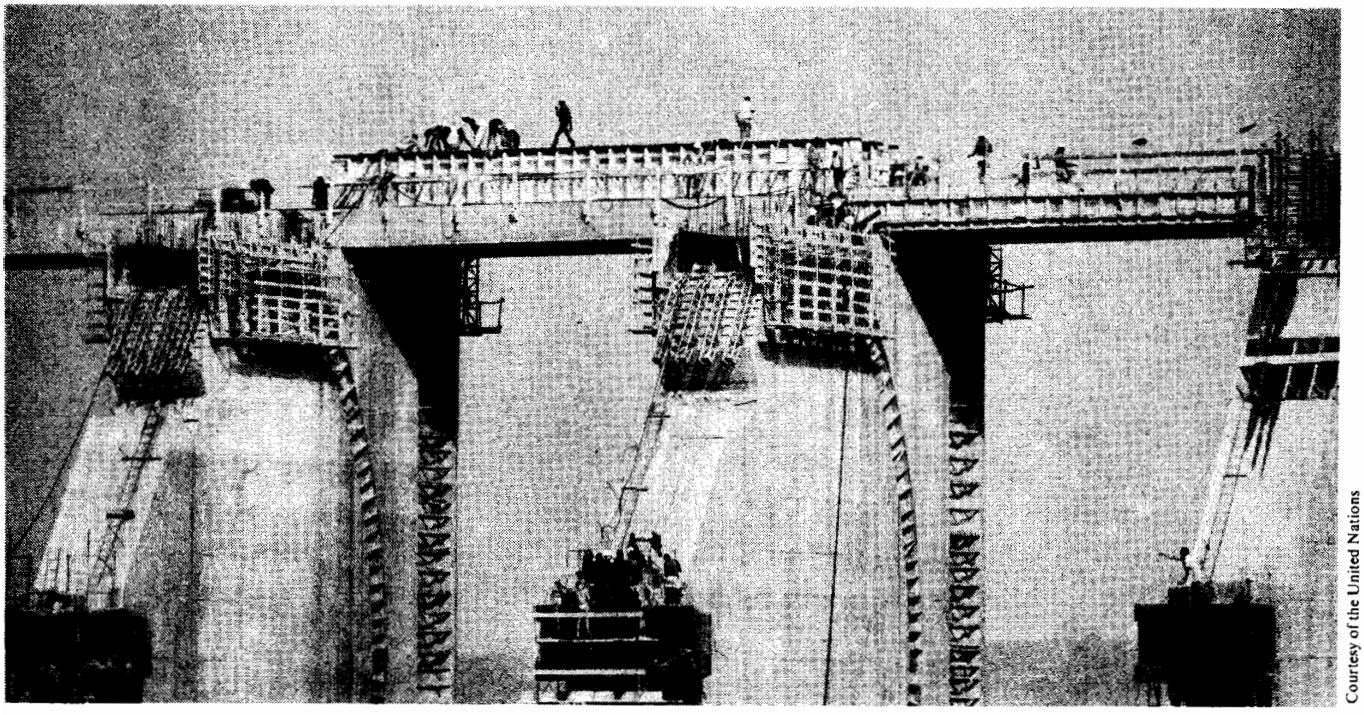


Courtesy of the United Nations

The Global Infrastructure Fund: evaluating methods and projects

by Ramtanu Maitra, P.E.

EIR *has asked Ramtanu Maitra, a structural engineer working in the nuclear industry, to make a preliminary evaluation of the Global Industrial Fund (GIF) concept initiated in Japan and some of the projects it specifies. Maitra was part of the group of scientists and engineers who formulated the Fusion Energy Foundation's long-range industrial development programs for India and Mexico, programs which have been widely considered among both government and private institutions in those nations. Maitra has been asked to evaluate GIF projects and propose methods of implementation.*

The evaluation of the Bering Straits project was contributed by Fusion *magazine editor Steven Bardwell.*

The 12 projects listed in the GIF plan are only a tentative listing, exemplary of more than 100 projects which Mr. Nakajima and his associates regard as worthy of consideration. The Mitsubishi Research Institute text does not discuss any project in great detail, but develops an overall concept, and then lists projects suggested by other sources. As Mr. Nakajima told a conference in Norway recently, "Our preliminary effort also convinces us of the need of having all of these ideas fully evaluated by a group of experts."

Contrary to the "incrementalism" shaping discussion of world economic development, the overall concept of the Global Infrastructure Fund plan is to use large-scale projects to "radiate" development into those areas of the globe which, though admittedly rich in resources, have frequently been regarded as hopeless—the so-called Third World. The GIF concept attacks the most basic barrier to development—the population's bondage to subsistence farming—by proposing to create capital-intensive agriculture to both feed populations and free labor for industrial employment.

The projects themselves would thus tend to draw backward populations into a modern industrial environment. Vast in scope and capital-intensive in design, the

The Kainji Dam, built on the Niger River in northern Nigeria.

projects are also designed to provide on-the-job training, in order to develop necessary skilled personnel. Such effects would be magnified by the "sub-infrastructures" the projects require: transportation, communications, housing, hospitals, educational facilities, etc.

As Mr. Nakajima pointed out in a recent speech, "In this way, the GIF would make it highly effective to transfer technologies from the developed countries to the developing countries, especially 'standard' technologies that are so abundant."

The concept of changing the climate of entire regions through the water-resource management schemes integral to some projects—control of the Bering Strait, filling in the Qattara Depression, creation of an African Central Lake, and so forth—would enable the world to augment food-grain production massively, permitting a much larger world population than presently envisaged, even at advanced-nation living standards.

In sum, the overall concept, as well as most of the projects, are well thought-out; the principal consideration remains not whether, but how to put them into practice. There is, however, one glaring exception, the energy component.

The energy question

The GIF plan proposes, in part, a "collection station for solar heat," involving "a large-scale installation for the collection of solar energy in a remote part of the world," with investment in "land, pipelines, and accessory equipment" reaching $20 to $50 trillion. It also proposes several large hydro-electric projects, from the Himalayas to South America, and also, "electric power generation using sea currents," citing "12 promising areas along undeveloped ocean shores extending from the equator to the temperate zones."

Aside from the worthwhile hydro-electric projects, the energy program of GIF is thus glaringly inadequate—but so fundamental is the energy problem, that this could doom the overall plan. Its proposals for solar collectors were suggested by the Club of Rome, an organization not marked by any commitment to Third World progress. The proposal for electric-power generation using sea currents is equally misguided.

Nowhere does the GIF plan mention application of existing nuclear-fission potentials or development of thermonuclear fusion potentials, although Japan itself is spending significant amounts (more than the United States) on fusion research, and the Soviet Union, for its part, is proceeding on a perspective of having this "energy of the stars"—safe, clean, and so cheap that 10 cents will secure the energy-equivalent of 300 gallons of gasoline—by early in the next century. Fusion thus not only promises to overcome all energy shortages, virtually forever (its fuel is ordinary sea-water and elements as common as lithium), but fusion technologies including isotope-separation techniques guarantee abundant resources of all types from the crust of the Earth's surface.

In the meantime, Third World development cannot occur without fission technology. Consider the energy requirements for food production alone—energy for fertilizer, for mechanization, for irrigation, for transportation, etc.—all implicit in other GIF projects. Compared to the tenfold increase in per-capita energy consumption required for the success of such development projects, solar-energy collectors would represent a net energy loss, and hydro-electric would make a minor contribution overall. The bulk of that energy must come from nuclear sources.

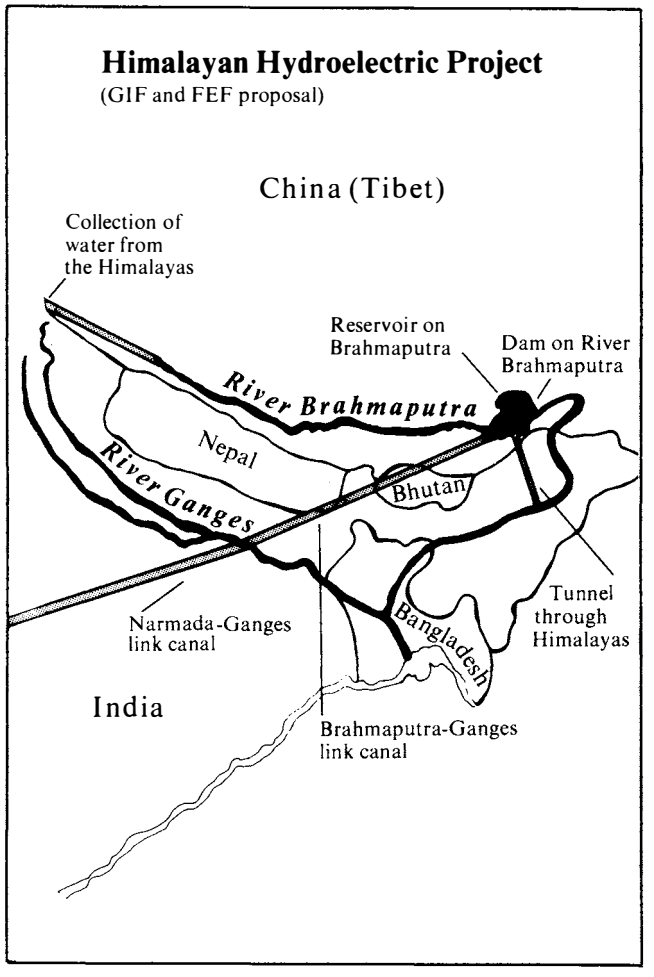
It is not merely increased energy per capita, but the use of the energy in its most dense form that is essential to agro-industrial development. What is involved is *energy-flux-density*.

Energy-flux density signifies a concentration and accompanying quality of energy, and is formally measured as calories passing through a standard cross-sectional unit-area of the energy producing process. For example, conventional coal and oil energy-generating systems provide 1,000 times greater density than solar-energy production, while nuclear fission is 100,000 times more energy-dense than solar, and nearly one million times greater than "biomass" (wood, cow dung, etc.). This bears directly on costs of generating a given magnitude of energy. In other words, solar energy is intrinsically 100,000 times less efficient than fission energy, and so forth. Nuclear fission thus requires substantially lower energy input to obtain even a much greater energy output, of paramount importance especially to a developing nation.

Particularly essential for Third World development projects will be the use of more advanced fission reactors, such as the High-Temperature Gas-Cooled Reactor and breeder reactor designs, with the advantage that they not only produce electrical energy, but large amounts of process heat capable of powering contiguous agro-industrial complexes.

Within a decade, however, it is possible (and the Soviet timetable is based on recognizing this fact) to have fusion-fission hybrid systems that not only produce energy, but function as "fuel factories" more efficient than breeders, producing enough new fuel in the course of producing energy to power 10 additional fission reactors, for example.

While from the energy standpoint alone, oil and coal might provide feasible resources, considerations of the "greenhouse effect" of large-scale application warn us away from these alternatives. The Earth's atmosphere may not survive the levels of carbon dioxide implied. A similar consideration applies to solar energy—even if



solar enjoyed an energy flux-density adequate to provide even the magnitude of energy we require, which it does not. The air pollutants produced in mining and manufacturing steel, glass, and cement for a large-scale solar-collection project—sulphur, nitrogen oxides, and carbon monoxide—would be horrendous, including modification of the hydrological cycle (rain) through the heliostats canopy (solar collector) and its effect on evaporation rates.

City-building through nuplexes

Related to the question of energy concentration is population concentration. GIF infrastructure projects provide the initial basis for industrialization, but the only means man has ever successfully employed to achieve it is the industrial city.

In the early 1960s, Oak Ridge National Laboratories in Tennessee developed an imaginative concept for Third World city-building. It was called "nuplex," short for "Nuclear Agro-Industrial Complex." At the present time, the Indian government is constructing such a nuplex in the state of Uttar Pradesh, using the Oak Ridge ideas.

A nuplex involves paired or clustered nuclear power plants surrounded by agro-industrial facilities, able by present standards to generate four gigawatts of electrical power, while industrial facilities' proximity both exploits waste-heat produced and economizes on distribution costs. A region is rapidly developed by introducing a large amount of power at maximum available energy-density, to be produced and consumed within a small area.

Nuplex waste-heat can be used to desalinate and purify sea water or polluted waters, making such "cities" pivotal in both clean water-management and agricultural development Industrial parks huddled around the power plants would produce agricultural machinery, agrochemicals, fertilizers, and so forth.

Each nuplex would require four to six years to construct, during which period engineering and many other skills employed on the job site would provide training for members of the indigenous labor force. This would necessarily be supplemented with schools for technicians integral to the nuplex, as well as cultural programs for workers and their families.

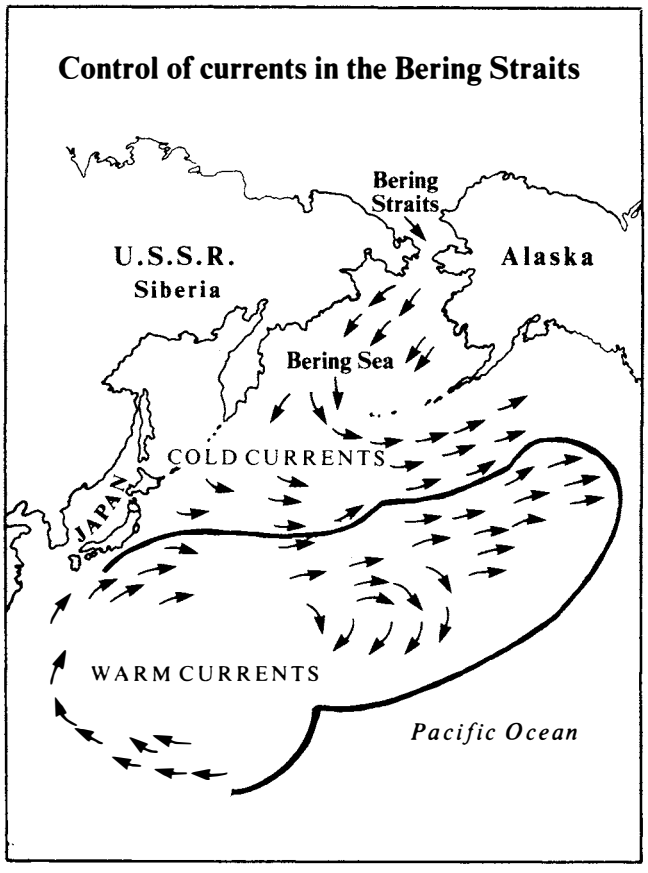
In such fashion, the nuplex becomes the center for radiation of high-technology services to the surrounding population at large. A network of such nuplexes could transform even the most dreaded deserts of Africa and far Asia into productive terrain.

The technology for such projects is proven. At present, engineers and scientists teamed from a number of nations, including the United States, France, West Germany, Italy, and India, could produce an integrated plan for nuplex-construction throughout the Third World almost on call.

The Himalayan project

The GIF plan proposes "damming of the Sanpo River on the upper reaches of the Bramaputra in the frontier area between China and the Indian province of Assam to make it flow into India through a tunnel across the Himalayas," and projects an annual hydroelectric generating capacity of 240 to 330 billion kilowatt-hours. The concept is generally correct, although the size proposed is inadequate, and the project would require some reshaping to accommodate an effective water-management plan. However, even as the proposal stands it would overcome a significant problem, the hazardous floods that ravage the foothills of the Himalayas and Bengal every year.

The River Brahmaputra carries a huge amount of water, but because of the terrain, this water is not useable to any appreciable extent in any of the countries the river passes through. It is the source of death and devastation during monsoon seasons in both northeast India and Bangladesh.



While the GIF proposal is excellent from the standpoint of hydro-electric capacity and flood control, the plan should be expanded to include vast irrigation works for Indian agriculture. Taking into account India's very fertile but undeveloped soil, the Fusion Energy Foundation incorporated into its 1979 Indian industrialization program an extensive plan for water works and fertilizer production, projecting a tripling of India's grain output within two decades on this basis. India would become a major food exporter.

The FEF program in this respect was based on work by Dr. K. L. Rao, the eminent Indian engineer and once Irrigation and Power Minister. In 1972, he envisaged a comprehensive plan that would revitalize the Ganges and control the waters of the Brahmaputra for effective use. Rao's plan looked forward to the production of an additional 30 to 40 million tons of foodgrains annually in north India alone, along with at least 40 gigawatts of additional hydro-electric capacity for industrial consumers.

Indian authorities subsequently developed the Himalayan Rivers Development plan, which called for construction of storage reservoirs on the Ganges and the River Brahmaputra and its principal Indian and Nepalese tributaries. Interlinking canal systems would transfer surplus flows from the eastern tributaries of the Ganges to the west, with a canal connecting the Brahmaputra and Ganges themselves.

The plan would bring 5 million additional hectares under irrigation, and generate 30 gigawatts of hydro-electric power per year. It would also considerably assist flood control in the Ganges-Brahmaputra basin, and could no doubt benefit Nepal and Bangladesh as well as northeast India.

The Bering Straits current

The economic potential of Siberia was "discovered" in the 1930s, and ever since, Soviet planners have been fascinated by its development prospects, including "warming" of the region. For example, Soviet meteriological texts rarely fail to note that the principal determinant of Siberia's cold weather is the Bering Strait current, which brings frigid Arctic air south past Siberia and Japan, and is thought to operate in much the same way that the warm Gulf Stream keeps England abnormally warm and moist.

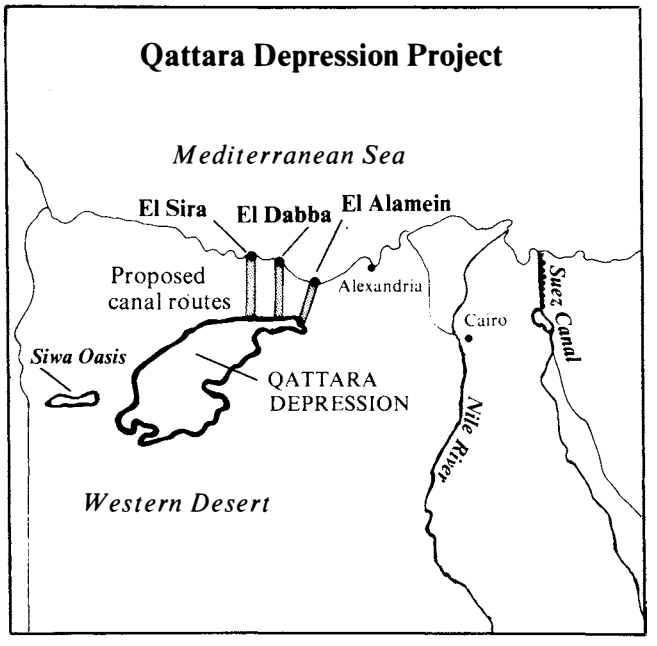
Various plans for the control of the cold-water current have been proposed, one of which is alluded to in the GIF scheme. An examination of the prevailing currents in the area show two reasons why the strait's current causes a cold climate in northwestern Siberia: First, the currents sweeping southward depress the temperature and stabilize the cold air masses over land; second, the southward motion of the currents diverts the warm South Pacific currents traveling northward away from the Asian land mass. The result is a highly stable region of coldness.

The GIF project would dramatically change this arrangement of currents, inducing a climatic modification (not merely weather modification) that would dwarf all other consequences of the plan.

The most feasible means of Bering Strait current-control is construction of a large hydro-electric dam across the straits. Such a dam would be uniquely designed to control flows of salt water in their gravitational or rotational driving motion, rather than making the usual fresh-water discharges into the sea. The engineering problems in such construction seem surmountable, and would certainly be repaid many times over were even a small part of Siberia or Japan to be warmed by the consequent climatic change.

A careful analysis of the project is impossible at this time, lacking a successful model of *global* climatic shifts. The interplay of ocean currents, atmospheric motion, and precipitation is a largely unsolved problem today. There is no even remotely reliable model for projecting long-term climatic change's effect on related earthly processes. While meteorologists have had limited success in short-term prediction, longer-term climate dynamics have eluded solution.

The Bering Strait project might, in a conservative



approach, await the solution to this scientific problem before becoming feasible; in a more daring approach, the straits might be seen as a great laboratory for experimental mapping of the physics of the Earth's climate.

The other major determinant of the northern and polar climates is the polar ice cap. Due to its high albedo (reflectivity of the surface) and its effect on ocean temperature, variants in the ice cap's extent and thickness can affect the climate in this region. This fact becomes important in the evaluation of several major water-project proposals.

For example, projects that involve diverting millions of acre-feet of water annually southward from far-north areas would produce a secular increase in the salinity of the Arctic Ocean by lowering the inflow of fresh water. This is to be considered in a number of such Siberian plans, as well as the NAWAPA project for moving Canadian and Alaskan water down into the United States and Mexico. The extent and impact of increased Arctic salinity is difficult to gauge on the basis of present oceanographic knowledge. It seems clear, however, that the effect would be to melt ice in the Arctic area and decrease the extent of the polar ice cap. A general warming trend would result, complementing the impact of the Bering Straits control-dam.

What other effects might it have? A serious study of the climatological impact of such projects would be a necessary component of the engineering evaluation.

The Qattara Depression

The GIF plan proposes "construction of a canal between El Dabba and El Sira; construction of a port at El Sira; and electric-power generation by the flow of water through the canal."

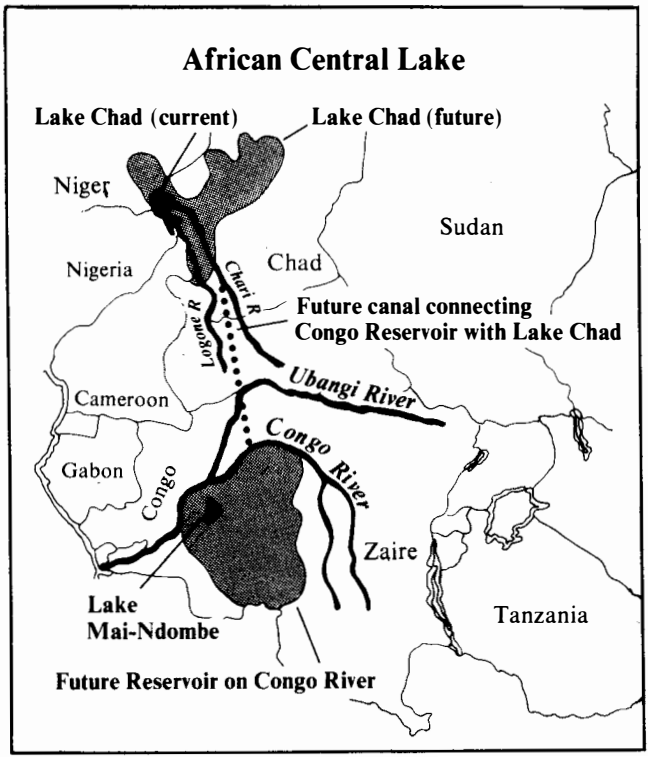
At the Western Desert of Egypt, about 50 miles south of the Mediterranean Sea, there exists a dry, massive depression. It is much lower than sea level. Simply cutting canals from the sea and using pumps where necessary would allow the Mediterranean water to rush in. Then a dramatic metamorphosis would occur in the entire region, "greening" the desert and making possible the transformation of the entire surrounding region into an agriculturally productive region. The GIF plan envisages such results.

In the early 1970s, a West German team of experts reached similar conclusions and declared the project economically viable. Agricultural development would tend to follow even without irrigation (the flow of Mediterranean waters, for example, would require desalination on a large scale to turn these flows to such a purpose) on the principle that "rain follows the plow." By creating a great pool of water inland in the Qattara Depression, presently arid, a vast evaporation process is engendered. This leads to increased regional rainfall, making feasible agriculture in nearby areas, in turn generating further plant-based evaporation process, greater rainfall, and so forth.

The German study envisages nuclear construction methods for canals approximately 140,000 square feet in cross-section. Excavation would occur by nuclear blasts as developed by the "Operation Plowshare" group at Lawrence Livermore Laboratory in the late 1950s, the Salvo process designed to emit negligible radiation. Simultaneous ignition of a group of explosive charges along the axis of the canal would have a detonation point so deep that a continuous cut with a hyperbolic cross-section along the axis would be formed by the row of craters. The excavation costs by this nuclear method would be half conventional excavation techniques.

Turbines placed where the sea-water rushes into the depression would create about 10 gigawatts of cheap hydro-electric power. The long-term benefits would be enormous. Agriculture would be enhanced by the evaporation process, while surplus hydro-electric power due to lower summertime requirements could be channeled into desalination facilities attached to irrigation works. Moreover, the vast lake formed at the site of the Qattara Depression would raise ground-water levels, permitting freshwater springs to form in the nearby Siwa oasis.

Industries located near the new hydro-electric-power source could use the salt and mineral resources extracted from the sea-water for basic petrochemical and fertilizer production. The fishing industry would soon locate on this 190-mile-long, 62-mile-wide lake, which



could also become a transshipment point for ocean-going vessels.

The African Central Lake

The GIF plan proposes "control of the flow of the Congo River by building a dam to create a vast lake in the Congo and Chad regions of central Africa to improve natural conditions." This would be an immense international project, resulting in hydrological, ecological, and climatological change permitting cultivation of 800,000 square miles of land, more than five times greater than Japan's own arable territory, where 110 million people live.

Today, millions face starvation in the Sahel, an area whose soil is as rich as that of the U.S. Great Plains, but unproductive through lack of water, fertilizer, and mechanized techniques. This area and the Congo basin south of it would become horns of plenty.

According to the GIF proposal, a dam would be built on the Congo River north of Brazzaville, creating the gigantic lake in what is now the Congo Basin, about 130 square miles. A canal excavated for this purpose would transport some of the water to enlarge Lake Chad in Central Africa.

The new Congo Lake would be connected with spoke-like rivers and canal systems, becoming the axis of interior African transport. The Congo's hydro-electric potential would be doubled.

The Congo Lake would be connected to Lake Chad, which is now nearly dried out at the center of enormous depression, by blowing a canal where the Congo river's right-hand tributary, the Ubangi, bends northward approaching the mountain chain of the northern equatorial ledge which regulates a water shed. The Chad depression is a mountain-enclosed basin 1,400 feet above sea level. By increasing the water flow, Lake Chad, now 800 feet above sea level at the depression's center, could be raised to the full altitude of the natural basin's ridge. In that case, the Congo Lake would provide enough water to Lake Chad to give 4,000 miles of coastline.

The Amazon project

The GIF proposes "construction of nine dams and seven artificial lakes across the Amazon, Orinoco, and Paraguay rivers," affecting seven Latin American countries.

This project, fraught with potential danger, requires very careful examination. In the 1960s, a plan floated by the Hudson Institute under the title "New Focus on the Amazon" called for building a 40-mile-long dam to block off the Amazon River and create a 500-mile lake, flooding an area twice the size of Lake Superior.

The Brazilian government quickly vetoed the plan, in part because it did not promote agro-industrial development, but only facilities for resource extraction.

In addition, Brazil feared the climatic consequences of indiscriminate deforestation. Climatic impact and instability becomes a major consideration in any large river-basin development program. Large-scale deforestations, necessary to build dams and lakes, weaken the soil and cause drops in annual rainfall. The degree of deforestation of the Amazon already undertaken has proved to be calamitous, and is even believed to have affected North American and European weather patterns dependent on the Amazon low-pressure zone built around columns of evaporation.

Nevertheless, judicious planning and competent execution could transform South American river basins into agricultural breadbaskets. Exemplary is the Rio de la Plata river basin which, with adjacent areas, has 250 million hectares of rich alluvial soil. Agronomists assign greater yield potential to this soil than to the U.S. Great Plains or the Soviet wheat belt; nor would it require the vast water projects of Indian, African, or NAWAPA plans to realize that potential.

Currently, Japan is involved in a project to develop 50 million hectares of arable land in Brazil's central Cerrados plain. This and the Rio de la Plata, expanded to encompass industrial projects, would be the best initial South American focuses.