



Restoration or Devastation?

A massive South Korean project to dam and dredge four major rivers has provoked bitter opposition from scientists and environmentalists

YEJU, SOUTH KOREA—A wetland a couple of hours' drive west of Seoul may be about as close as it gets to unspoiled nature in South Korea. Baweenupgoobi's 230-plus hectares of sand dunes and gravel bars hug a bend in the South Han River, whose clear, shallow waters join the North Han and flow through Seoul. In winter, the wetland is etched with ponds and rivulets; summer rains swamp the land, as evidenced by debris lodged high in willows. The habitat offers a niche for migrating waterfowl and unusual plants, including a rare type of chrysanthemum. "These plants have evolved in harmony with seasonal flooding, and the wildlife have adapted to it," says Jeung Mingull, an ecological geneticist at Kongju National University in Gongju.

But the harmony may not last. Dams now under construction will turn the South Han into a chain of lakes. One end of Baweenupgoobi, supposedly a protected natural heritage site, has been stripped of vegetation to prepare for dredging; much of the rest will be

under water. "The government calls it 'river restoration,'" scoffs Jeung. Environmentalists mock the phrasing by calling it "river killing."

The ecological transformation extends far beyond Yeosu. Launched last November, the government's Four Major Rivers Restoration Project calls for building 16 dams, dredging 570 million cubic meters of sand and gravel to deepen nearly 700 kilometers of riverbed, renovating two estuarine barrages, and constructing bike trails, athletic fields, and parks along the waterways. At \$19 billion, it is one of the costliest engineering projects in the country's history. And it is attracting fiery opposition, notably from the Professors' Organization for Movement Against Grand Korean Canal (POMAC), a group of 2800 academics who accuse the government and supporters of twisting data and ignoring expert panel recommendations on issues such as water quality, flood control, rainfall patterns, and environmental impacts to justify a massive construction boondoggle.

Both sides agree on one point: The project will dramatically transform the Han, Nakdong, Geum, and Yeongsan rivers. Four Rivers "will be an ecological disaster," Jeung charged at a hearing in Seoul Administrative Court last month on an injunction to halt work on the South Han River. "[It] will be very beneficial for the environment," countered Jae Park, an environmental engineer at the University of Wisconsin, Madison, and a rare academic who openly supports the government position.

On 12 March, the court rejected the request for an injunction, but a suit to cancel the project is moving forward. Legal actions on the other rivers are pending. Winning even one of the suits "would be a major event in the history of the environmental movement in Korea," says Lee Sang-don, a lawyer at Chung-Ang University in Seoul.

Landscape architects

Four Rivers is a pet project of South Korean President Lee Myung-bak, a former construction company executive nicknamed "the bulldozer" for his "can do" approach to engineering projects. One of Lee's signature accomplishments in his previous role as mayor of Seoul was to demolish an elevated highway to revitalize the Cheonggyecheon River. The river is far from natural: Water is pumped in from the Han, and it flows through a concrete channel. But its walkways, landscaping, fountains, and illumination provide an oasis in what had been a grimy industrial area. When completed in September 2005,

Unnatural development. Dams are displacing natural gravel bars (*inset*) on the South Han River.

the “restored” Cheonggyecheon was a huge hit with the public—and helped Lee win the 2007 presidential election.

One of Lee’s campaign pledges was to create a Pan Korea Grand Waterway by damming, dredging, straightening, and widening the Han and Nakdong rivers and connecting them by a canal carved through the peninsula’s central mountains. Barges, he said, would be able to move 540 kilometers between Seoul, in the country’s northwest corner, and Busan in the southeast. Lee promised that the waterway would take heavy trucks off roads, draw tourists to artificial lakes, and reinvigorate rural communities. Private investment and sales of dredged materials were supposed to cover the project’s cost.

Even before Lee took office on 25 February 2008, academics had challenged the data his team put forward to support the Grand Waterway. “It was truth versus falsehoods,” says Choe Young Chan, an agricultural economist at Seoul National University. Opposition mounted, and on 25 March, 2400 scientists, engineers, economists, and lawyers from the country’s universities converged on Seoul for the inaugural meeting of POMAC. Using members’ contributed expertise, the association pegged the project at double the cost that Lee estimated and found that sales of dredged materials would hardly make a dent in the cost. POMAC asserted that little freight moves between Seoul and Busan, and a survey of shippers turned up scant demand for a canal. The academics also questioned the project’s claimed benefits for drinking-water supplies, rural economies, and the environment.

Opponents got an unexpected boost a few weeks later when Lee announced that he would reopen South Korea’s market to U.S. beef imports, which had been banned during a mad cow disease scare. That spring, farmer and consumer groups held candlelight protest vigils in major cities. Their ire expanded to encompass other unpopular policies, including the Grand Waterway. On 19 June, Lee announced he was abandoning the canal plan.

Six months later, in December 2008, Lee unveiled a new scheme: Four Major Rivers. The “multipurpose project” will control flooding, secure water supplies, and create lakes for water sports as well as riverside parks for 1700 kilometers of bike trails and recreational facilities, says Je Hae-Chi of the Four Rivers project office. The government estimates Four Rivers will generate 340,000 jobs

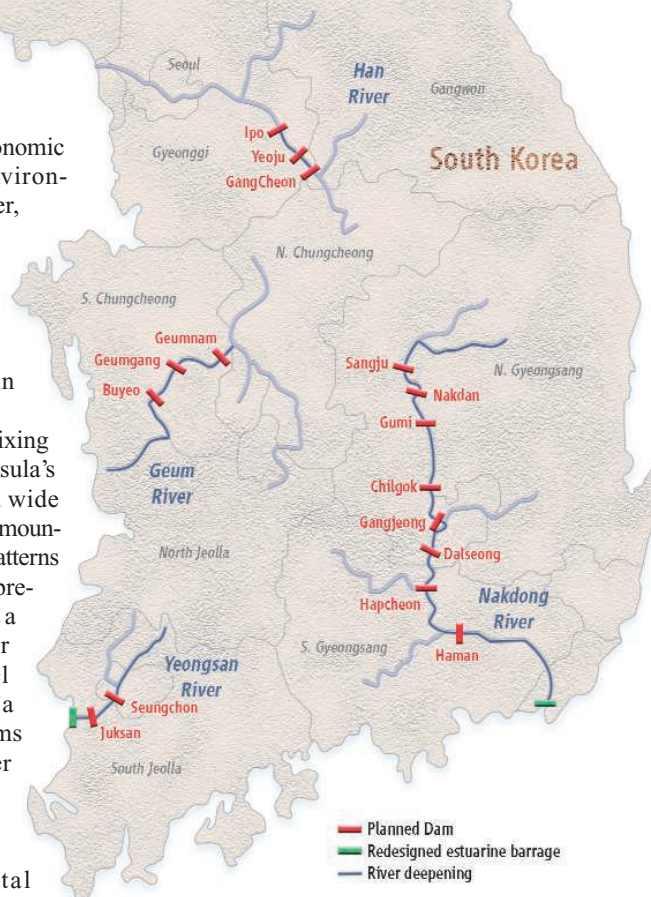
and \$35 billion in long-term economic benefits. After a 3-month environmental assessment last summer, Lee’s Grand National Party, which holds a majority in the National Assembly, pushed through enabling legislation. Lee wants the job finished before his 5-year term ends in early 2013.

Backers see the project as fixing a natural imbalance. The peninsula’s seasonally shallow rivers and wide floodplains are a consequence of mountainous geography and weather patterns that bring two-thirds of annual precipitation during the summer. As a result, during winter, low water flows expose extensive gravel bars in riverbeds—“evidence of a water deficiency,” Je says. Dams will relieve flooding and water shortages, he says, by capturing water during the rainy season for release during dry months.

Touting the environmental benefits, Lee’s administration has wrapped the project in a green mantle. River restoration is the largest component of the government’s Green New Deal, a package announced in January 2009 to counter the economic downturn with stimulus spending that promotes sustainable development (see sidebar, p. 1570). It’s “a totally different project” from Grand Waterway, says Hong Dong-gon of the Four Major Rivers project office.



On the ground. Activists use aerial photos to explain the impact of the Four Rivers plan.



Dam country. Sixteen dams will transform South Korea’s four major rivers.

To POMAC, however, the new plan is the Grand Waterway resurrected. The canal link through the mountains is missing, Choe says, but otherwise “the number of dams and their sites and the amount of dredging remains the same.”

Opponents decry what they see as unnecessary tinkering with nature. There is no question that flooding occurs on small rivers and tributaries far upstream of the planned dam sites. Instead of filling dams downstream and then building embankments and more dams on tributaries, as the government proposes, POMAC’s Park Chang-Kun, a civil engineer at Kwandong University in Gangneung, says upstream flooding could be controlled by selectively raising riverbanks and employing other watershed-management techniques. Cities along the four rivers do not face water shortages, adds Choe.

As for environmental impacts, a draft report from Birds Korea, a Busan-based environmental group, notes that Ministry of Environment data and independent surveys show that the shallow braided streams “support a higher density of waterbirds per hectare than river-impoundments.” The report concludes that habitat loss from Four Rivers will affect about 50 bird species, some considered threatened. Fish, amphibians, and reptiles will also be affected, Jeung says: “Many riverine species will disappear.”

More fundamentally, some academics believe the plan reflects outdated thinking about watershed management. “The Four Rivers Project is out of step with the way river management is evolving in the developed world,” says G. Mathias Kondolf, a geomorphologist at the University of California, Berkeley. He says planners in Europe and the United States now aim to give rivers room to meander and flood. This approach is more ecologically sound, Kondolf says, and eliminates river maintenance imposed by dredging and embankments. Project official Hong counters that based on their research and case studies of rivers in South Korea, dams and dredging “is the best solution.”

Reluctant activists

Experts who favor more ecological management of South Korea’s rivers say their findings and recommendations have been steamrolled by an administration that, in Park Chang-Kun’s view, is “distorting scientific data for political purposes.” But from the government’s standpoint, Je says, “people are in opposition for the sake of opposition.”

The list of those in opposition is growing—and includes most of the public. In a survey last October, before construction started, the Korea Society Opinion Institute reported that 26.4% of respondents wanted to see the Four Rivers Project canceled immediately; another 73.5% wanted it postponed until there was a social consensus. Dozens of South Korean and international environmental organizations have issued



Differing views. Government official Hong Dong-gon (left) sees dams as a solution for flooding and water shortages; scientist Jeung Mingull sees them as an environmental disaster.



statements opposing the plan. And the Catholic Bishops’ Conference of Korea published an instructional comic book that challenges the government on the Four Rivers Project for its “greed” and neglect of “the natural Created Order.”

Amid this wave of opposition, POMAC has played a crucial role by assessing the environmental and economic impacts of the government’s plans, holding press conferences, and supplying the expertise underpinning the lawsuits. The multitude of scientists who have joined POMAC awes like-minded colleagues in other countries. “There is a long tradition of academics working with environmental or community groups as advocates, but I have never seen any numbers like these,” says Randolph Hester, an environmental planner at the University of California, Berkeley. The self-professed activist says that for community causes in the United States, “we can get three or four

people to help us, and they might spend a week out of the year doing work for us. I’ve seen nothing like the commitment of this group.”

Even in South Korea, “such activism by academics is very unusual,” Jeung says. Politics often divide the community, but on this issue the Lee administration’s policies “have brought conservatives and progressives together,” he says. They claim to be reluctant activists. “I hate to do this; I still have to publish and teach,” Choe says. Lee Won Young, an urban planner at the University of Suwon in Hwaseong, says he got called before his university’s president to explain the time he has devoted to the cause.

The outcome of the battle over Four Rivers is up in the air. The ruling Grand National Party has blocked hearings on the subject in the National Assembly. Last month, the Democratic Party held its own hearings in which assembly member Kim Jinai outlined three scenarios for stopping the project. One is local elections in July; a trouncing of the Grand National Party could convince some assembly members to cross party lines on Four Rivers, he said. Another possibility is a construction-related disaster such as a spill of toxic chemicals that would make going forward politically impossible. The third barrier is the lawsuits. “I am confident we will win the final decision,” says Lee. But the “very complicated litigation” could last 2 years, he says. In the meantime, construction is going full throttle.

—DENNIS NORMILE

With reporting by Ahn Mi-Young in Seoul.

A ‘Green’ Blessing Raises Questions

SEOUL—South Korea’s controversial plan to transform the ecology of four rivers has become an improbable poster child of the Green New Deal movement.

In October 2008, the United Nations Environment Programme launched an initiative to encourage governments then planning recession-fighting stimulus packages to support environmentally friendly projects and forge what UNEP called a “Global Green New Deal.” Three months later, South Korean President Lee Myung-bak announced a Green New Deal under which about 80% of a \$38.1 billion stimulus package would go to eco-friendly projects. South Korea “grasped the nettle early on,” UNEP spokesperson Nick Nuttall wrote in an e-mail to *Science*.

A huge chunk of South Korea’s Green New Deal spending—originally \$10 billion, later increased to \$19 billion—was budgeted for “river restoration,” specifically the Four Major Rivers Project, an engineering scheme that critics charge is anything but friendly to the environment (see main text). Nevertheless, the Lee administration claims UNEP has given Four Rivers its seal of approval. A press release from the Office of National River Restora-

tion states: “UNEP Qualified Korea’s Epochal Green Growth Project, Korea will be newly born through the 4 Rivers Restoration Project!”

In an April 2009 UNEP report on the Global Green New Deal, economist Edward Barbier of the University of Wyoming in Laramie singled out South Korea’s green plans for special mention. But Barbier told *Science* that he did not intend to highlight river restoration “as a good project or a bad project.” Nevertheless, South Korea’s Green New Deal continued to get glowing mentions in UNEP documents. For example, an update on worldwide green stimulus spending prepared for the G20 Pittsburgh Summit meeting last September said South Korea stood out for the large percentage of its stimulus going to green investments and listed the Four Rivers project as one of the key measures.

Environmentalists seem to have finally gotten UNEP’s ear. A November draft overview from UNEP on South Korea’s Green Growth vision notes that the Four Rivers project is controversial and urges the country to assess and mitigate potential impacts on wetlands. UNEP “seemed to back off from the [previous] endorsement of the [Four Rivers] project while saving face,” says G. Mathias Kondolf, a geomorphologist at the University of California, Berkeley. The final overview is due out next month.

—D.N.