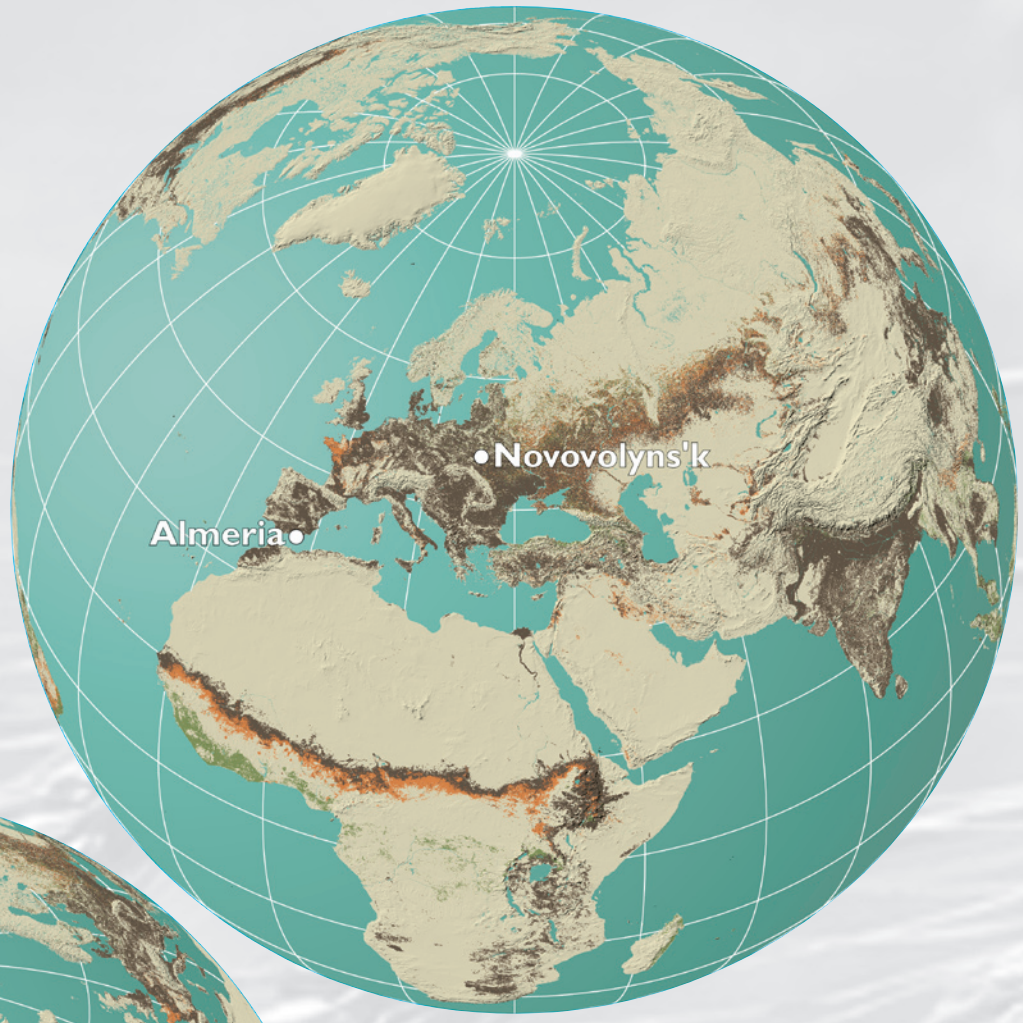
Credit: Unknown/UNEP/Topfoto

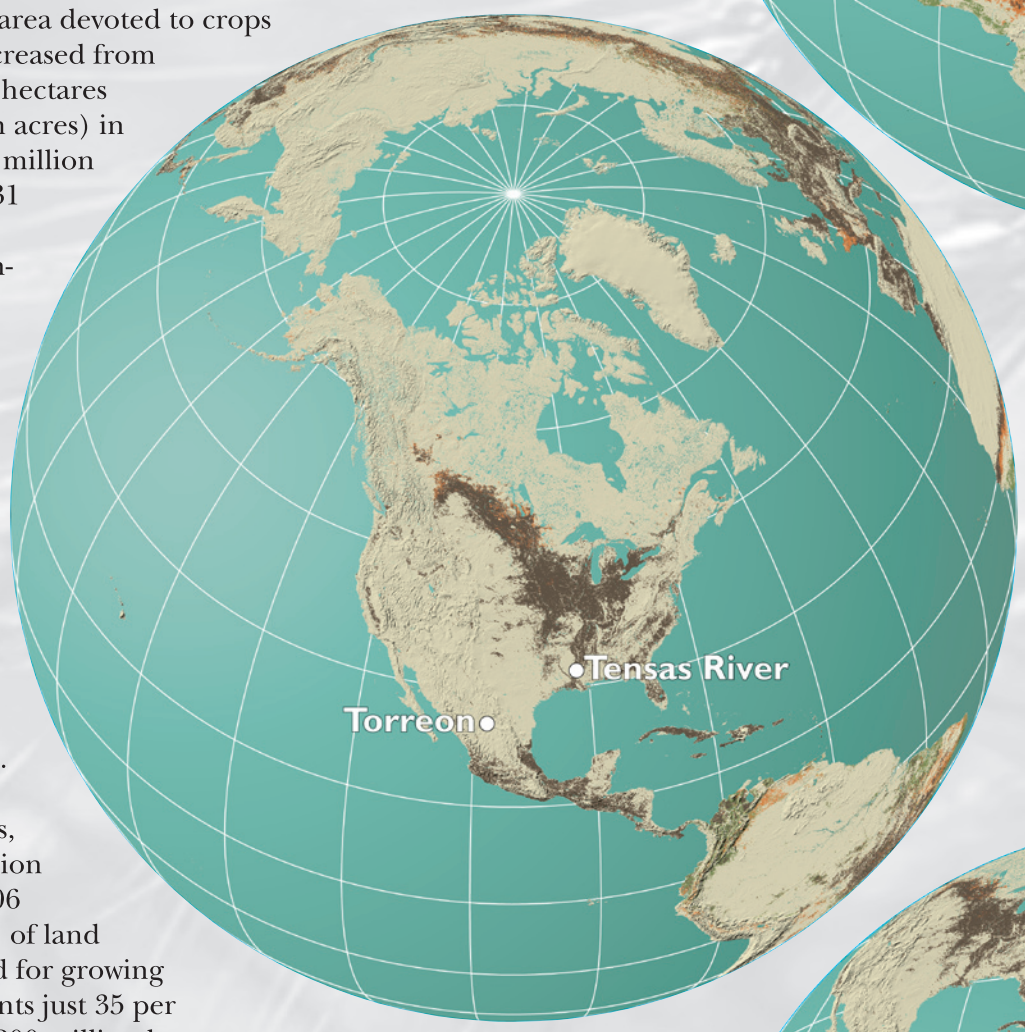
3.5 Cropland

The success of the human race can, in many respects, be attributed to the development of agriculture. The ability to raise crops and therefore control a large portion of our food supply has enabled humankind to expand and flourish as a species, and to grow in numbers far beyond the natural carrying capacity of the environment. It is also through agriculture that people have brought about some of the greatest changes to the global environment.

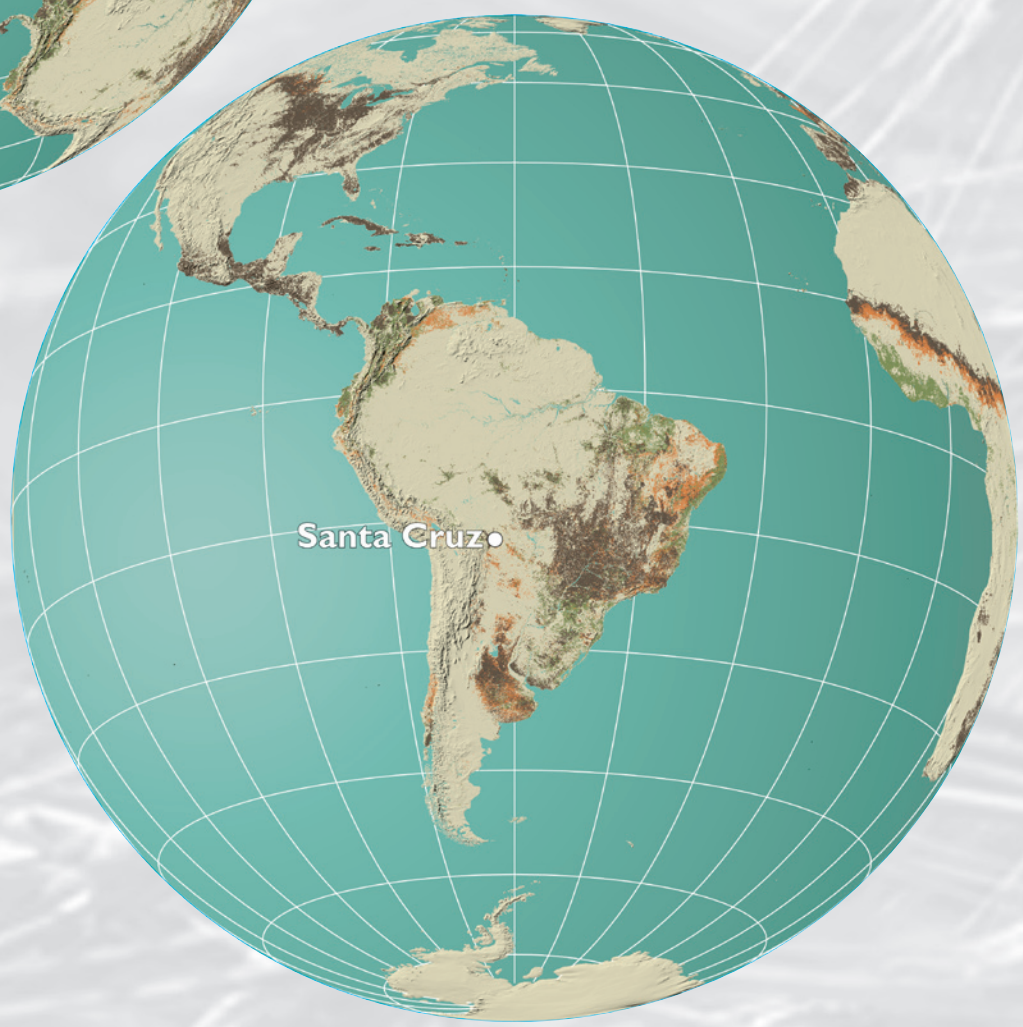
The Food and Agriculture Organization of the United Nations defines cropland as "land used for cultivation of crops" (FAO 2002). The foods and fibers we grow on croplands around the world are many and diverse. They include: annual crops such as maize, rice, cotton, wheat, and vegetables; crops harvested after more than a year such as sugar cane, bananas, sisal, and pineapple; and perennial crops such as coffee, tea, grapes, olives, palm oil, cacao, coconuts, apples, and pears.



The total area devoted to crops worldwide increased from 1 350 million hectares (3 336 million acres) in 1961 to 1 510 million hectares (3 731 million acres) in 1998, an annual increase of about 0.3 per cent. Most of this expansion took place in developing countries, where cropland expanded 1.0 per cent annually (Wiebe 2003). According to FAO estimates, the 1 500 million hectares (3 706 million acres) of land currently used for growing crops represents just 35 per cent of the 4 200 million hectares (10 378 million acres) of the world's land judged to be suitable for crop production. Nevertheless, much of the undeveloped arable land has marginal productivity due to costs for sustainable development and use.



Food production has more than kept pace with global population growth (WRI 2000). On average, food supplies are now 24 per cent higher per person than in 1961, and food prices are 40 per cent lower. It is estimated that world population will be in-

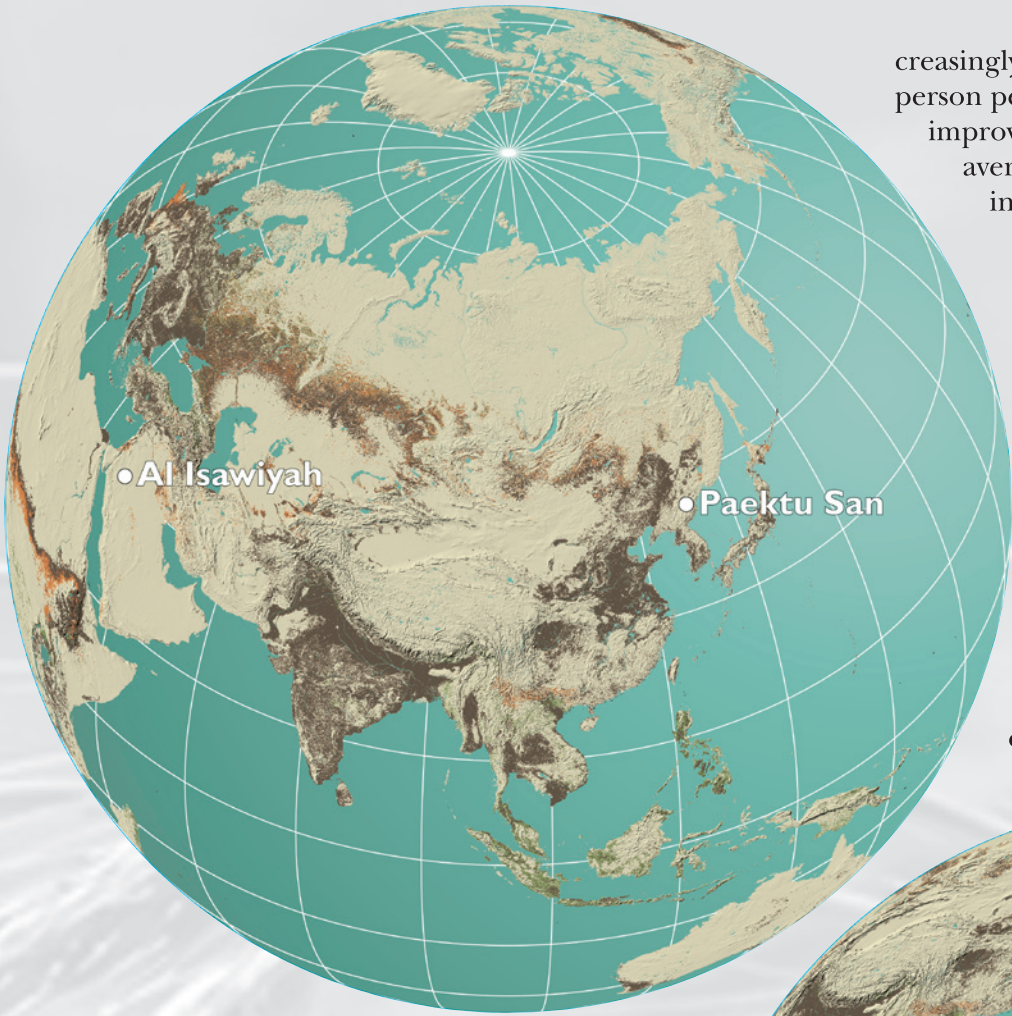


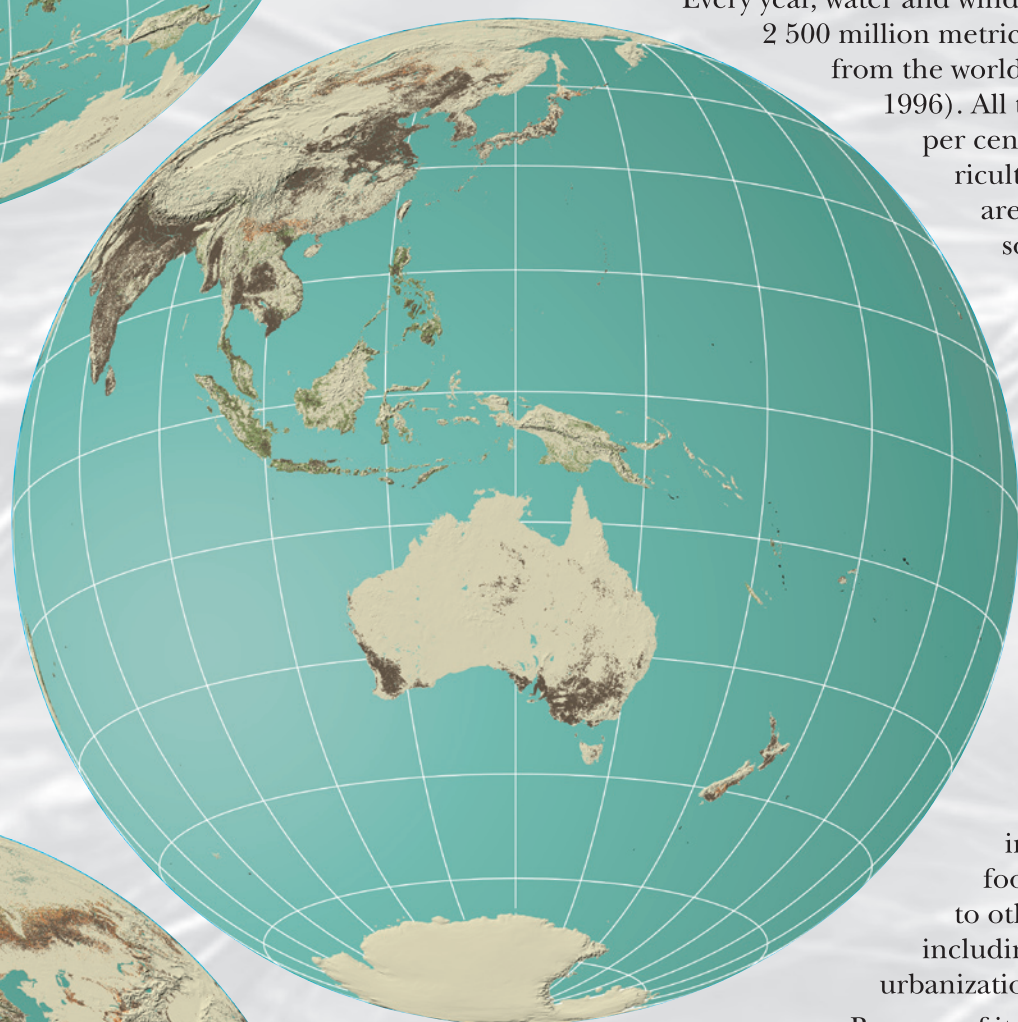
creasingly better-fed until 2030, with 3 050 kilocalories (kcal) of food available per person per day compared to 2 360 kcal in the mid-1960s and 2 800 kcal today. This improvement reflects rising consumption in many developing countries, where average food intake will be close to 3 000 kcal per person per day by 2030 (Bruinsma 2003).

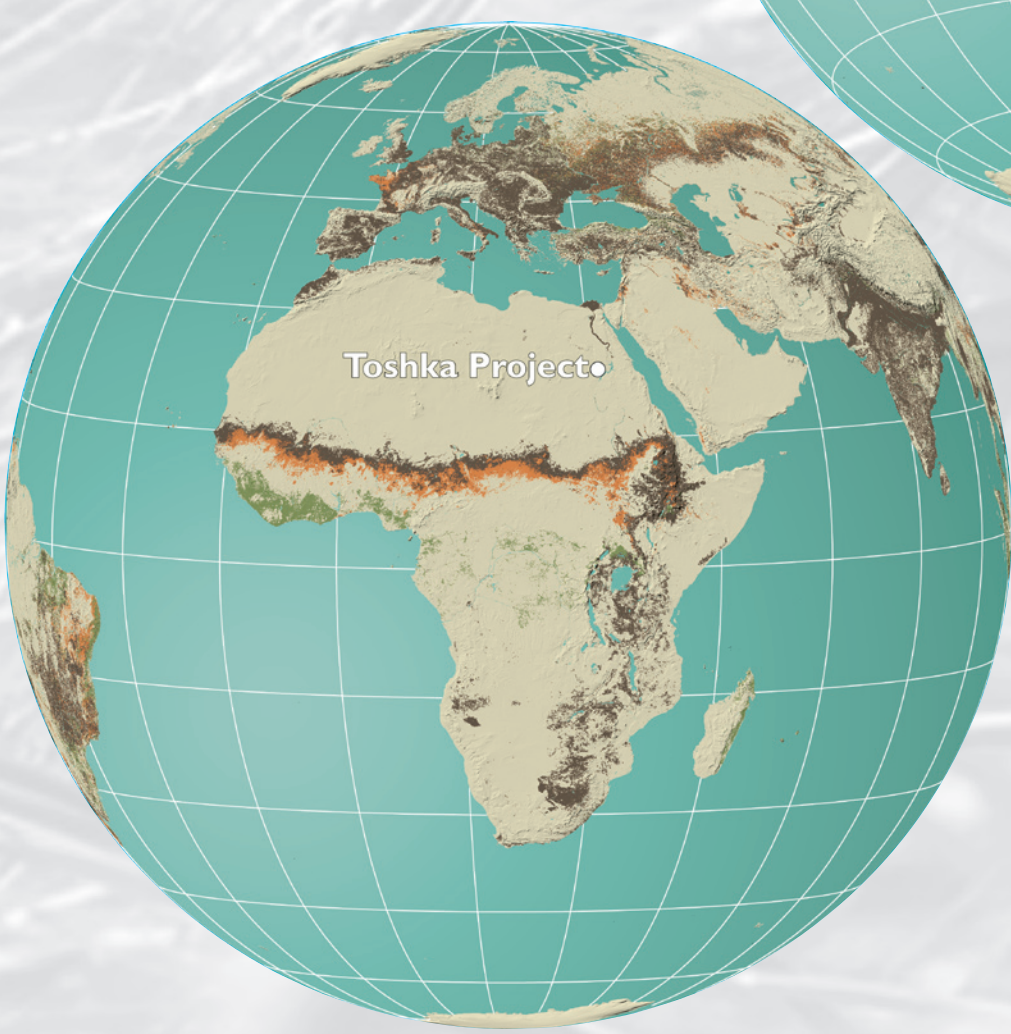
Despite increases in food production, we seem to be approaching the limits of global food production capacity based on present technologies (Kendall and Pimentel 1994). At the same time, environmental damage caused by agricultural practices is continuing, and, in many parts of the planet, intensifying. Worldwide, enormous areas of forests and grasslands have been converted to cropland. The conversion of natural ecosystems to agricultural landscapes has negatively impacted biodiversity and many other aspects of environmental health. Irrigating and fertilizing cropland has, for example, widely affected water resources as well as freshwater, coastal, and marine ecosystems. Of all human activities, agriculture consumes the greatest amount of water, accounting for roughly 70 per cent of all water withdrawals worldwide. On average, a person needs about four litres of drinking water per day. Yet it takes between 2000 and 5000 litres of water to produce the food that one person consumes daily (FAO 2003).

Every year, water and wind erode an estimated 2 500 million metric tonnes of topsoil from the world's croplands (FAO 1996). All told, about 85 per cent of the world's agricultural lands contain areas now degraded to some degree by erosion, salinization, compaction, nutrient depletion, biological degradation, or pollution. The extent of cropland degradation raises questions about the long-term capacity of agro-ecosystems to produce food. At the same time, some of the world's best farmland is being withdrawn from food production and put to other uses, including "consumption" by urbanization.

Because of its direct impact on global food production, damage to and loss of arable land has become one of the most urgent problems facing the world today (Kendall and Pimentel 1994). The problem is seriously complicated by the fact that for many of the more than 1 100 million people who currently live in extreme poverty, economic growth based primarily on agricultural activities is essential to improving their lives.



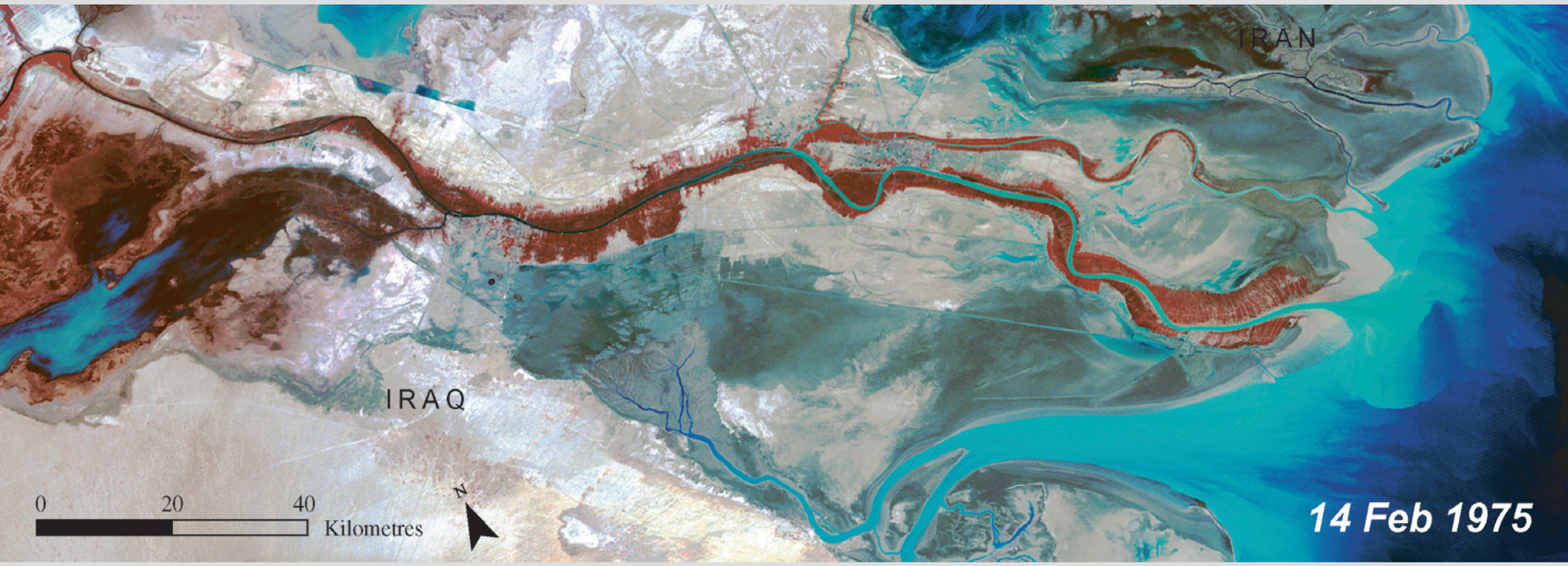




Cropland

- Cultivated and managed areas
- Cropland mixed with tree cover
- Cropland mixed with shrubs or grasses

Source: Global land cover 2000 (GLC 2000)



Healthy vegetation is characterized by a distinctively strong reflectance in the near infrared and appears red. In the infrared Landsat images above, the date palm belt skirting the Shatt al-Arab appears as a dark red hue in 1975. In 2002, the intensity of infrared emittance in the date belt is considerably diminished; the pallid red brown indicates stressed and dead vegetation, and the replacement of palms by reeds and desert scrub.

Case Study: Shatt al-Arab Palm Forest Destruction 1975–2002

(By Hassan Partow, UNEP/DEWA/GRID-Geneva & GRID-Sioux Falls)

Lining the 193-km-long (120-mile-long) Shatt al-Arab estuary, formed by the confluence of the Tigris and Euphrates Rivers, is the largest date palm forest in the world. Stretching back from the riverbanks towards the desert, date plantations extend for distances varying from a few hundred metres to almost six kilometres (4 miles). In the mid-1970s, the region counted some 17-18 million date palms or a fifth of the world's 90 million palm trees. By 2002, more than 14 million, or 80 per cent, of the palms were wiped out.

Destruction of the palm forest is due to a variety of factors. War has had the most direct impact, but salinisation and pest infestation have also caused long-term damage. The livelihoods of millions of people dependent on dates for food and income are in ruins, including a regional trade with export earnings ranked second only to oil.

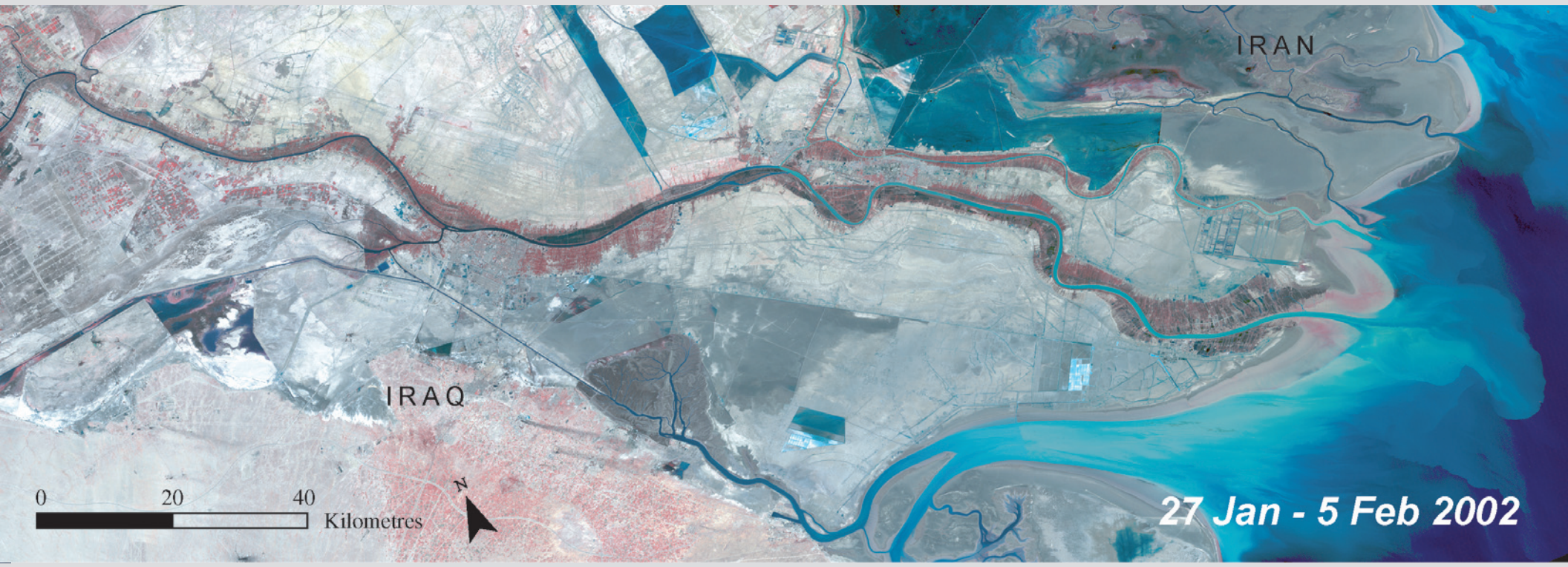
Impact of War

Most of the Shatt al-Arab is in Iraq. But roughtly about the last half of its course, near its juncture with the Karun River, forms the border between Iraq and Iran. Demarcation of the borderline has been disputed by the two countries and was invoked as a cause in the outbreak of hostilities in 1980. The conflict, which lasted for eight years, was the longest conventional war of the twentieth century, claiming an estimated one million human lives and causing extensive environmental damage. With the Shatt al-Arab waterway recast into a major theatre of war, the palm forest was unavoidably caught in the prolonged and intense crossfire. The destructive power unleashed by modern weapons in ground battles and aerial bombardments as well as deliberate felling reduced the palm forest to an emaciated shadow of what it was in its lustrous past.

Salt and Pests

Date cultivation along the banks of the Shatt al-Arab is a rare example of extensive tidal irrigation. Under the influence of the strong twice-daily tidal action of the Gulf, upper layers of fresh estuary water are swept into the creeks, irrigating date palm groves on the flood and draining them on the ebb.

Credit: Nik Wheeler/UNEP/Grid-Geneva



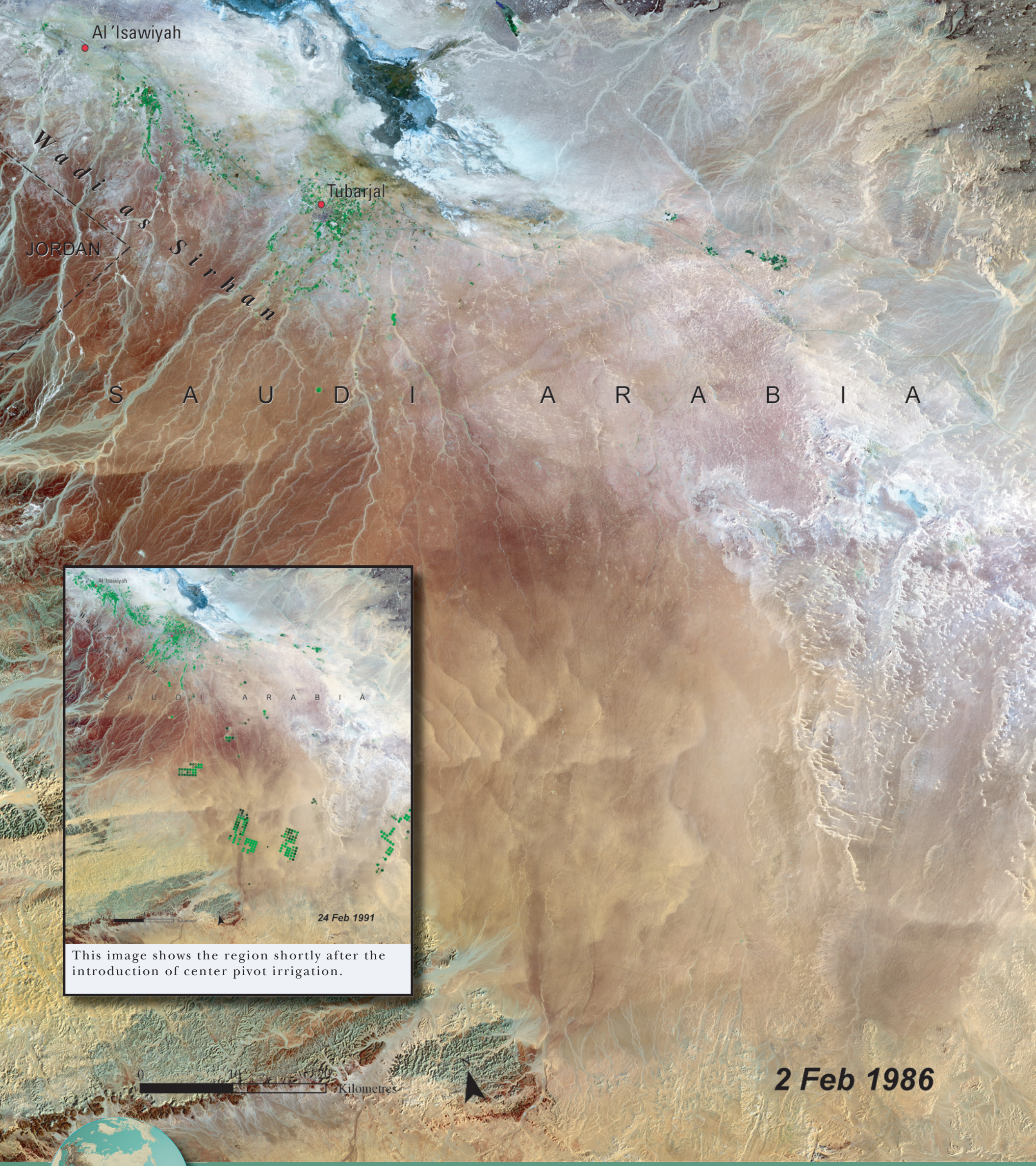
Analysis of Landsat satellite imagery shows that of the 52 000 hectares (128 494 acres) of date farms fringing the Shatt al-Arab in 1975 only 11 000 hectares (27 181 acres), or 21 per cent, remained in 2002. In total, war, salt and pests have destroyed approximately 14 million palms—around 9 million in Iraq and 5 million in Iran. Moreover, many of the 3-4 million remaining palms are in poor condition.

Alarming signs of salinisation in the Shatt al-Arab region began emerging in the late 1960s. The situation rapidly deteriorated as dam construction intensified throughout the Tigris-Euphrates basin, considerably reducing freshwater flows and eliminating periodic flooding of the Shatt al-Arab that formerly washed out accumulated salts. The supply and quality of water reaching the estuary dipped further with the desiccation of the vast Mesopotamian wetlands immediately above it and the diversion of marsh waters. Moreover, decreased inland discharge has stimulated deeper seawater penetration into the Shatt al-Arab, and water quality is steadily worsening due to polluted backflow from expanding irrigation projects in the watershed. Despite the date palm's high salt tolerance, excessive salinity has triggered large-scale palm dieback, with those nearest to the sea most affected but with the process continuing unabated inland. Finally, abandonment of date farms during the war and overall deterioration in palm vigour has rendered the trees susceptible to ravaging pest infestations, which have been particularly severe in the 1990s.

Credit: Hassan Partow/UNEP/GRID-Geneva

The Phoenix Factor

The date palms, whose botanical name is *Phoenix dactylifera L.*, resemble the mythical Phoenix bird that sprang from the ashes in that date palms are also able to regenerate from fire damage. Biotechnology may be the modern phoenix that will help replace the millions of palms that have been destroyed along the Shatt al-Arab. Iran is using a new cloning technique to accelerate mass date production, as dates are naturally slow to propagate. Already, thousands of palm plantlets have been introduced. Biosafety regulations, however, will need to be observed to ensure that the Iran-Iraq treasure grove of 800 plus date varieties, representing more than a quarter of world date diversity, is not jeopardised by a broad dissemination of cloned palms.

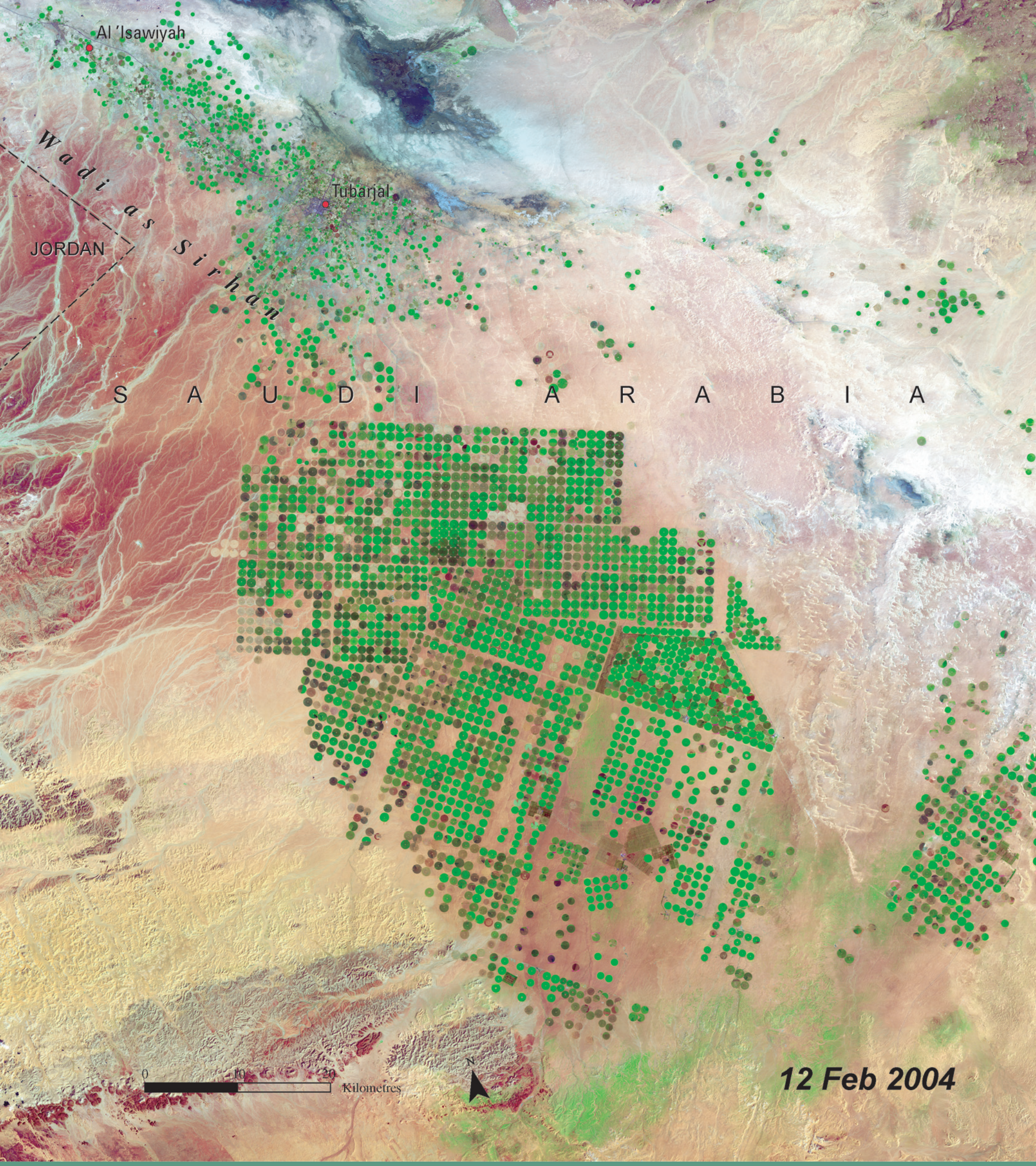


This image shows the region shortly after the introduction of center pivot irrigation.

Cropland

Al' Isawiyah, Saudi Arabia

Rich in oil but lacking abundant water resources, Saudi Arabia has used oil revenues to adopt some of the best technologies available for farming in arid and semi-arid environments. One such technology is the center-pivot irrigation system (CPI). In satellite images, CPI-irrigated fields appear as green dots.



These three images, from 1986, 1991, and 2004, reveal the effects of this irrigation strategy in a vast desert region in Saudi Arabia known as Wadi As-Sirhan. This region was once so barren that it could barely support the towns Al'Isawiyah and Tubarjal that can be seen in the upper left of each image. Following the introduction of center-pivot irrigation, however, barren desert was gradually transformed into a greener, food-producing landscape.

The irrigation system draws water from an ancient aquifer—some of the water it contains may be as much as 20 000 years old. Judicious use of water resources, and climate-appropriate technology, has in this situation helped improve food production without being detrimental to the environment.

S P A I N

Dalías

Almeria

El Ejido

Roquetas de Mar

La Mojonera

Campo de Dalias

Balerma

Almerimar

Punta Entinas-Sabinar

Alboran Sea

0 3 6 Kilometres

N

24 Jan 1974

Cropland

Almeria, Spain

This pair of satellite images shows the impact of massive and rapid agricultural development in Almeria Province along Spain's southern coast. In the earlier image, the landscape reflects rather typical rural agricultural land use. In the 2000 image, much of the same region—an area covering roughly 20 000 hectares (49 421 acres)—has been converted to inten-

sive greenhouse agriculture for the mass production of market produce. (Greenhouse-dominated land appears as whitish gray patches.) In order to address increasingly complex water needs throughout Spain, the government adopted the Spanish National Hydrological Plan (SNHP) in 2001. Initially, this water redistribution plan involved the construction of 118 dams and 22 water transfer projects that would move water from parts of the country where it was relatively abundant to more arid regions. In 2004, the Spanish government announced it would begin exploring more environmentally friendly water-saving technologies, such as wastewater recycling and seawater desalinization.

Ustyluh

Novosilki Sanctuary

U K R A I N E

Novovolyns'k

Pribuzhzhya Sanctuary

P O L A N D

Fedorivka Sanctuary

0 5 10 Kilometres

N

27 Jul 1988

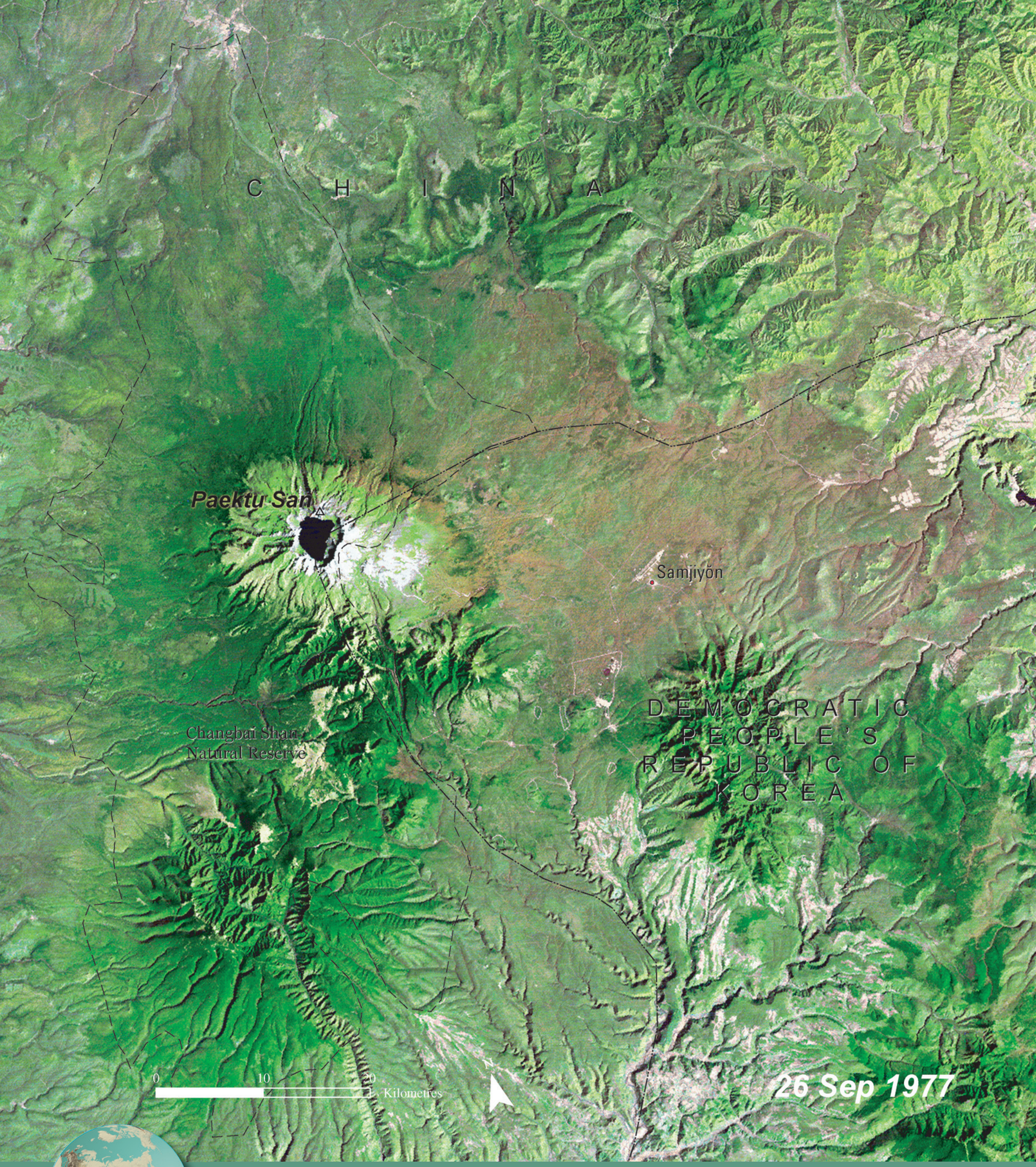
Cropland

Novovolyns'k, Ukraine

The unique transformation of the former USSR into today's modern states has had a profound effect on the lay of the land in Ukraine. These images show a notable difference in the agricultural land use patterns between Poland and Ukraine, probably reflecting dif-

ferent policies and approaches to land use. Of particular interest are the sizes and patterns of the fields in the two countries; while Poland the farms are comparably much smaller, those in Ukraine are larger.

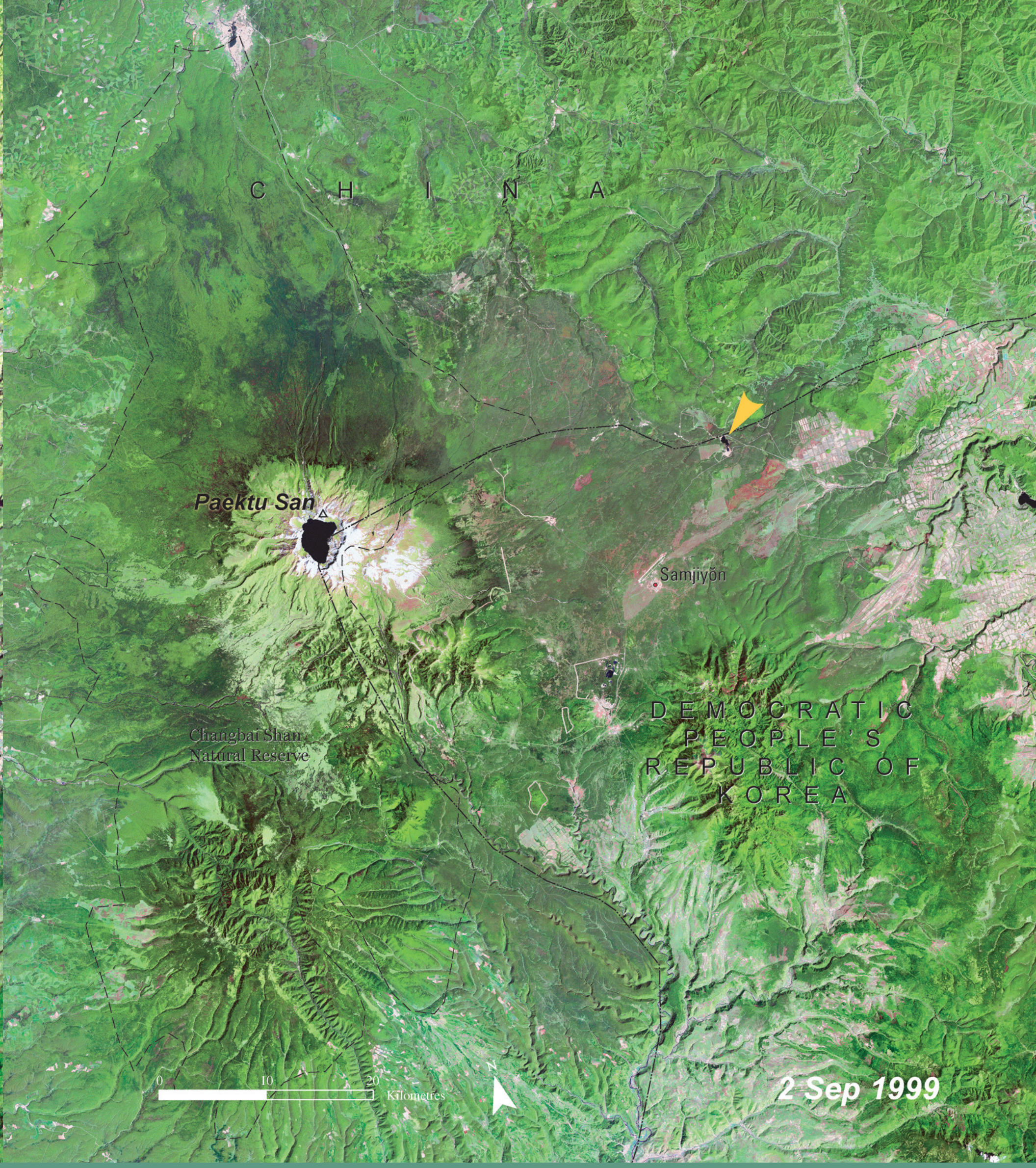
Though the town of Novovolyns'k has not changed appreciably in size, an apparent change in the approach to land use in Ukraine has taken place; in the 2000 image, larger fields have been divided, following the pattern in Poland. The satellite images reveal quite vividly the contrast in land-use practices between the individual farms of Poland and Ukraine's former state farm plan—and how the latter has changed over time.



Cropland

Paektu San, North Korea

Situated on the border between China and North Korea, the mountain Paektu San is a symbol of patriotism for the Korean people and an embodiment of their national spirit. The mountain's rich volcanic soils and its dry, relatively cool climate make it suitable for agriculture.



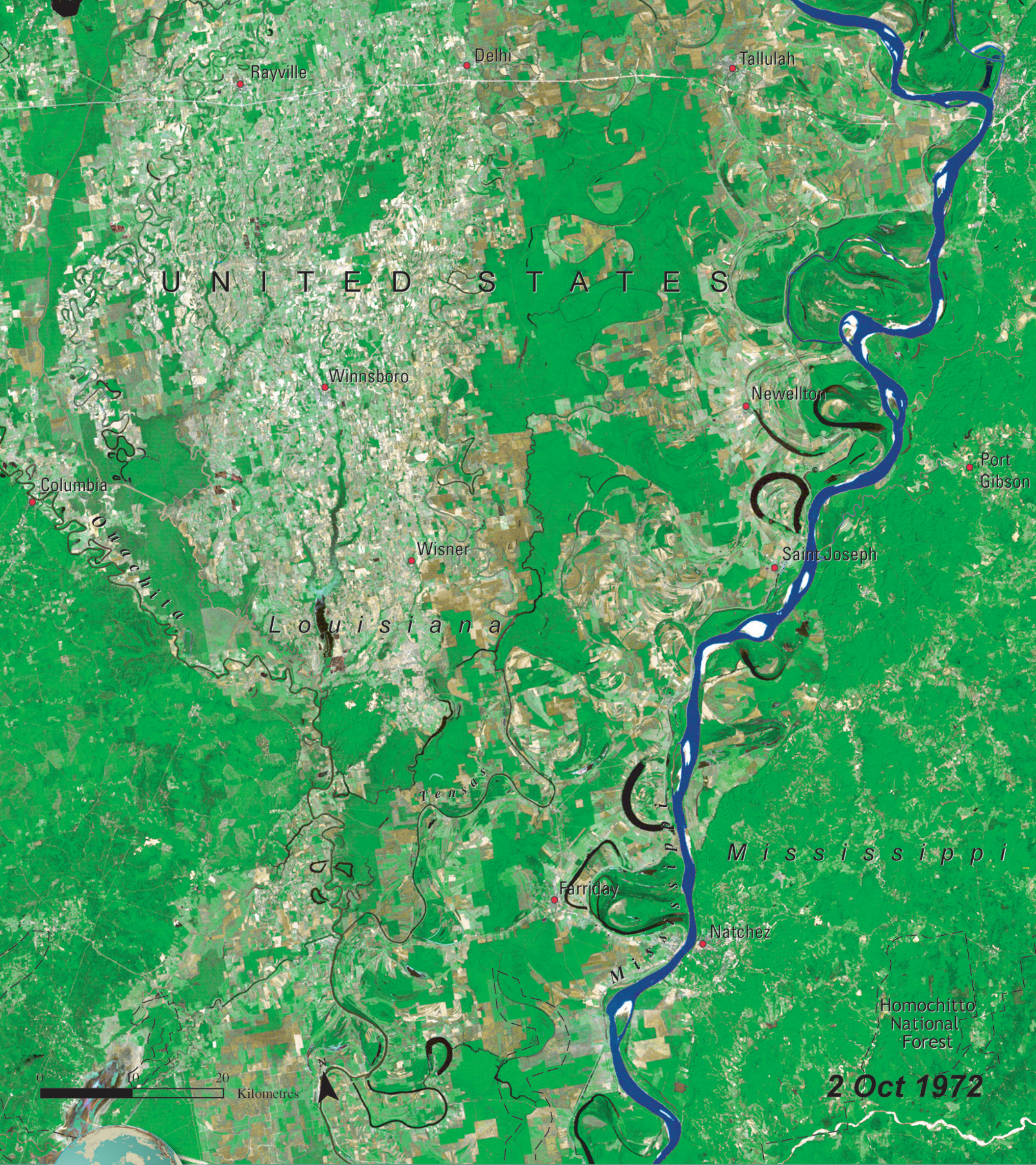
These two satellite images reveal the degree to which agricultural activities have expanded on and around Paektu San, particularly on the North Korean side of the border, where intensive land development has served to both increase food production and underscore North Korea's territorial claims. In these images, green represents natural vegetation while grayish-brown areas are bare agricultural lands in which crops have not yet emerged from the soil. Areas of deforestation and other types of land clearing appear pink and are dissected by the fine lines of mountain streams. Near the center of the more recent image there is further evidence of land-cover change along the border between the two countries where a dam has been constructed.

Lack of bridges and roads offered only limited access. By 1986, roads were established and clearing for agriculture had began in earnest.

Cropland
Santa Cruz, Bolivia

Santa Cruz is situated in Bolivia's rich, fertile lowlands, a region highly suitable for agriculture. In the 1975 satellite image, the region's forested landscape appears as a dense, essentially unbroken expanse of deep green that extends

to the Rio Grande (Guapay) River. By 1986 (inset image), roads had been built that linked the region to other population centers. As a result, large numbers of people migrated to the area. A large agricultural development effort (the Tierras Baja project) led to widespread deforestation as forests were clear-cut and converted to pastures and cropland. By 2003, almost the entire region had been converted to agricultural lands, including the area east of La Esperanza across the river. In the area north and west of Los Cafes (upper left), notice the grid of squares on the landscape, each with an internal star-shaped pattern. At the center of each square is a small community.



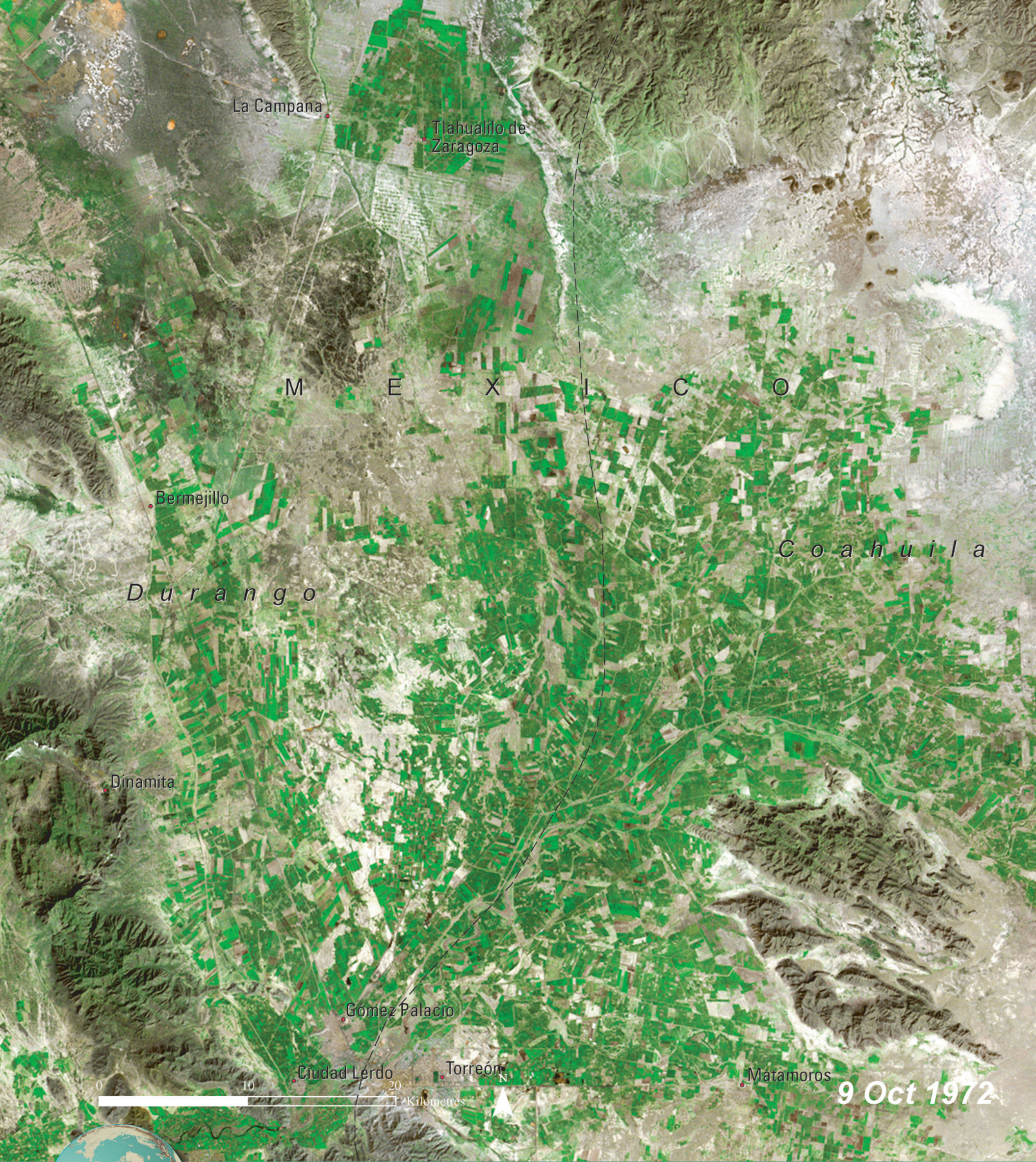
Cropland

Tensas River Basin, United States

The Tensas River Basin watershed lies in eastern Louisiana and covers 272 000 hectares (672 126 acres) in the Mississippi River Alluvial Plain. Historically, 90 per cent of this land was forested. Roughly 85 per cent of the forests were cleared during the 1960s and 1970s for the planting of

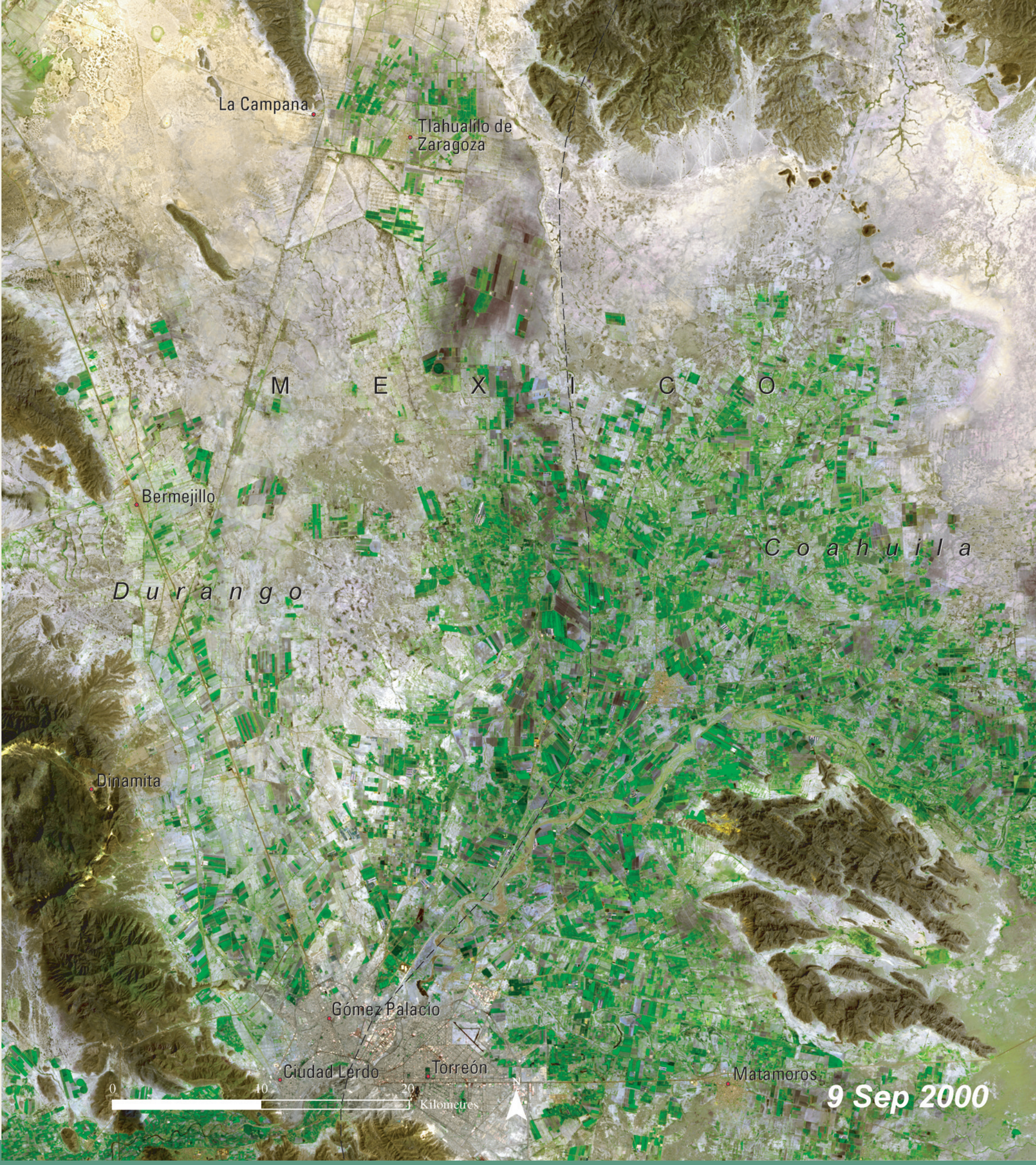
soybeans. Clearing of the forest has exacerbated flooding problems and increased erosion.

As this pair of images reveals, intensive agricultural development has continued in the Tensas River Basin over time. Croplands appear in shades of tan; forests are green. The only remaining large tracts of hardwood forests in the watershed are in isolated wildlife refuges and management areas. Small forest remnants also occur on some private lands. The contrast between the amount of land cover change that has occurred on opposite sides of the Mississippi River in these images is striking. In the state of Mississippi, the forests remain largely intact, possibly due to the absense of lands suitable for cultivation.



Cropland
Torreón, Mexico

The city of Torreón is located in the State of Coahuila in central Mexico. Founded in 1893, Torreón is a modern industrial city that is home to flour mills, textile plants, iron foundries, a rubber factory, and various other industries.



Torreón is also situated in a rich agrarian region noted for its cotton and wheat farms and cattle ranches.

Since the 1970s, however, there has been a significant decrease in cropland in the Torreón region due to drought and subsequent extraction of ground water from aquifers. In 1992, the Mexican government passed the Federal Water Law, in which the government sought to shift responsibility for some water management rights issues from federal to local governments, or even individuals. This left farmers in a position to negotiate their own water rights. At the same time, however, prices of water for irrigation were also raised. The amount of land around Torreón on which crops are raised continues to decrease.

Cropland
Toshka Project, Eygpt

Egypt's Toshka Project has transformed part of the country's scorching hot southern desert into a region dotted by lush, neatly tended vegetable plots that are supplied with water and fertilizer by drip irrigation systems. These images, from 1984 and 2000, document the

changes and success Egypt has had in this desert reclamation project, which was begun in the mid-1990s and aimed to double the size of Egypt's arable land in fifteen years' time.

The project created four new lakes in the desert by drawing water through a concrete-lined canal from Lake Nasser, which was formed by damming the Nile River at Aswan. The water flows through the canal into the Toshka Depression, where it forms the lakes visible in the 2000 image. The faint blue-green areas visible around some of the lakes are agricultural lands, newly created by irrigation. While providing people with new arable land on which crops can be grown, the Toshka Project's environmental impacts are still under study.