The greening of Saudi Arabia — A cost / benefit analysis

Elie ElHajj examines Saudi Arabia's agricultural development and the challenges it poses to non-renewable water resources and future supplies

Arid conditions constrained food production and population growth in the Arabian peninsula over the centuries. In the early 1980s, however, Saudi investors were induced by substantial government subsidies to import the technology, the equipment, the seeds, the fertilisers, the engineers and the workers to turn the Saudi desert green.

Between 1980 and 1993, Saudi irrigated surface increased 262%, irrigation water use increased correspondingly by 262%, and cereals production increased 19 folds. Saudi Arabia became the world's sixth largest wheat exporter.

Starting in 1993, low crude oil prices, persistent budget deficits since the early 1980s, and the financial burden of the 1991 Gulf War led the government to scale down its wheat growing subsidy programme. Within four years, the cereal-growing surface dropped by 50%, cereal production dropped by 62%, and wheat production dropped by 71%.

The Saudi agricultural venture has been hailed in the national discourse as a spectacular achievement. However, no accounting of the true cost of this experiment in terms of money and water has ever been made. This article attempts to shed light on these issues.

Between 1984 and 2000 the estimated cost of the Saudi agricultural venture was over US$100 billion. While the cost of Saudi wheat averaged over US$500 per tonne, the international price for wheat averaged US$120 per tonne.

If money is not an issue, water should certainly be a concern. Between 1980 and 1999, 300 billion cubic metres of water were used, equivalent to six years' flow of the Nile into Egypt or an average of 15 billion cubic metres annually, equivalent to what Syria and Iraq together receive from the Euphrates waters annually.

Ground water

The story of Saudi agriculture goes back to the 1970s, when the government surveyed groundwater resources intensively. However, the volumes were considered too low. In the early 1980s, two new studies concluded that considerably more groundwater reserves existed than was previously estimated.

Two-thirds of the irrigation water in Saudi Arabia is thought to be sourced from non-renewable aquifers, according to the Ministry of Agriculture and Water (MAW). However, according to the Saudi Ministry of Planning (MOP), the non-renewable proportion is estimated at about 85%. It is believed that the non-renewable aquifers were formed 600 million years ago. Absence of technology or funding kept the aquifers undisturbed till the early 1980s.

At the high water extraction volumes of the 1990s, and as Saudi Arabia's population continues to grow, the non-renewable aquifers will eventually get depleted. As to when the day of reckoning might come, it is uncertain.

To predict such a date with confidence, accurate estimates of the non-renewable reserves, as well as reliable projections for water uses are needed, particularly in agriculture, which typically consumes some 90% of all water uses everywhere. In the absence of accurate data and at the risk of being wildly off the mark; using the differing estimates of water uses by MAW and MOP, in addition to making certain assumptions regarding water reserve volumes, Saudi non-renewable water reserves might last between two and three decades.

Irrespective of predictions, however, the reality today is disconcerting. In many regions natural springs have dried up. Seawater intrusion in areas of the Saudi East Coast has deteriorated water quality. Poor sanitary and drainage systems and the unmonitored use of inorganic fertilisers and pesticides have turned the water of most aquifers brackish.

Back in 2003, a wheat farmer in Qassim was reported in *The New York Times* as saying, "I've had to lower my pumps 100 metres in the past 10 years." His "4,000-foot-deep wells" produced water that was "increasingly mineral-laden." The Saudi Minister of Water recalled "flowing springs when I was a boy in the Eastern Province. Now all of these have dried up and you have to dig."

Water 'export'

High water use in Saudi agriculture continues unabated despite the drop since 1993 in the size of the irrigated surface and cereals production. While the latter dropped by 30% between 1993

Saudi population, land and water use and agricultural produce
for 1961, 1973, 1980, 1985 and the period 1990-2000

Year	Population —millions	Cereals		Vegetables		Fruits		Alfalfa		Meat excl fish (000 tonnes)	Milk (000 tonnes)	Waer use (billion cubic metres	Total land (000 hectares)
		Land (000 hectares)	Tonnes (000)	Land (000 hectares)	Tonnes (000)	Land (000 hectares)	Tonnes (000)	Land (000 hectares)	Tonnes (000)				
1961	4.2	NA	361	NA	216	NA	186	NA	360	38	97	N/A	343 a
1973	6.6	201	113	18	399	38	355	29	344	81	217	N/A	373 a
1980	9.6	455	267	53	756	72	470	29	388	74	349	7.472	609
1985	12.2	634	2,191	93	1,443	75	686	145	2,134	303	414	11.607	946
1990	15.4	978	4,138	109	1,900	91	804	201	2,106	404	516	16.513	1,379
1995	17.1	708	2,671	159	2,692	130	1,052	305	3,069	544	698	19.088	1,302
2000	20.4	620	2,168	91	1,926	193	1,189	217	3,262	643	1,039	N/A	1,120b

Sources: Population data and data marked (a) are from Food and Agriculture Organization of the United Nations Statistical Database. Data marked (b) are from Saudi Ministry on Planning's Statistical Yearbook, 2001: p. 511. The other data are from Ali bin Saad Altukhais (2002), Saudi Ministry of Agriculture and Water: tables 4, 5 and 6.

and 2000 the former dropped by only 7%. Also, in terms of per-hectare water use, while the average between 1990 and 1994 was 12,000 cubic metres, the average between 1995-1999 jumped by 25%, to 15,000 cubic metres.

This situation was due to growing more thirsty produce than cereals; namely, alfalfa, animals for meat, and fruits. Alfalfa needs six times the water required by wheat. Significantly, the shift was not for domestic consumption alone but also for exports. Exporting alfalfa was banned in 2000.

Foodstuffs are encapsulation of water. Foodstuffs are virtual water. In temperate environments, a tonne of wheat requires 1,000 tonnes of water to grow and a tonne of meat requires 16,000 tons of water. Under the searing desert sun, much more water is needed to grow the same produce.

To export foodstuffs is to export water. Saudi balance of trade suggests that Saudi Arabia shipped away in the form of live animals, meat products, fruits and vegetables between 1997 and 2001 the equivalent of 2.5 billion cubic metres of water each year, or 12.5 billion cubic metres for the period. If the water embedded in alfalfa exports were added, the water lost to exports might double.

To put 2.5 billion cubic metres of water in perspective, such a volume is sufficient to satisfy the drinking and household water needs of Saudi Arabia's 27-million population for an entire year. And, while the water used in agriculture is lost forever, some 70% of household water is typically returned as sewage, which could be treated for reuse. Thus, Saudi householders' net water use could be less than one billion cubic metres *per annum*.

It is therefore curious that at a time when most Saudi cities, Jeddah in particular, endure severe household water shortages, 18 billion cubic metres of water is being used in desert agriculture. Also curious is the fact that more than 80% of the household water needs of the ten largest Saudi urban centres is desalinated and piped to the inland cities of Qaseem and to Riyadh, hundreds of kilometres away, at a time when Qaseem and Riyadh regions are rich in groundwater, pumped for agriculture.

Food self-sufficiency

How realistic a goal is Saudi self-sufficiency in foodstuffs? Ostensibly, Saudi Arabia's emphasis on food independence is to enhance national security. How realistic a goal is such an objective?

To begin with, food independence in a country like Saudi Arabia is a flawed notion. A boycott of wheat and meat is not as critical to national security as a boycott of desalination equipment and spare parts, let alone the myriad of other critical Saudi imports.

Secondly, food independence in Saudi Arabia is impossible to sustain. Saudi renewable water sources are insufficient and its population growth is high. The Saudi population doubled between 1980 (10 millions) and 2000 (20 millions). "An individual needs about 1,000 cubic metres of water each year … to raise the food needs of that individual" (Allan, *IW&I,* 2001). Saudi Arabia's population of 27 million needs a minimum of 27 billion cubic metres of water in the form of domestically grown foodstuffs. Of such a volume Saudi Arabia provides agriculture with an estimated 18 billion cubic metres.

Saudi balance of trade shows that for each year between 1996 and 2001 the country imported an average of US$5 billion in foodstuffs. As population grows and affluence increases the proportion of meat in diet the ratio of Saudi food imports to total food needs would grow.

Conclusion

The Saudi agricultural venture is an example of unsustainable development. This venture merely shows that a combination of money and water can make even a desert bloom, until either the money or the water runs out.

An economist would argue that where the production of domestic foodstuffs falls short of the requirements, it is beneficial to fill the gap through food imports from abroad instead of investing in economically and environmentally unsustainable local desert farming.

This article is adapted from a PhD dissertation by Elie Elhadj, Experiments in Achieving Water and Food Self-Sufficiency in the Middle East, The Consequences of Contrasting Endowments, Ideologies, and Investment Policies in Saudi Arabia and Syria, *published in 2006. Details: http://www.dissertation.com/book.php?method=ISBN&book=1581122985*