



# Middle East Problem Paper

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Desalting Technology and a  
Palestine-Arab Economy

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Should the momentum of Arab-Israeli negotiations be sustained, the principal parts of a durable peace of the 25-year-old conflict may, in the coming year, finally begin to fall into place. If so, a crucial element in the final shaping of the peace, as well as its durability, will be the establishment of an adequate economic base for a Palestine-Arab community. A population of 2 million or more is involved; in a decade, with current population growth, this may approach 3 million, with a labor force of almost a million seeking productive employment.

Regardless of the final political form of the Israeli occupied territories of the West Bank and the Gaza enclave that could emerge from a successfully completed Arab-Israel negotiation process--whether a separate mini-state or in some federal relation to Jordan--it is important to recognize the present limitations of the area in relation to the economic needs of the Palestine-Arab community.

The Gaza-West Bank economy now supports a population of about 1 million--400,000 concentrated in the small Gaza strip and 600,000 in the much larger but still limited West Bank. Even with the substantial employment opportunities under the occupation offered by the Israel economy - of particular benefit to the

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Gaza population - the average standard of living is still miserably low. The annual per capita income in the Gaza is currently not much more than \$130; and that in the West Bank, \$200. Even these low incomes have only been realized because a substantial part of the population after the 1967 war fled to Jordan's East Bank, increasing the Palestinian population there from 400,000 to about 700,000--a good part in a precarious economic condition. Finally there are about 150,000-200,000 Palestinians who have long been in a refugee status in Syria; and an additional 150,000-200,000 in Lebanon. With peace and a new Palestinian homeland, a preponderant part of these two groups may opt to join their fellow Palestinians, thus compounding the problems posed by an inadequate economic Palestinian base.

An extraordinary international capital fund to underwrite Palestinian social and economic development over the next 10-15 years will undoubtedly be established as part of an Arab-Israeli peace settlement. Essential as such a fund will be, it can, at best, be expected to offset only part of present Palestinian inadequacies. The probability is that a critical portion of such a fund, over the next ten to fifteen years, would not find an outlet in economically productive projects whether in industry or agriculture and that while substantial economic growth would be achieved, it would still fall short of what was needed. Not lack of capital but lack of adequate investment opportunities may be the bottleneck that would prevent the creation of a base for a modern and prosperous Palestinian economy in the years

ahead. It is in this connection that modern desalting technology applied to a limited North Sinai coastal area adjoining the Gaza Strip as well as parts of the southern Gaza itself might make the crucial difference.

## II.

The coastal desert adjoining the Gaza Strip and extending westward toward El Arish, without access to usable water, has presently little economic value. However, in the context of a large scale development program based on desalination, this could be radically changed and could result in a valuable supplement to the Gaza and thus to Palestinian economic prospects. For this to be realized, Egypt, assuming it regains sovereignty over the Sinai, will have to be prepared to open up a limited stretch of this coastal land--about 50 miles in length and 20 miles in depth--to Palestinian settlement.

With proper planning and technical assistance, desalination of sea water could make this part of the desert a highly productive resource. An agriculture of high value products dominated by citrus cultivation could be developed exploiting the favorable climate. Towns and industries can be expected to grow in interaction with the high income agriculture. Over a ten-year period, a small but highly dynamic economy capable of supporting at a relatively high income level over 500,000 Palestinians is conceivable. In the succeeding decade this could easily expand to 1 million. Linked economically though not necessarily politically to the Gaza-West Bank-Jordan economies, where the predominant

part of the Palestinians are located, the dynamic effects of this new economic sector should result in stimulating growth of these areas. In sum, a combination of technology, capital and a strip of desert land could add a margin to an economic base for a Palestine-Arab community that might make the whole workable.

### III.

For illustrative purposes the dimensions and economic characteristics of a North Sinai agricultural economy using desalted water are outlined below.

The water system for the North Sinai could include 24 distillation units and associated power generating facilities. Each unit would be self contained and produce 25 million gallons daily (mgd), a water output capable of irrigating throughout the year 5,000 acres of citrus and other high value fruits and produce.

The desalting plants would incorporate recent advances in design that promise substantial reductions in cost. Major US companies are prepared to manufacture such units and guarantee their performance despite the fact that these will be the first of their kind to be in operation.

A combination of advanced technology and low cost energy (as discussed below) should produce water for agriculture at a cost of about 35¢/1000 gallons or \$115 an acre-foot. The water costs of growing an acre of citrus would be about \$500; other costs—capital, labor,

fertilizer, etc.--would raise total costs to about \$1300/acre.

Given the highly advantageous North Sinai site and the experience in Gaza with citrus it is not unreasonable to anticipate yields of 20 tons of fruit per acre. At \$130/ton, the prevailing farm gate price for picked and packed citrus for export, gross revenues of \$2600/acre could be realized. If yields or prices fell short by as much as 25 per cent, revenues of over \$1900/acre would still be earned.

With total costs, at full production, of \$1300/acre, the margin above costs would thus be in the range of \$600-\$1300/acre. This margin is so large that the program would be economically justifiable even if yields or prices proved to be substantially less than the lower limit indicated above.

A citrus orchard, properly maintained, has a lifetime of full production of about 50 years. If the North Sinai program is organized on the basis of owner-cultivator units of 5 acres per man, and if roughly half of a gross profit margin of \$1000/acre is allocated to central management and taxes to cover costs of essential government services--the remainder still would provide an income to the owner-cultivator of a 5 acre orchard and his family of about \$4000 a year by the tenth year of operation--\$1500 wage income and \$2500 profits. In contrast, annual income of a rural family unit in the occupied West Bank is less than \$1000.

Direct employment of owner-cultivators when the full 120,000 acres are in production would be about 25,000. Assuming on the average a family of five for each cultivator, a relatively prosperous income could be achievable for a population of 125,000.

The indirect employment and income effects generated by this new productive sector could be much greater. For every worker directly employed in the highly commercialized export oriented type of agriculture projected, an additional three might be employed in marketing and transportation, in citrus processing industries, in consumer goods production, and in government services.

The full desalting system with a capacity of 600 mgd and ancillary facilities should cost out in the range of \$500-\$600 million. The direct agricultural investment costs for the 120,000 acres would require an additional \$100 million. Total investment requirements for a ten-year desalting-agricultural program for the North Sinai should thus be between \$600-\$700 million, or an average of between \$60 and \$70 million a year.

Expanding business, services and infrastructure outside of agriculture would require additional capital, but a significant proportion of this might be privately financed once the market oriented agriculture opened up non-agricultural opportunities for private enterprise. In addition, agricultural profits would provide a source of savings that could be channeled to the non-agricul-

tural sectors and, as well, a taxable base to pay for government services.

The first phase of the program would be the most time consuming. The design, engineering and construction of the first pair of desalting units, and of the other facilities of the water system, will take at least four years before the system can be in operation. A comparable planning and organizational phase would be required on the agricultural side for the 10,000 acres that the initial pair of units would irrigate.

However, once the initial phase is successfully completed, additional pairs of units could be installed and additional land could be committed to cultivation in six-month intervals and the full 120,000 acre program could be in operation within ten years of the initiation of the program.

Thus, within a limited coastal desert area, the above analysis indicates that a Palestinian population comparable in size to that in the West Bank could establish itself and in a 10-12 year period develop an economy whose output would provide a per capita income at least four times that presently earned by the West Bank population.

#### IV.

A North Sinai project as proposed would be based on a highly energy-intensive evaporator-desalination technology. There are of course ample resources of energy fuel in the Middle East region and the problem



would be one not of adequate supplies but whether the oil or gas would be available at acceptable costs to the project.

Only a few years ago (1970) the market price of Persian Gulf oil was about \$2 per barrel. The price has risen since substantially and over the past six months has escalated to over \$7 per barrel. However, even \$2 per barrel oil would be equivalent to about 30¢ per 1000 gallons for just the fuel energy component of the cost of producing desalinated water and would push the total cost of desalted water to between 55¢ and 60¢ a thousand gallons as against the 35¢ per thousand gallons assumed in this analysis. Such costs could limit sharply the potential benefits of a North Sinai project. If oil to the project were priced at \$7 per barrel--the energy cost component in the cost of water would approximate \$1 per 1000 gallons and would eliminate the project on economic grounds.

There are, however, a number of ways that fuel energy costs could be brought within the compass of a feasible project.

The optimum solution would be a dual purpose water-power complex using as energy fuel natural gas produced in association with oil and burnt off ("flared") because it has no marketable outlet.

By coupling the production of electric power to the production of desalinated water through a joint use of steam energy, a more efficient use of this energy is

achieved than would be the case with separate desalting and power generating plants. In the case of large scale desalting and power units the economies of joint production could be substantial. In effect, these economies reflect the more efficient use of the energy fuel that feeds the system.

Using gas that would otherwise be "flared" results in another powerful downward thrust on the cost of fuel energy conversion to water and power. Even allowing for the cost of piping this gas a thousand miles from say Saudi Arabian oil fields to a North Sinai project, the cost of this energy fuel to the desalting power complex would be in the range of oil equivalent prices of 75¢ to \$1.25 a barrel.

The combined effect of the economies of joint production and low cost gas are so large that they could be shared between the power units and the desalting units and still result in cost of desalted water production in the 30¢ to 35¢ per 1000 gallon range; and the electric power produced could be sold to Arab countries in the region at a price substantially below the going market price for power.

Assuming a 600 mgd water producing capacity as projected for the North Sinai project, technical constraints require that the electric power generating capacity of the water-power plant be at least 1800 megawatts (MW) to realize a substantial part of the potential economies of joint production; and a capacity of 2200 MW would be closer to the optimum. If there

is rapid economic development in the region, growth in power requirements of Jordan, Lebanon and Syria in the period 1975-1985 could be on the order of 1200 MW; and growth in Egypt's power needs could be even larger-- in the range of 2000-2500 MW.

It is thus possible to conceive of a regional power grid emanating from a North Sinai water-power producing complex supplying an important part of the power requirement of all these countries over the next decade at exceptionally low cost and making thereby a significant contribution to their overall development.

As an alternative to gas, comparable results could be achieved if Arab oil producing countries as a group, or, Saudi Arabia with its huge oil reserves alone, were prepared to commit oil to the North Sinai project at a price comparable to what they may charge for their own domestic energy requirements. Such a price probably would fall within a range of \$2 and \$4 a barrel oil.

In view of the resources of oil and gas of the Arab countries one of these alternatives--or some combination of them--should provide the energy fuel at acceptable costs to a North Sinai desalting project.

This conclusion, moreover, does not necessarily depend on the concept of a dual purpose water-power technology. The economics of joint production would certainly, as indicated, increase the options and substantially increase the benefits that can be realized from the region's energy resources. However, if a dual

purpose technology, in part or whole, does not prove feasible for a North Sinai project, a single purpose desalting program, not coupled to large power production, would still be economically viable if the region's gas that would otherwise be "flared" could be tapped and thus provide exceptionally low cost energy fuel.

#### V.

In sum, desalting technology and development capital can provide the cutting edge of a new economic sector in the North Sinai that would measurably broaden the economic horizon of the Palestine-Arab community.

The desalting technology can be linked to large scale electric power generating facilities. The result would benefit not only a Palestine economy but the Arab region generally through the provision of low cost power for development. Arab oil or gas, essential to a North Sinai project, would then have wide ranging benefits for the Arab world. If the project could be based on natural gas that would otherwise be "flared," the benefits would be that much greater.

Despite these attractive possibilities, neither the technology nor large amounts of capital for development can be a substitute for the necessary political will to negotiate. But if political and security interests finally bring the parties to the Arab-Israeli conflict to the negotiating table to work out the conditions for peace, then the economics of a durable peace must get their due attention. If so, the kind of cooperation by all the interested parties that a successful application

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of desalting technology will require should be high on the agenda.

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Δ Jerome Fried was formerly a member of the Policy Planning Council, Department of State. Since leaving the State Department, Mr. Fried has done extensive research on the application of desalting technology to the Middle East. He is co-author, with M.C. Edlund, of A Concept for Development of the North Sinai (Virginia Polytechnic Institute) and Desalting Technology for Middle Eastern Agriculture: An Economic Case (Praeger).