SAHEL

SCIENTISTS STUDY DROUGHT CYCLE

[AN] *While almost universally cited as one of the causes of Africa's current famine, the affliction of drought, or inadequate rainfall, is still poorly understood. Scientists have determined that the food-poor west African region known as the Sahel has experienced wide variations in rainfall for centuries. Discovering the causes of this erratic weather and making accurate forecasts, as free-lance journalist* **Russell Herman** *reports, may become an important factor in designing remedies for Africa's food deficit.*

While most of Africa south of the Sahara Desert has experienced drought in the last year, the problem is especially pronounced in the Sahel, an ecologically fragile zone extending along the southern rim of the desert from Mauritania and Senegal on the Atlantic coast through Mali, northern Burkina Faso, Niger, Chad, and into Sudan (see box).

The Sahel has suffered an almost continual rainfall shortage for the past 15 years, except for a handful of beneficent rainy seasons in the mid 1970s. To make matters worse, the rainfall figures for 1983 and 1984 were the lowest in this century.

Fifteen consecutive years of drought would be enough to cause severe hardship almost anywhere. The Sahel's situation is even more drastic because agriculture, grazing, and other human use of the land expanded dramatically during the unusually wet 1950s, a process encouraged by the introduction of deep wells with mechanical pumps. When the moisture levels declined toward normal in the 1960s and then plunged into drought, the ecosystem could no longer support these enlarged burdens.

But the great variations in rainfall during the last three decades are not unusual in the Sahel. Scientists believe, in fact, that these extreme shifts in weather have been recurring for several thousand years. By examining the chronicles of traders, the diaries of travelers, and other records, geographers have extended their knowledge of the region's moisture budget back into the colonial period and beyond. Geological remains of ancient silt deposits, stream beds, and lake margins as well as fossils of aquatic micro-organisms take the estimates further back into prehistory.

These data are remarkably consistent. Rainfall in the Sahel has fluctuated dramatically over the last several centuries, with the region being one of the world climatal zones in which "average weather" is a largely meaningless term.

Sharon Nicholson, in a (United States) National Academy of Sciences report, writes: "In dealing with the Sahelian environment, climate must be treated as a variable, not a constant. Climatic fluctuations in the region are abrupt and extreme; rainfall in one decade may be nearly double that of the next. Both wet and dry episodes may persist on time scales of one to several decades, creating a false sense of 'normal' conditions."

As to the causes of the Sahel's climatic shifts, there are numerous hypotheses. Three of the most intriguing suggestions, though they are not sufficient to explain the situation, illustrate its complexity.

The Inter-tropical Convergence Zone: The northern and southern "trade winds," as they sweep toward the equator, dominate the weather of sub-Saharan Africa. In the Sahel, the northern trades take the form of the dry "harmattan" that blows from the northeast across the Sahara. The southern trades come from the opposite direction after picking up their load of moisture from the tropical Atlantic.

The meeting of these two systems of winds is known as the inter-tropical convergence zone (ITCZ). As the northern hemisphere tilts toward the sun during the middle of the year, the ITCZ moves north and monsoon winds bring summer rains to west Africa.

The ITCZ hypothesis claims that drought occurs in the Sahel when the ITCZ fails to move far enough north, thus positioning the monsoon rains well south of the Saharan zone. Suggested in the scientific literature of the mid-70s, this theory is sometimes presented as fact in non-technical accounts. Researchers now think it is false, at least in its simplistic version. Though the ITCZ clearly exists and is a major factor in the Sahel's climate, its movements are not sufficiently dramatic to explain the Sahel's periods of drought and relative wetness.

Ocean surface temperature: Some researchers postulate that a southward shift in pockets of warmer temperatures on the surface of the Atlantic between west Africa and South America leads to drought years. This configuration of ocean temperatures was present in the dry years 1949, 1968, 1972, and 1984 (when it was the strongest of this century). Though these few examples could be coincidental, they are suggestive enough to prompt continuing study.

This hypothesis gains credibility from a stronger correlation between drought years in southeastern Africa and a phenomenon halfway around the globe. In the eastern Pacific, the tropical waters are unusually warm in some years. Named *El Nino* (Spanish for "the child") because it appears around Christmas, this warming trend is connected to many far-reaching events, including landslides in the Andes (because of its effect on rainfall). In addition, it now appears that reduced rainfall in southeast Africa followed 22 of 28 recent *El Ninos.*

Biogeophysical feedback: The third hypothesis addresses not the origins of the droughts, but their persistence. Called "biogeophysical feedback," this theory proposes that drought causes physical changes in the land which then perpetuate the drought.

The most obvious result of inadequate rainfall is a reduction in plant life. When soil loses its protective cover of vegetation, the sun bakes it dry. Besides further diminishing the soil's ability to support life, its loss of moisture may directly reduce rainfall. Some researchers believe that as much as two-thirds of the rain that falls in the Sahel may originate from evaporated soil moisture. Whether that is true or not, few would contest that bare, sun-baked, rootless soil is less able to absorb what rain does fall. This leads, at the very least, to erosion and further loss of plant life.

Another subject for study is the moisture level in the atmosphere. Most land is much more reflective when bare than when covered by vegetation. Increased reflectivity heats the atmosphere above the soil and dries it. If the moisture is not present in the air, it cannot fall as rain.

But neither is the presence of moisture in the atmosphere alone a perfect guarantee of adequate rain. Rainstorms require a supply of microscopic particles around which may form the ice crystals that are the source of raindrops. The most potent of these "condensation nuclei" are produced as parts of the cell walls of certain bacteria that grow on plants and in decaying plant material. Loss of plant cover might interrupt this source of a necessary element for producing rain.

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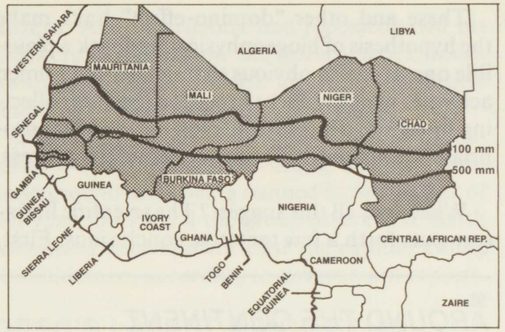
THE TERM 'SAHEL'

[AN] The Sahel is an ecologically fragile zone roughly 200-400 kilometers (124-248 miles) wide and extending across the southern rim of the Sahara Desert. Technically, it is defined as the area receiving an average annual rainfall between 100 and 500 milimeters (4-20 inches), which makes it as dry as the southwestern United States.

Containing approximately two million square kilometers (772,000 square miles) of land, the Sahel is slightly larger than Mexico or the sum of the continental European countries of Austria, Switzerland, France, Spain, Portugal, Italy and both Germanies. Encompassing a quarter of Senegal, roughly 40% each of Mauritania and Mali, half of Niger, and almost a third of Chad, it is bounded on the north by the Sahara proper and on the south by a wooded savanna known as the Sudanian zone. ■



The Sahel. */Africa News map*