a plant that thrived without fertilizer after a lab director forgot to fertilize one of the trial seeds. Arcadia licensed the technology in 2002 for an undisclosed amount.

To date, Mr. Rey says Arcadia has invested "tens of millions of dollars" into the nitrogen technology—to develop genetically modified seeds or plants than can grow with half the amount of fertilizer normally required. The amount hasn't exceeded $40 million, he says, but "the ongoing investment rate is pretty aggressive."

In 2005, Mr. Rey's company signed an agreement giving Monsanto rights to develop and commercialize the nitrogen-efficient technology for canola. Terms weren't disclosed.

Others are also trying to develop such seeds. "Essentially all of the biotech companies have some program involving nitrogen use," says Fred Below, professor of crop physiology at the University of Illinois. He says developing countries will be beneficiaries of this technology because they have a hard time affording fertilizer.

Rice's Role

Mr. Rey first came across the idea that rice was a big contributor to air pollution in China in a conversation with researchers from the International Fertilizer Industry Association in January 2006.

A few weeks later, he was reading an article about carbon credits at power plants as he worked out on an elliptical trainer at a gym near his garden-surrounded home in Berkeley. If power plants could generate carbon credits, he thought, why couldn't rice fields?

He began doing more research on sources of greenhouse-gas emissions. He learned that the biggest source of agriculture-related greenhouse gases is nitrogen fertilizer. That's because only about half the fertilizer applied to fields is typically consumed by the plants. The rest seeps into the ground, becoming a primary contributor to water pollution, or is emitted into the air as nitrous oxide, a greenhouse gas nearly 300 times as potent as carbon dioxide.

In October 2006, Mr. Rey met with agricultural researchers visiting the U.S. from Ningxia, a tiny mountainous province in China near Mongolia. The researchers explained that China, the world's biggest user of fertilizer, had a huge problem with runoff that was leaving lakes and rivers devoid of life. Rising fertilizer prices are hurting poor farmers.

Harsh Land

In Ningxia, the land is harsh and water is limited. To help crops grow, farmers dump heaps of fertilizer on the land, making the province one of China's biggest per-acre fertilizer users. The researchers invited Mr. Rey to visit Ningxia to see if his nitrogen fertilizer technology could help.

Mr. Rey was intrigued, but was confronted with a problem other biotechnology companies face: How to make money in China?

Chinese farmers tend to save seed from harvest to replant the following year. Others save seeds and repackage them illegally to sell on the black market. Both practices deny biotech companies their main source of revenue—a fresh supply of seeds that must be bought or licensed each year.

Biotech firms also struggle to keep track of China's myriad farms. The average size of a Chinese farm is less than one acre, compared with 440 acres in the U.S.

That problem is familiar to veterans like Monsanto, which became one of the first foreign companies to introduce a genetically modified cotton seed in China in the late 1990s. The company has since scaled back investments there and refrained from introducing its latest seed technology in part because of "the inability to effectively control the spread of the technology illegally," according to Brett Begemann, executive vice president.

For Mr. Rey, the threads of a solution began to come together with what he calls the "carbon wrinkle." Rather than charging farmers a premium for genetically modified seeds—the traditional business model—farmers would pay for the price of regular seed, plus about half of the carbon credits generated by their reduced fertilizer use.

That would give farmers an incentive not to cheat: The more of his rice seed they plant, the less fertilizer they use and the more carbon credits everyone gets to cash in.

In January, Mr. Rey arrived in Ningxia, a place he says he never could have located on a map a year ago, to meet with local officials. Decreasing fertilizer use is a potential "big savings for farmers and the regional economy," says Liu Rong Guang, president of the government-run Ningxia Academy of Agriculture and Forestry Sciences.

But one of the first questions locals had was how poor farmers would pay for genetically modified seeds. Mr. Rey explained the carbon-wrinkle idea and interest increased, he says. It helped, he says, that Ningxia is already home to other carbon-credit projects, mostly generated by large wind farms.

His idea is still at least five years away from being fully implemented, in part because the carbon credit methodology needs to be accepted by a U.N. body.

To help make the case to the U.N., Mr. Rey recently journeyed about 100 miles outside Yinchuan to join Chinese researchers from the Ningxia Academy in an experimental rice paddy growing conventional rice. He plunged in with the researchers, to tend to a series of yellow metal boxes equipped with plastic tubes. The boxes were trapping nitrous oxide being emitted from the fields. Syringes sucked out the air into malleable metal bags.

Measuring Emissions

The measurements will show how much nitrous oxide is emitted from conventional rice using different amounts of fertilizer. That information will be the basis for research submitted to the U.N. seeking approval for the carbon-credit methodology.

So far, China has allowed the commercialization of genetically modified versions of cotton and some minor food crops, including tomatoes and sweet peppers. Commercializing bioengineered seeds for major food crops—such as corn, soybeans and rice—remains forbidden.

Some government agencies in China still harbor reservations about the safety of such crops, says Jikun Huang, director of the Chinese Academy of Sciences. But he thinks that will eventually change as China's population grows. "China considers biotechnology as a major importance to promoting agricultural productivity in the future," he says.

By some estimates, China is expected to soon surpass the U.S. as the world's largest emitter of greenhouse gases. Mr. Rey thinks that by the time his technology is ready in a few years, China will have warmed up to the idea of using biotechnology to benefit the environment.

"It's a no-brainer," he says.

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