The World Water And Climate Atlas For Agriculture
A New Technology

Scientists at the International Irrigation Management Institute (IIMI) and Utah State University have created a new global database called The World Water and Climate Atlas for Agriculture that will serve as a high-tech tool for farmers, agronomists, engineers, conservationists, meteorologists, researchers and government policy makers.

"The Atlas integrates the available agricultural climate data into one computer program and represents the most comprehensive, quality-controlled climatic data set in existence," says CGIAR Chairman Ismail Serageldin.

The Atlas enables users to zoom in on any 2.5 square kilometer region of the globe and extract critical data such as precipitation and probability of precipitation, maximum and minimum temperatures and average temperatures.

"All of this data is converted into maps that clearly delineate climatic conditions, no matter how remote an area of land may be, in a user-friendly computer program that agronomists can use to assist even the poorest farmers," says Mr. Serageldin. "The Atlas will help identify the agroclimatic conditions appropriate for specific crops."

Donald T. Jensen, Director of the Utah Climate Center at Utah State University in Logan, Utah, and Andy Keller, Ph.D., of IIMI, created the Atlas from data received from 56,000 weather stations around the world. The Atlas covers the 1961 to 1990 period, in order to conform with World Meteorological Organization (WMO) specifications for a "normal period" of climate examination.

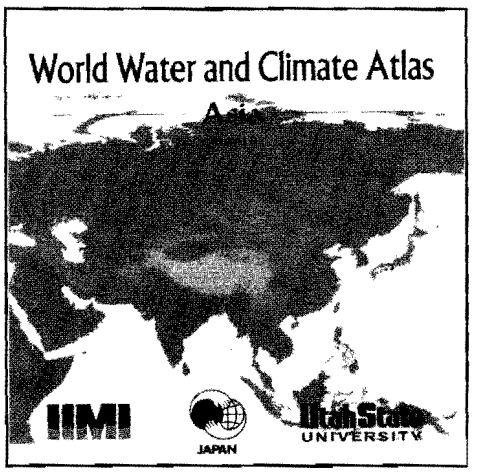
"The Atlas, because of its precise mapping of weather data over a 30-year period, could help scientists increase their understanding of the global warming phenomenon," says Mr. Jensen. "We expect scientists to find many other important applications for the Atlas that we haven't even dreamed about ourselves."

Some of the data is now available on CD-ROM. In July, the entire Atlas will be accessible on the Internet. The project was funded by the Government of Japan through the CGIAR.

"The Atlas will assume even greater importance in coming years, as water, especially for agriculture, becomes scarcer," says David Seckler, IIMI Director General. "Some 70 percent of all water used each year goes for irrigation, which produces 30-40 percent of world food crops on just 17 percent of all arable land."

Practical Applications

The Atlas will provide an extremely powerful base for further mapping of water-related data—for river basins, land usage projects and population centers—and as the basis for exploring the changes in agricultural potential that would result from independent estimates of climate change. The Atlas itself is not a predictor of such changes, but will be a valuable tool in interpreting the effects of any changes.



Using this meteorological encyclopedia, engineers can develop very specific plans for irrigation and water conservation projects for districts, states and entire countries. The quality of irrigated land in many places is declining due to increasing soil salinization, overpumping and contamination of groundwater aquifers.

Agronomists and researchers can use the Atlas' long term climate data to assess the potential for plant adaptation to climatic conditions. "The Atlas will show, for instance, where rice or potatoes, or any crop, could be grown where they are not now being grown," says David Seckler. "It will also show what more valuable or more nutritious food crops farmers might grow on their land."

The Atlas demonstrates how the two most important measured values—available water and temperature—influence plant growth, crop yields, and the choice of various management practices. Scientists can combine the long-term data with crop growth simulation models to assess the value of different plants and plant traits for plant selection and/or plant breeding.

The Atlas will serve the interests of small and poor farmers in at least three ways:

- International funding agencies such as the World Bank, along with national and local governments, will have a much clearer picture of how to direct increasingly scarce agricultural investment resources;
- Extension agents can print and distribute data generated by the Atlas for specific areas to help improve the performance of water resource and irrigation systems, ultimately leading to improved crop production by poor and small-scale farmers;
- By helping poor farmers to increase their incomes, the Atlas would help to better preserve the Earth's environment—where too many people are poor, hungry or unemployed, preservation of nature, forests and wildlife will deteriorate.

What the Atlas Contains

The World Water and Climate Atlas includes ten-day, monthly, and annual summaries of average, maximum and minimum temperatures, precipitation and precipitation probabilities, evapotranspiration (the total water evaporated from bodies of water or used in crop growing) and two indices. One index, the moisture availability index, delineates regions where moisture is adequate to grow crops. The second index measures a new concept, NET, or net evapotranspiration, which is

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the difference between evapotranspiration and precipitation. It helps locate areas needing irrigation.

If the NET in a designated area during a certain period is positive, it means not enough rainfall exists to maintain current cropping patterns without supplementary irrigation. Where the NET is negative, enough rainfall for crops exists. The NET is not the same throughout each year. In Southern California, for example, in winter, the NET is negative; in summer, it is positive.

The CD-ROMs contain monthly and annual summaries of rainfall and temperature, which are displayed on maps. For example, net rainfall (rainfall minus evaporation) is designated by different colors; deep blue marks heavy rainfall, green less and red signifies dry. In South Asia—mainly India, Pakistan and Bangladesh—only the southern region is blue in February, with the northern regions of the Indo-Gangetic plains green and red. By May through August, the entire South Asia region turns all blue as the monsoon season reaches its peak. By September and through December, the northern regions again become red and green, showing that they have dried out significantly.

A user can then focus onto a smaller area, which will then fill the computer screen to get more detailed information about climate variation on that smaller area of interest. A user can extract information from a point on a map, or bv delineating an area, such as a water basin or irrigation system.

"By looking at patterns of the past, we can find patterns on the future. We will see that when some regions of the globe are dry, it will mean that other areas will be wet," Mr. Jensen says.

For monthly data, the Atlas is produced on 6 CD-ROMs, which divides the world into sections. The first section—covering data for Asia—is provided on the initial CD-ROM, with additional data on the Internet. For 10-day data, IIMI and the Utah Climate Center will issue 17 additional CD-ROMs.

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To accomplish the mapping, state-of-the-art spatial interpolation techniques are used—daily data from the weather stations are plotted on the map electronically, and daily estimates are made for locations between the stations.

The Atlas also incorporates digital elevation modeling, or DEM, which captures effects from mountains and other high areas, such as temperature lapses (temperatures decrease with altitude) and rain shadows (more rain falls on the windward side of mountains than the leeward sides).

The Atlas also improves the quality of the maps through careful screening of data, which is important because many of the sites at which data is collected are "biased"—for example, by airfields and towns, where large expanses of concrete result in higher temperatures than prevail in surrounding agricultural areas. Also, by comparing climatic data of one station with other nearby, similar stations, data that was not properly collected or recorded is screened.

The "cleaned" data is processed through advanced mathematical procedures to produce a grid of 2.5 km squares (1 square mile) of interpolated data for the surface of the earth. Each "grid" includes all selected climatic variables. The Atlas estimates tem-