'Great Man-Made River' courses through desert in Libya

by Marcia Merry

Over the past year, a major link has been completed in Libya's "Great Man-Made River" (GMR)—a project designed to provide an integrated national grid of piped water from aquifers deep beneath the deserts of the Sahara. Concrete pipes are carrying water from well fields in southern and east-central Libya, northward for various uses in the coastal areas where the population of 4.3 million is concentrated.

The water is especially welcome because the coastal aquifers that have supplied the population centers in the Tripoli and Benghazi regions, have been depleted by heavy pumping over the years, and there has been significant infiltration of salt water from the Mediterranean Sea. This is a prime location for desalination plants, but without financial credit and high technology, Libya can only afford to desalinate water to supplement water supplies for urban and industrial use, and cannot yet hope to meet the expense of desalinating the large volumes of water needed for agricultural expansion.

Libya's territory is larger than the combined land area of France, Germany, the Low Countries, and Switzerland. However, it has no natural rivers; over 90% of the land is desert.

Water from under the desert

Underneath the desert sands, however, are vast quantities of water—part of the pattern of aquifers in the various sedimentary rock basins located across northern Africa. Geologists identify at least 11 sizable basins containing deep aquifers in the 3,000-mile span from the Atlantic coast of Africa to the Red Sea.

In planning the GMR, geologists have focused on two hydraulically distinct basins in central and southeastern Libya: the Sarir—or Sirt—Basin, and the Kufra Basin. Both are believed to have huge amounts of underground water. The Kufra Basin extends under the adjoining lands of Chad, Sudan, and Egypt.

The Kufra Basin has been the least geologically mapped, but there is no denying its immense value as a resource. Discussions in the past among Libya, Sudan, and Egypt for joint development of water for this desert region, in order to create oases of vegetation and human habitation, have not reached fruition as Egypt withdrew under pressure from the Reagan and Bush administrations. Throughout the 1980s, London and Washington intervened, in collaboration with the International Monetary Fund and World Bank, to deter GMR-style development. Typical of this anti-development approach is the "Arab World Survey" of May 1990 by the London *Economist,* which stated, "Libya is another offender" planning water projects. "It is building a spectacular system of pipelines, known as the 'Great Man-Made River,' to move water pumped from under the Sahara Desert northwards to the coastal region for use in agriculture." The *Economist* said it is wrongheaded to plan water for farming, and that it costs too much—an estimated $25 billion for the entire plan.

Water project moves ahead

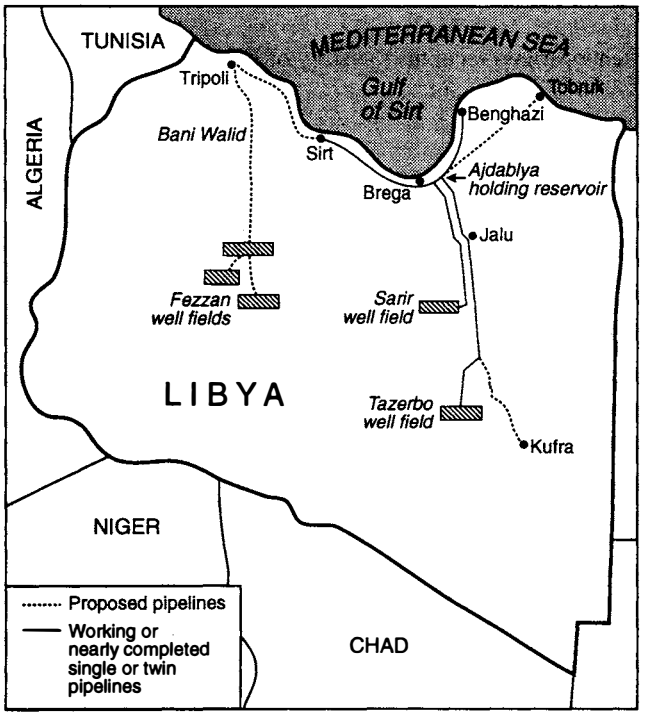
Despite London's scorn, planning and work has proceeded, and the accomplishments of the GMR project to date give a preview of how water projects of all types could make the Sahara Desert bloom.

The map shows the outlines of the scheme. The solid lines in eastern Libya indicate the pipelines completed or targeted for completion in the first phase of the project. Water is pumped up in the Tazerbo Well Field (on the border zone between the Sirt and the Kufra basins), and piped northward, joined by water pumped from the Sarir Well Field (Sirt Basin). Twin pipes course north via the town of Jalu to a holding tank at the Ajdablya Holding Reservoir, and thence via pipeline to Benghazi and Brega, and thence to the town of Sirt.

Future phases of the GMR are shown by the dotted lines. The western branch of the "river" calls for pumping in the Fezzan Well Fields in west-central Libya, with a pipeline to run northward to Tripoli. The main twin pipeline is 1900 kilometers, and is designed for carrying an eventual water flow of 2 million cubic meters per day to the north. Submersible pumps will lift the water to the highest level in the system—about 300 meters above sea level—from which it can flow by gravity to all points. Extensions of the first phase of the eastern part of the GMR are shown in dotted lines. A link is planned from the Ajdablya Holding Reservoir to the coastal town of Tobruk. Another link is planned to extend to Kufra.

Construction began in September 1984. The manager for the project has been the engineering firm Brown and Root from the United States, with the building work done by the South Korean Dong Ah Industrial and Construction Co.

Design of Libya's 'Great Man-made River' brings underground water to coast



Two mammoth pipe-manufacturing plants were built at Sarir and Brega. They were designd to be the biggest concrete pipe factories in the world. The pipe for the man-made river is four meters in diameter, made of pre-stressed concrete. The fabricating process starts with casting concrete in molds around welded steel pipe cylinders. Then the pipe is wrapped with carbon steel pre-stressing wire and coated with mortar.

The question marks over GMR plans have not been about river routes or construction techniques, but rather, about the fundamental scientific issues of hydrology. What are the characteristics and expected behavior of the acquifers? Mathematical simulation models have been run, but the answers are still uncertain.

All agree that the amount of water in the southeastern Libya aquifers is huge, on the order of several thousand cubic kilometers. The Sirt and Kufra aquifers are an estimated 1,000 meters deep. And it is agreed that much of the water is "fossil" water, that is, ancient. However, among the unanswered questions: Is there a hydraulic connection between the Sirt and the Kufra basins? What are the rates of recharge, discharge, and flow-through of the aquifers? How old is the water?

Taking a negative position on all points that bear on the development potential of the water resources is Dr. Edmund Wright of the British Geological Survey. Wright argues that the aquifer systems are not in equilibrium, that is, they are not being "recharged," or replenished. He contends that there is a demonstrably slow response to change in the water.

Wright points to carbon dating tests that place the age of the water in the central Kufra and Sirt basins as between 24-34,000 years old. Water in the northern parts of the Sirt Basin is younger, in the 14-24,000-year range or even 5-8,000 years old. Wright theorizes that there is recharging, but only by younger fossil water, and argues that the two basins have only restricted flow between them. Wright has advanced pessimistic calculations about the availability of water that imply relatively high pumping costs and a drawdown of fossil water.

Opponents of large-scale water development plans—based mostly in official policy circles in Britain and the United States—have cited Wright's viewpoint as justification of their own policy of preventing economic development in northern Africa and the Middle East.

Aquifers are recharging

In opposition to this, Dr. Moid Ahmad, consultant to the GMR project and professor at Ohio University's Department of Geological Sciences in Athens, Ohio, has conducted numerous studies and tests showing how the aquifers can be beneficially put to use. Agreeing that much of the vast fossil water in the Libyan aquifers is ancient, Ahmad nevertheless dismisses the significance of the carbon test to prove or disprove the movements of water because, he points out, the tests relate to dissolved carbon, not necessarily to the water itself.

Ahmad also stresses that there are indications of some recharge of the Sirt-Kufra system coming from the Tibesti Mountains, on the Chad-Libya border, and from the Ennedi Mountains on the border with Sudan. His studies estimate that a rate of 120 cubic meters per second could be pumped from the various projected well fields of the GMR in eastern Libya, and that sufficient drawdown is available to last at least 50 years.

Dr. Ahmad advises that large-scale water development from aquifers, combined with advanced agro-forestry, would have a measurable ameliorating effect on regional environments. In an article entitled "An Hydrologist's Plan to Combat the Greenhouse Effect," (*Water International,* June 1990), Ahmad surveyed the hydraulic basins on several continents where the potential exists for major reforestation and rehabilitation.

Dr. Ahmad wrote in 1981 that "Libya can be an exporter of food." He said that many basins in the Sahara have underground water potential for agricultural projects, in some cases capable of irrigating 100,000 hectares of desert land. "It is estimated that the Sahara can produce 5 million tons of wheat per year. A summer crop can also be raised to meet the particular demands of each country. The need for these types of developments to increase the food for world consumption is now critical and people throughout Africa cry out to be fed daily."