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work is proceeding apace but at others the future is very uncertain.

At Jubail, which Bechtel are managing, 15 major industries and 50 associated industries were planned and eight international companies including such names as Shell, Exxon etc.. have signed interim agreements.

Some of these plants will undoubtedly eventually pay their way, particularly if the construction costs are ignored. Saudi Arabia, Kuwait and Abu Dhabi are well able to cover the development costs of their heavy industries, accepting to pay any price for it, while some of the other countries, whose smaller oil reserves imply a greater need for alternative sources of income, may have greater difficulties.

For the next year particular choices of industrial development may be questioned particularly as even the capital intensive industries will require large numbers of immigrants.

Trade. With the shortages of most commodities during the inflation years trade has boomed and imports more than doubled in a period of less than one year. All the elements favourable to trade were present; a strong local demand for goods, rising prices which meant extra profit between the time of buying and the time of selling, very high margins due to bottlenecks in the distribution system, a fairly monopolistic traditional merchant sector,etc...

The immense boom in imports to the countries of the Gulf after 1973 was of course a direct result of the increase in oil prices. Imports to Saudi Arabia in 1976 were, in value terms, more than six times those of 1973.

In tonnage terms, construction materials, cement, steel, accounted for a large part of this increase and generally accounted for about 60 percent of the total tonnage imported into the Gulf countries.

In all of the countries in the area, except perhaps for Bahrain and Kuwait, the infrastructure was in 1973 poorly developed. The 3 years to 1976 saw massive developments everywhere in the Gulf, and the ports and roads where they existed became unbelievably congested with several months delays. By the end of 1976 there were signs of slowing the pace of growth, and by mid 1977 it was obvious that the strains on infrastructure and human resources were having inflationary effects on business, particularly in the lower Gulf.

Another factor of inflation is the regular increase in current development expenditures in some of the Gulf countries. It has been estimated that by 1980 the expenditure on construction will be about 2 billion dollars in the five smaller states and 9 or 10 billion in Iran and Saudi Arabia.

Contracting and construction
In the initial inflationary phase, shortage of accommodation and high rents led to a frantic construction boom. Given existing rents, any project was feasible, and produced very high rates of return. The banks were willing to lend for construction as this was the main productive activity in the Gulf.

The firms that accepted fixed prices contracts were very quickly wiped out as costs were going up by almost 5 percent a month. New contracts were done forecasting continuous price increases and quotes were way above present costs in anticipation of future price increases.

IMPORTS BY NATURE
(In percentage)

GULF PROJECTS
Value and proportion by country
(Value in millions of dollars)

Saudi Arabia	26,800	54 %
Iran	11,100	22 %
Iraq	4,400	9 %
UAE	3,500	7 %
Kuwait	2,250	4,5 %
Bahrain	700	1,4 %
Qatar	600	1,1 %
Oman	500	1 %
Total *	**49,850**	**100 %**

* Survey of all the projects over 10 million dollars reported in the 19 months between July 1977 and January 1979.

Although it must be well known by now that the South Koreans have been minning major contracts in the Gulf, the magnitude of their success is astonishing. The value of their contracts is greater than that of Japan and the USA put together. This trend has deflationary effects, since South Koreans are working on a very competitive price basis, compared to US and European firms offers.

The question one should ask is whether a lower rate of inflation coupled with a slower rate of growth

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Arab Economist
edward dent

ARABS SEEK TO IRRIGATE ARID LANDS

Unless the cost of tradeoffs is calculated beforehand with considerable precision, warns a representative from the Division of Engineering and International Programs of the National Science Foundation of America, major alterations affecting arid lands may ultimately cause more harm than good.

In contrast to some of the bright visions of the 1950's, virtually all designed to bring water in vast quantities from where it is to where it isn't, and make the deserts bloom, arid land scientists today stress more modest plans and goals. Instead of trying to graze cattle in lush meadows in the middle of the desert, they are more interested in containing than dramatically reversing desertification, protecting the land wherever they can from the incursions of man and nature, while using technology gently to minimise adverse effects and get as much as possible out of the fragile soil.

The dramatic impact of some great technological leap forward to the reclamation of deserts and arid lands, nevertheless, has not lost its appeal. Where there is money, there is still the temptation to try and create greenery from the sand. Thus, in Egypt, there are plans underway to flood the 18,000 square-kilometer Qattara Depression, 120 meters below sea level in the Libyan Desert, with water from the Mediterranean Sea. It is argued that flow in the canal would provide hydroelectric power, and the new lake would pour water into the atmosphere, while the vast, underlying aquifer would be protected by a water cap on its principal natural discharge, if the seepage of salinity does not cause too serious a problem.

EVERY FIX HAS ITS PRICE

The trouble with this and other grandiose schemes is that even when feasible, every fix, technological or otherwise, has its price. And what scientists have begun to learn, especially in recent decades, is that, unless the price in side effects can be foreseen with some precision, the risk of major environmental alterations may outweigh any benefits that might accrue, as for example, constraints of energy, or water and soil salinity, of receding aquifers, of ecological systems, and of the habits and customs of man himself. All such factors call for caution.

After all, constraints on human exploitation of arid lands have been present since the beginning of recorded human time. Witness Mesopotamia and the civilisation that flourished in the Tigris-Euphrates Valley 6,000 years ago. The first recorded civilisation was thriving in this region by the fourth millennium BC. In 2,000 years its irrigation practices ruined the soil so completely that it has still not yet recovered. At its zenith Mesopotamia supported some 25 million people; today Iraq, which straddles that immense region, has a population of not much more than ten million. Similarly, the ghosts of mismanaged irrigation in the ancient fertile crescent —silt-laden canals and landscapes glistening with caked salt— still haunt

modern societies. The scientific literature is full of approaches to the long-term build-up of salts in irrigated lands not properly drained.

The problem is not only confined to the Middle East either. The harm that has been done may be seen in the United States as well. Consider the United States West, where the Colorado river flows south. Here the surface run-off into the river results in salinity levels so high that the US Government has been obliged to build a desalination plant to assist Mexico. Ironically, the very dams that control floods and permit irrigation often eliminate a former benefit of flooding: the flushing from the soil of accumulated salts in the flood-plain. Salinity has become a problem in the Nile River basin since the construction of the Aswan Dam, and major drainage projects are currently under way to reverse the waterlogging of newly irrigated but poorly drained soils.

SILT AND SALT

One problem of irrigation is the gathering of silt. Siltation raises the beds of canals and blocks their flow. As a consequence, water may spill over the banks, or a straight channel may become unstable and meander. Modern nations rarely have the surplus labor or other resources which are needed to keep irrigation canals and reservoirs from silting up. More serious than silt, however, is salinity. Salt comes from three main sources: from the evaporation of irrigation water, from salt-bearing rock under the soil; and from the application of fertilizers. Most plants and crops –except salt-absorbing plants known as halophytes– do not grow well when salinity is present. If irrigation is not coupled with adequate drainage, the soil structure or a high water table may not allow water to carry salts down past the root zone. Where this salinity persists and is gradually being built up, as for example in southern Iraq, the formerly irrigated land reverts to not only desert, but desert caked with salt.

On the other hand, it should be pointed out that numerous technologies have been devised for preventing the build-up of salt on irrigated lands, or for developing plant varieties more tolerant to salts, but at the same time it must be said that no major breakthrough has been achieved. The most common method is still draining by flushing, but these often just pass on the problem to downstream farms.

It should also be noted that as the pressure on river irrigation systems has increased, the potential of underground water supplies as a means of mitigating aridity has attracted increasing attention. Satellite and other remote sensing techniques are helping to pinpoint these reservoirs and their drainage systems. Assuming the groundwater is sweet –and it should be remarked that some of Libya's underground reservoirs, for example, are four times as saline as sea water– use of ground water has several advantages over surface water. Principally, as long as the water table is deep enough to permit percolation of water into the ground, irrigation water with its accompanying salt burden is not passed from farmer to farmer downstream.

LIBYA'S UNDERGROUND RESERVES

Under the Kufra Desert area of southeastern Libya lies a 140,000 square kilometer sweet water reserve that could irrigate 400,000 hectares for 800 years. And Egypt, much of Sudan, Chad and Libya, are underlain by what are called the Nubian sandstone aquifers –one of the world's largest artesian basins. This aquifer is believed to contain some six million cubic meters of water– some of it fossil water laid down some 25,000 years ago. Libya, as are parts of the Western United States, is employing a technique called center-pivot irrigation as a way of tapping and exploiting underground water. This method involves linking wells in the aquifer to rotating sprinklers that can water fields over a kilometer in diameter.

Use of center-pivot irrigation compared to alluvial canals and ditches allows greater automated control over the amount of water applied, and enables the farmer to apply fertilizer and insecticide through the water delivery system as well. The drawbacks of pivot-irrigation systems, however, are its energy intensiveness and its drain on the aquifer. Libya, for instance, is reported to be finding an alarming and unforeseen drop in the water table that is being tapped for a 50,000 hectare irrigation program. And the diesel fuel consumed to power the pumps and rotate the pipes is roughly ten times that needed to till, plant and cultivate and harvest the average corn (maize) crop.

Of course, for an oil-rich country, the system's energy costs may not be a factor; in fuel-importing economies it is. Other problems related to the tapping of ground water is the fact that much of it tends to be concentrated in areas far away from densely populated regions, thus making large-scale exploitation somewhat uneconomical. However, Iraq is working on small irrigation schemes to provide water and small oases for bedouins, so they can grow their own food, and Saudi Arabia has also developed schemes to tap its huge supply of ground water for irrigation. Finally, a US-Egyptian joint project supported by the National Science Foundation is providing remote sensing data on ground water and drainage systems in Egypt, and neighboring countries are considering various forms of cooperation to utilise the expertise for similar projects.

GREENHOUSE TECHNOLOGY

Most of man's efforts to exploit the deserts have involved attempts to use technology to change the environment. The limit of such efforts is the enclosure of a space to permit the environment to be totally controlled. Basic to such technology is the greenhouse (built of air-inflated plastic or using a combination of fiber glass and plastic). Taking advantage of the sun, of seawater for evaporative cooling and irrigation (after distillation) and of protection from wind, sand blasting and insects, these facilities have produced more than twenty times the yield of open-field crops. Desert greenhouses require outside power from diesel engines for generators to maintain air pressure and circulation, and to pump water from the sea or the ground. But they require less water than open-field crop because of higher levels of humidity, concentrated planting, and the greater control over irrigation that is possible.

Because fruit matures more quickly in the greenhouse, several crops can be harvested annually. The tiny Middle East sheikhdom of Abu Dhabi has been harvesting almost a ton of vegetables a day from two hectares of controlled environment greenhouses on Sadiyat Island. Indeed, Abu Dhabi now no longer finds it necessary to

import many of the fruit and vegetables, that it once did. From the human standpoint, also, greenhouses may raise the social status and attractiveness of farm labor. In a situation like that of Abu Dhabi, where agriculture is typically at the bottom of the social structure, the amenities of modern technology make the work more appealing. Though the air in a greenhouse is more humid, it is cooler; the fruit is grown up off the ground and closer together, making it easier to harvest, and there are no rain, mud or bug problems either. Still, the greenhouse requires some highly skilled labor to manage the cooling, irrigation and other systems. It also requires reliable power. A breakdown can result in an increase in the inside temperatures up to 60 degrees Centigrade very quickly. Road networks and availability of spare parts are also crucial.

AGRICULTURAL EXPORTS FROM MIDDLE EAST

Thus, economic and social factors so far have limited desert green houses to advanced economies with well developed transport and market systems, or to isolated communities that do not have local or open-field

AGRICULTURAL DIFFICULTIES IN LIBYA

The situation in Libya with respect to the agricultural sector clearly demonstrates some of the problems that planners have had to face in their quest to make the desert bloom.

Dryfarming techniques are generally considered to require a rainfall of some 200 mm per year; otherwise irrigation must be used. Only along the coast does Libya have sufficient rainfall for this mode of farming to be practicable. Otherwise the state has had to rely on irrigation. Irrigation along the coastal plain depends on natural water reservoirs fed by the runoff from the mountain slopes, but during the 1960's the underground water table was also tapped to supplement the supply. This sudden increase in water meant that by the late 1960's irreversible damage had been done. The water table throughout the Jefara region began to fall at the rate of one meter per year. Government inaction allowed the uncontrolled exploitation of this resource to continue. By the 1970's the rate of the fall had moved up to five meters per year. Two years ago sea water contamination of irrigation reserves appeared as the water table in some areas fell below sea level.

It was not until 1978 that water conservation became a part of agricultural planning. But the damage had been done. Turning to another scheme, experts have noted that the much acclaimed Kufrah project has also run into difficulties. Great hopes were placed on this scheme, as well as considerable money –a $100 million capital outlay and some $30 million per year in running costs. But it ran into deep trouble almost from the beginning. The water table had fallen by 15 meters in the 100 wells supplying the project: 30 times the predicted rate of decline. The alfalfa crop required three times the planned irrigation rate for satisfactory growth, and fodder yields were still only half of that predicted. The collapse of the water table meant that the massive cost –$10,000 per hectare– of reclaiming the land could not guarantee agricultural viability. In 1975 it was decided not to expand the production project to the planned 50,000 hectares. Livestock there was also abandoned in favor of intensive irrigated cereal production. Even so, the results are still disappointing. In 1979 yields were as low as 2 tons per hectare, which was not much better than the yield for modernised coastal dry farming.

PROJECTS AT SARIR AND FEZZAN

In spite of these setbacks, however, other projects went ahead, as for example at Sarir and in the Fezzan, during the latter part of the 1970's. These projects were allocated $2.5 billion in the 1976-80 plan, almost double the allocation to all other agricultural projects. In the Fezzan American expertise was called in, and wheat yields of up to 5 tons per hectare have been recorded last year. It seems, therefore, that this project may come some way to approaching the planners expectations.

Although Libya's past experience in boosting agricultural production must be regarded as disappointing, the new Five Year Plan nonetheless stresses agriculture. This new plan still relies on massive investment and attention has been focussed on the coastal region, where it is hoped to reclaim more land. An additional 66,000 hectares are to be irrigated, mainly in the Jefara plain, and the Sirte region is to provide an additional 350,000 hectares for dry farming. Another 1.5 million hectares will be reclaimed for pasture.

The expected rise in agricultural growth is based on this reliance on coastal agriculture, but it is impossible for the depleted coastal aquifers to provide the water required. Two alternatives exist: desalination of sea water, or the provision of water from the fossil desert reserves. It is the latter option that seems to have been selected, although it is to be funded outside the new plan's provisions.

Two pipelines are to run from Sarir to provide water at Sirte and Ajedabiya for industry and agriculture. This development necessarily calls the future of the vast desert schemes into question. They were scarcely mentioned during the discussions of the new plan in January, and have in fact been downgraded because of their expense and poor return on the capital investment.

Clearly, Libya's experience shows that in spite of vast amounts of money, it is not always possible to make the desert bloom satisfactorily. Worse, one may do irreparable damage to the environment. Libya's needs for agricultural produce might best be served by importing rather than by pursuing the present goal of agricultural self-sufficiency.