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Editor's Note

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Urban Sprawl: Similar Issues and Solutions Across the Globe

By Paige Buck, Public Affairs Specialist, NRCS, Champaign, Illinois. Originally published in the newspaper "Illinois Farm Week," May 2005.

In April 2005, Illinois Natural Resources Conservation Service (NRCS) and SWCD staff held discussions and hosted tours with visitors from South Korea who were in search of solutions and strategies to manage their nation's urban sprawl threats.

Doctors Chun-Man (Peter) Cho and Mie-Oak Chae both work for the Land and Housing Research Division of the Korea Research Institute for Human Settlements (KRIHS) in Anyang-Si Kyonggi-Do, Korea. Also visiting was Je-Yeon Kim, a Junior Official of the City of Paju, Korea. Before visiting California, the three flew to Illinois to meet with us and learn more about how the use of the Land Evaluation and Site Assessment (LESA) tool could help control rapid urbanization trends in South Korea.

NRCS developed LESA back in 1981 in response to requirements of the Farmland Protection Policy Act. LESA was introduced to conservationists and leaders across the country as a system and formula assisting communities that need to define current land uses in order to prioritize and determine what land areas should be protected and which can be developed. In Illinois, 34 of our 102 counties currently use LESA systems.

For years, both Dr. Cho and Dr. Chae studied LESA data and research concepts, and now they plan to apply what they learned. South Korea is a land mass about the size of Florida. Slopes in much of Korea are so steep that it is important to ensure that land suitable for agriculture remains as such. There are nine large metro areas, metro areas that are growing. A few years ago, the central government demanded that a growth management system be established by 2005 and that it be locally implemented by 2007. That deadline is approaching fast.

The Korean visitors explained how unplanned development in areas of semi-urban land is causing problems that demand a solution. South Korea has laws in place that severely restrict development. Korean laws dictate land use and zoning. They have only four zone types: 1) Urban Zones, 2) Management Zones, 3) Agricultural and Forest Zones, and 4) Environmental Conservation Zones. Urban development is permitted only in zones 1 and 2. Within these two zones, there is a critical need for a structured and scientific method of planning and decision-making. For them, their LESA—named Land Suitability Assessment System (LSAS) in Korea—is the answer.

By visiting Illinois and California, they gained more information on how successful LESA has been here and visited regions of the States where planned urban development with LESA has been used and is working well.

Both Dr. Cho and Dr. Chae were amazed and impressed by Illinois' adamant desire to protect farmland. Dr.

South Koreans visit Illinois.

Cho asked, "Why do you want to keep so much agriculture here?" We explained to them how agriculture is connected to three out of every five jobs in Illinois. We also explained how highly productive our soils are here and how crucial it is to ensure that the best soils are used in the best way and not paved over with concrete.

After preliminary discussions with State Soil Scientist Bob McLeese, NRI Specialist James Johnson, and myself, Dr. Cho and Dr. Chae headed north to Kane County, a rural county on the edge of Chicago's metro area that fights urban sprawl on a daily basis. NRCS District Conservationist Tom Ryterske, Kane County SWCD Resource Analyst Jonathon Koepke, and SWCD Land Use Analyst Kelsey Knowles discussed Kane County's LESA system and Natural Resource Inventories (NRIs)—the tools they use to help communities manage development. The Kane County LESA was recently updated to incorporate changes to soil survey information resulting from the update of the Soil Survey of Kane County and changes made to the Kane County Land Resource Management Plan. The group visited three sites—one farm site purchased and protected by the county and two sites (both with high LESA scores) that are experiencing development pressure. "The Doctors were amazed at how flat Illinois was and also how dark and black our topsoil is," said Ryterske. "They said that if they had this soil in Korea, it would be a national monument that people would come and visit," added Ryterske.

In our discussions, the Koreans learned that we all face many of the same difficulties regarding urban sprawl. "It is difficult to persuade landowners not to sell out," Dr. Chae said. Like Illinois, Korea also struggles with the task of educating local units of government about the need to have a plan for development. "The pressure to develop is alive in Korea," explained Dr. Cho, who confirmed that their top priority is to balance development with conservation and agriculture in their country. All the Korean visitors were shocked to see stockpiles of dark soil and to witness a development project where the black topsoil was being scraped off.

Korea, Canada, Japan, and the United States are the top nations actively seeking planned development.

It was clear from the visit that our South Korean visitors are eager to use LESA (LSAS) to help them create an organized system for urban planning. Compared to NRCS's LESA, their version is even more mathematical in nature, giving even more weight to the land use decisions the system will create. Dr. Chae explained that LESA allows or disallows development. She confirmed that in their Management Zones, the only areas that are a mix of urban land and agricultural land, LSAS will provide what they need.

Our staff and partners were honored to have such educated and motivated individuals visit us and ask for our own experiences and successes with the LESA system. "For so many NRCS employees here in Illinois and across the country, sometimes it's hard work to convince community leaders to use LESA and let it help them. It's even more special to know that something NRCS developed and something we

stand behind is not just making a difference here in America; LESA is helping protect natural resources across the globe," added Ryterske.

The visit also provided NRCS and SWCD staff the rare opportunity to understand or at least to raise their awareness of issues facing the Korean people in their quest to balance support for the need of a dependable agricultural base and basic infrastructure required by urban populations.

As part of Dr. Cho and Dr. Chae's presentation of the Land Suitability Assessment for the Sustainable Development of Korea, they showed us all an artistic rendering of the Korean peninsula that depicted the land as a tree; the trunk represented the mountains, and the cities and towns were depicted as blossoms on the branches. This artistic representation demonstrated very clearly a respect for the land that is shared by NRCS and SWCD staff. ■

How Societies Collapse

By Robert Ahrens, Director, National Soil Survey Center, NRCS, Lincoln, Nebraska.

During 1938 and 1939, a time when we in the U.S. were especially conscious of soil erosion, Dr. W.C. Lowdermilk, then Assistant Chief of the Soil Conservation Service, toured Western Europe, North Africa, and the Middle East to study abuses and uses of the land. A few years later he published the popular booklet "Conquest of the Land Through Seven Thousand Years," in which he documents great civilizations and population centers that perished or dwindled through abuse of the vegetation and soil resource. This booklet is a must read for all soil scientists and conservationists and is available online at http://www.nrcs.usda.gov/technical/ecs/agecol/conquest.html.

A more recent book, *Collapse: How Societies Choose to Fail or Succeed,* by Jared Diamond examines why some societies proved fragile and what distinguished societies that collapsed from those that persisted and even flourished. As a geographer, Diamond offers a different perspective than Lowdermilk. Lowdermilk focused on the problems associated with long-term cultivation, whereas Diamond examines five factors that contribute to the breakdown of civilizations. The first of Diamond's factors consists of environmental aspects that can be referred to as the resilience of an area's forests, soils, animal populations, etc. The reasons for environmental collapse in some societies and not others involve either exceptional prudence of the people, exceptional fragility of some aspects of the environment, or both. Diamond recognizes that no society's collapse is attributed solely to environmental damage or any one factor, but a combination of events. Climate change, particularly drought, is another factor that has contributed to the demise of civilizations. A third pressure on societies is hostile neighbors, which may be intermittent or chronic, but when a society is already in a weakened state, it surly adds to the collapse. A fourth factor Diamond considers is the opposite of increased attacks from neighbors and that is decreased support from friendly partners. Societies often rely on imports of essential goods (e.g., oil, stones for tool making, and beads). In some societies there is a delicate balance between the trading partner and the enemy, who can be one in the same. The final factor that Diamond considers is how well societies respond to problems. Deforestation, for example, in some societies is tolerated or ignored, while other societies respond to deforestation with cultural changes or policies of preservation.

Diamond explains how one or more of the factors mentioned above have contributed to the collapse of past as well as modern societies. Easter Island and its mysteries intrigued 18th century explorers and have generated speculation for three centuries. The island lies about 2,300 miles west of the Chilean coast and 1,300 miles east of the Pitcairn Islands and is one of the most remote of the habitable places on earth.

Hundreds of stone statues, many of them toppled, representing a long-eared legless human male torso line the perimeter of a volcanic crater, as well as some of the island's coast. Another 100 are scattered along roads as if abandoned in transport from the quarry. Remnants of partial statues still lie in the quarries. Remarkably, the statues range in height from about 15 to 70 feet and in weight from 10 to 270 tons. Speculation about the civilization that made the statues and the technology to transport the statues on a treeless island without apparent materials to construct sleds or some sort of devices of transport has spurred several theories.

Easter Island has a rather mild, subtropical climate and relatively fertile soils. Early European visitors to the island encountered a grassland without a single tree or shrub more than 10 feet tall. In addition, the native animals included nothing larger than insects. There were no birds, snails, or even bats. The early Europeans estimated the 18th century population of Easter Island at about 2,000, largely existing as small farmers growing yams, bananas, and taro. So what happened to the society that quarried, carved, and transported the huge statues? How

were the statues transported without ropes and large trees to be made into some sort of sled or device for rolling the statues in place on large pedestals?

Pollen studies and carbon dating indicate that for the past 30,000 years before human arrival on the island and during the early years of Polynesian settlement, a forest of trees and woody bushes towered over the shrubs, herbs, ferns, and grasses. The forests produced fiber for making ropes and huge logs for making sleds and large canoes.

The archeological evidence indicates that a rather complex society inhabited the island, which had an ample food supply to support activities associated with making and transporting the huge statues. Deforestation destroyed the needed materials required for constructing not only sleds to transport the statues but also canoes for fishing. All the animals and plants associated with the forest ecosystem died, soil erosion ensued, and the amount and variety of food plummeted as hungry people pressured the remaining wildlife until only insects remained.

So why would a society cut down the forests that were essential to their way of life and standard of living? Diamond admits that we may never know for sure, but competition among the different chieftains likely played a role. Each chieftain urged his people to make bigger stone monuments than the others. The natural resources became stressed in a somewhat fragile environment, and because of Easter Island's isolation, there were no friendly neighbors with whom to trade for needed goods.

In "Conquest of the Land Through Seven Thousand Years," Lowdermilk describes Mesopotamia as a land with an estimated 21,000 to 35,000 square miles of irrigated alluvium and a population projected to be between 17 and 25 million. A huge labor force was needed to maintain the extensive canal system and remove sediment. The deposition occurred naturally but was aggravated by overgrazing at the higher elevations. Internal revolutions as well as invasions by nomads periodically interrupted canal maintenance to the point that the extensive canal system could not be maintained and villages and cities withered without a reliable source of food. Diamond's factors for the collapse of societies apply to Mesopotamia. The environmental factors associated with overgrazing, erosion, and sediment load compounded by unfriendly neighbors made it impossible to maintain the elaborate canal system that was required to feed a large population.

Diamond uses Iceland as an example of a country taking corrective action to control an environmental disaster. Iceland was first settled toward the end of the 9th century by Norwegians and Vikings from the British Isles. Unfortunately, the settlers had little appreciation for the ecology, climate, and soil conditions in Iceland. Deforestation and overgrazing combined with a short growing season, strong winds, and violent storms factored into Iceland's problems with soil erosion. Iceland is regarded ecologically as the most heavily damaged country in Europe. Today, it is one of the richest countries on a per-capita basis. Why did Iceland's society succeed while others failed in the face of ecological disaster?

First, the early inhabitants eventually realized the consequences of their practices and took corrective action. They stopped raising destructive animals, such as pigs and goats, and abandoned the practice of grazing the more fragile highlands. They worked together to make decisions about livestock numbers, grazing patterns, and sheep quotas for each farmer. During the Middle Ages, Iceland's economy was stimulated by the trade of dried cod. The Icelanders were able to trade fish for other needed commodities. By 1950, about 90 percent of Iceland's exports were marine products, a clear indication of a switch away from the once important agricultural sector. Today, Iceland continues its efforts to establish trees, shrubs, and grasses and control erosion. It even has a Soil Conservation Service. The early residents of Iceland realized that a problem existed and then responded with corrective actions. Iceland is blessed with abundant fish, geothermal power, and hydroelectric power.

Diamond uses several other examples of the struggles, collapses, and successes of societies to illustrate his five points. The demise of the Anasazi in Chaco Canyon is largely the result of an overtaxing of the resources in a fragile environment severely impacted by droughts. The demise of the Maya is attributed partly to drought; partly to population pressures to farm the poorer, sloping soils that had been eroded; and partly to the energy and resources expended to fight and defend themselves during internal wars.

Diamond also examines modern societies. China is a good example of a country lurching between accelerating environmental damage and accelerating environmental protection. From 1922 to 1927, Lowdermilk worked in China on an international famine prevention project. He observed the channel of the Yellow River 40 to 50 feet above the flood plain. Millions of Chinese farmers through thousands of years had

lifted the channel of the river above the plain with hand labor. The river periodically broke through its raised channel and dike system and flooded thousands of acres of cropland. This flooding resulted in famine. Lowdermilk also noted the tremendous sediment load of the river that lessened the capacity of the channel to carry floodwaters. The sediment came from extensive erosion of the highlands in the extensive Yellow River drainage. Rather than control the erosion, the Chinese were trying to control the river.

Today, China is striving for First World living standards. In the process, it is undergoing environmental degradation. China's most notorious problem is air pollution. Its cities have the worst air pollution in the world. Pollutant levels are several times higher than the levels that are considered safe for human health. Water quality in most of China is declining because of industrial and municipal discharges and agricultural runoff of fertilizers, pesticides, and manure. China's problems with erosion, fertility loss, salinization, and desertification compounded with urban and other pressures are reducing the amount of land available for agricultural production. Soil losses are estimated at 5 billion tons per year. In addition, China suffers from destruction of habitat by deforestation and degradation of grasslands and wetlands. The extent of native plant species has decreased, and the extent of invasive species has increased. China's rise in economic power has been costly. The introduced alligator weed costs roughly $72 million per year to control. In Xian alone, factory closures caused by water shortages result in losses of $250 million. Sandstorms inflict about $540 million in damages, and losses of crops and forests to acid rain are about $730 million per year. China is spending $6 billion for a "green belt" to protect Beijing from eolian depositions. Annual losses from water and air pollution amount to $54 billion.

Diamond acknowledges that China is making some progress in managing the environment and has a history of enacting strict laws, such as those related to population growth. The success or failure of China's efforts to establish a healthier environment will affect all of us. Air pollution from China reaches the U.S. Likewise, our continued reliance on coal and gasoline affect the entire planet's climate. Nations are going to need to work together to solve environmental problems. This necessity is in contrast to some of the older civilizations that failed to react to potential problems and largely had themselves to blame.

Both author's efforts complement each other. Lowdermilk's concentration on societies that cultivated lands for hundreds or thousands of years provides insight into solving soil erosion and land use problems in the U.S. Diamond examined an array of societies and uses five factors to provide a framework for examining past and future successes and failures. Lowdermilk's work reinforces Diamond's, and although he does not mention the five factors per se, Lowdermilk certainly alludes to several of them.

Diamond's previous work, *Guns, Germs, and Steel*, won a Pulitzer Prize. The one thing in *Collapse* that will bother soil scientists is the fact that he is not a soil scientist and his explanations of soils and terms will appear somewhat casual and oversimplified to us. This defect should not keep us from reading an otherwise stimulating book. ■

Establishment of the National Geospatial Development Center

By J. Hempel and T. Harris, National Geospatial Development Center, Morgantown, West Virginia.

The National Geospatial Development Center (NGDC), a collaborative between the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), and West Virginia University (WVU), was established in 2004 to support the natural resource business needs of NRCS through the innovative use of geographic information science technology (Geographic Information Systems [GIS] and related tools).

In cooperation with other NRCS centers, government agencies, academic institutions, and the private sector, NGDC is responsible for the research and development of geospatial tools to support and expand the efficient delivery of NRCS programs. The NGDC also provides opportunities for graduate and undergraduate students interested in the application of geospatial technologies to natural resource issues.

The NGDC is led by NRCS Co-Director Jon Hempel and WVU Co-Director Trevor Harris. NGDC staff consists of NRCS and WVU staff, WVU-affiliated faculty, plus graduate and undergraduate research assistants. The staff has expertise in soil science, GIS, cartography, database management, scientific geovisualization, remote sensing, and computer programming.

Organizationally, NGDC reports to the Soil Survey Division within the Soil Survey and Resource Assessment Deputy Area of NRCS; however, the NGDC will address projects from across the agency.

The NGDC office is located on West Virginia University's downtown Morgantown campus. The office is currently housed on the ground floor of the Chemistry Research Annex, former home of the Physical Sciences Library.

Computing resources are up-to-date and consist of a 10-terabyte array for data storage and three quad-processor servers for daily operations and application development. The NGDC is connected to the WVU network through a gigabit connection. USDA resources are accessed through VPNs.

NRCS staff consists of Co-Director Jon Hempel, Spatial Data Specialist Sharon Waltman, Data Management Specialist Henry Ferguson, GIS Specialist Amanda Moore, Natural Resources Specialist David Arthur, and Administrative Assistant Jill Arnott. A Business Analyst position will be filled in the near future.

WVU staff includes Co-Director Dr. Trevor Harris (Department Chair, WVU Department of Geology and Geography), Geospatial Technology Coordinator Jesse Rouse, Visualization Coordinator Vic Baker, System Administrator Jim Canon, and Administrator Dr. Briane Turley. Affiliated faculty from the Department of Geology and Geography include Dr. Tim Warner and Dr. Jennifer Miller.

For a complete listing of NGDC staff and students, as well as detailed directions to our office, please visit our Web site (http://www.ngdc.wvu.edu).

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Completion of Soil Survey Celebrated at Ag Expo

By Brian Buehler, Public Affairs Specialist, NRCS, East Lansing, Michigan.

EAST LANSING, Mich. – July 19, 2005 – A group of scientists who have spent their professional lives toiling in a little-noticed and under appreciated field had their day in the sun at this year's annual Ag Expo at Michigan State University.

About 65 soil scientists were recognized for the completion of a giant undertaking, a soil survey of the entire State of Michigan. The project which began in 1901 will be completed this summer and was celebrated at Ag Expo. Following the event's opening breakfast, a ceremonial soil sample was taken on the Ag Expo grounds. This was the final sample to be taken this summer.

"This is a big event for the soil scientists who participated in the survey; we have retirees and people coming from out of state to be here," said Bill Frederick, State Soil Scientist

With the auger is State Soil Scientist Bill Frederick along with representatives from the USDA Forest Service, Michigan State University, and the Michigan Association of County Governments and State Conservationist John A. Bricker.

for the USDA Natural Resources Conservation Service.

The Michigan Soil Survey is part of the National Cooperative Soil Survey, which was commissioned in 1899. In addition to the Natural Resources Conservation Service, employees from the U.S. Forest Service, the Michigan Department of Agriculture, Michigan State University, and various county governments also worked on the project.

Soil scientists traveled to every corner of the State, taking thousands of samples and mapping soil types in farm fields, sand dunes, and marshes on the State's 36.5 million acres of land. Their efforts have provided a greater understanding of the State's resources and geologic history. The information will be used to help plan future land use and to determine the suitability of land for specific uses, such as agriculture, housing, or other types of development.

The next stage of the soil survey, which involves digitizing the survey information and creating interactive maps, is well underway. ■

Risk Assessment and Exposure Analysis on the Agricultural Landscape

From "NRCS Technology News," June 2005.

In 2002, the University of Nebraska at Lincoln entered into an agreement with the National Soil Survey Center (NSSC) to develop the soils part of the "Risk Assessment and Exposure Analysis on the Agricultural Landscape," a project sponsored by USDA-Risk Management Agency (RMA). Working with the UNL Department of Computer Science and Engineering, scientists at the NSSC developed criteria for a computer program that would generate soil productivity indices for dryland commodity crops, such as corn, wheat, soybeans, and cotton. RMA will evaluate the results for use as a risk assessment tool in its crop insurance program.

Productivity indices rate soils according to their inherent capacity to produce seed, fiber, and biomass. Inherent productivity is nearly invariant over long periods of time. Temporary fluctuations in productivity resulting from above average or below average management do not affect productivity indices. On the other hand, long-term changes in soil properties that cause significant changes in productivity do affect the indices. Erosion, land leveling, and salinization are examples of long-term changes that cause such changes.

The inherent capacity of the soil to produce cultivated crops is only one factor that determines the overall productivity. Crop varieties and management practices also cause yields to vary from place to place and partially mask the inherent quality of the soil. Except in extreme circumstances, such as prolonged drought, inherent soil capacity varies little throughout the geographic extent of a given soil identified in the Soil Survey Program.

The National Geospatial Development Center in Morgantown, West Virginia, created soil productivity index maps for a limited number of Nebraska counties using digitized soil survey data acquired from the Soil Data Mart (http://soildatamart.nrcs.usda.gov). The maps show the geographic distribution of soils that range from nonarable (index <30) to very highly productive (index >70). These maps are useful not only for testing productivity indices, but also for displaying the distribution of agriculturally important soils.

Scientists at the NSSC developed soil productivity indices to avoid inequities that are possible when soils are arrayed by use of traditional yield data alone. These indices use soil data that are accessible in every county where commodity crops are grown. Although the immediate focus was on commodity crops in selected counties in Nebraska, productivity indices can be made available for commodity crops in other areas of the United States.

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Smithsonian Soils Exhibit

A message from Paul G. Kamps, Development Officer, Soil Science Society of America, Madison, Wisconsin, to Stanley P. Anderson, editor of this newsletter.

Stan,

Please feel free to circulate the following information to your members and colleagues for use on their Web sites, in newsletters (specifically the CSSS newsletter) and magazines, and in other publications and for

distribution to any list serves you think might be interested. I also invite you to visit our Web site (http://www.soils.org/smithsonian/).

Click on the following link for a recent news release, with photos, of this exhibit that will help more than six million visitors a year understand how soil is intricately linked to the health of humanity, the environment, and the planet: http://www.soils.org/smithsonian/files/update.pdf ■