The Modernization of Agriculture in the United Arab Emirates

Saif S. Saif

ABSTRACT

The United Arab Emirates (U.A.E.), with a population of 1.6 million is located in an arid landscape. That results in a scarcity of arable land and water. To understand the aims of the U.A.E. in adopting modern agricultural methods, current agricultural activity in the U.A.E. is examined. Also a background of traditional agricultural ways and tools are associated in order to comprehend the practices farmers must follow to secure their needs from their agricultural endeavors. This research focuses on the agricultural methods which have been promoted by the government. Modernization of agricultural methods has achieved higher production, and is related to oil revenues in the U.A.E.

KEY WORDS: United Arab Emirates, arid lands, desert agriculture, irrigation methods, agricultural economics.

The United Arab Emirates (U.A.E.), one of the Arabian Gulf countries with a commanding position on the Arabian Gulf, has reaped great revenues from the oil and gas discovered there in the early 1960s. Despite this wealth, this country’s location in an arid region results in a scarcity of arable land and water (Fig. 1). Most of the land is covered with a "desert" or immature soil which is not suitable for agriculture. Fortunately, with the revenues derived from oil exports and the establishment of the Ministry of Agriculture and Fisheries (M.A.F.), the country has begun a process of modernizing its agriculture to supply the demands of its increasing population and the need for agricultural production.

However, simply investing money does not necessarily mean a problem is resolved. A serious look must be taken at the government’s efforts to determine if it is succeeding and to answer certain questions. How efficient were the old or “primary” agricultural methods use of water? What have been the immediate consequences for agricultural production in view of the country’s rising population over the last three decades? With the government’s support and improved agricultural methods, have farmers
achieved higher production? Is the government satisfied with the production levels that have thus far been reached? Finally, what are the advantages and disadvantages of the new agricultural methods, and do farmers accept these methods?

To understand the aims of the U.A.E. in adopting modern agricultural methods, one must examine the current agricultural projects in the U.A.E., including a background of the traditional agricultural tools and techniques. This article focuses on the new agricultural methods which have been promoted by the government, and highlights how this modernization of agricultural tools and techniques have resulted in an overall higher and more self-sufficient production.

TRADITIONAL AGRICULTURE

In the U.A.E., traditional agricultural methods are those which employ simple means of farming and which depend on primary tools and equipment (Fig. 2). Usually, people apply their own labor as well as animal power to farm the land. Although this manner of farming began in ancient times, many of the same tools and methods of irrigation are still in use alongside modern applications. The traditional tools utilized include the ox-drawn plow, the meshah (harrow), and the mahhash (trowel) for tilling the soil, the das, and miyaz (sickles), the minsharah (saw), and the khaseen (axe) for cutting and the methrab (wood stick) and ittelah (iron rod) for digging holes in the ground. These simple tools are hand-made and are the result of the limited technology and natural resources of the area.

Since there are neither rivers nor lakes within the territory of the U.A.E., most of the water obtained for agricultural purposes is derived primarily from underground sources. Four major water sources at the disposal of the inhabitants are available: springs, rainfall, wells, and, aflaj. The aflaj is an underground
canal which allows water to flow from high elevations down gently sloping tunnels to the farms. There are approximately 140 aflaj and springs in the U.A.E. Included are continuous flowing aflaj which operate year-round and a shallow water which aflaj carries water only in the rainy season.

By using their simple tools and the water which is available, cultivators have been able to consolidate their material as well as their nutritional needs. This simplicity has also been applied to various ways of bringing water to the surface from wells for irrigation. One of the oldest ways to bring water up from a well is al-Yazerah (Fig. 3) in which oxen and/or donkeys are teamed up to haul a pail up from the well. A second method, al-Manzefah or Shadoof, employs "loads" and "levers" to bring containers of water to the surface.

Equally as influential on the lives of farmers in the U.A.E., are the types of crops which can be grown given the climatic conditions and resources. In the past, agricultural areas were limited in the U.A.E., and where they existed, they were primarily geared towards date-palm cultivation, the country's main crop (Fig. 4). This reliance on the date palm stemmed primarily from the fact little else could be grown and that it provided a source of food and raw materials where both were scarce. Other crops include: tobacco grown for both local consumption and export; cereals, cultivated in al-Ain and its suburbs during the winter when aflaj water is plentiful; alfalfa, grown as fodder for camels and other livestock; and other vegetables and fruits, produced wherever enough water was available.

PRESENT WATER/LAND MANAGEMENT

Many of the sources utilized for the preparation of this article indicated that there were no problems related to obtaining water for irrigating crops in the past. This stems from many facts. First, the U.A.E.'s population was low, which
Figure 3. Al-Yezerah a traditional well system.

Figure 4. Palm tree plantation in U.A.E.
There are no automatic calls for less demand for irrigation. Second, agriculture was second in economic importance to pearl diving; thus, irrigation and water-securing systems were well developed. Third, agriculture in the U.A.E. does not consume a lot of underground water, which is the result of utilizing primary irrigation systems and there being only a limited amount of farmland. Finally, the types of crops, vegetables, and fruits have been cultivated require modest quantities of water.

Despite past self-sufficiency in terms of water acquisition for farming, the current situation is changing quickly. As mentioned earlier, the population of the U.A.E. lives in an arid climatic region which is more than 80 percent desert and has a limited number of water sources. There are no perennial rivers and precipitation is only about 4.3 inches annually. The problems worsened with the growth of cities which increase the number of inhabitants and create a heavy demand for water. Unorganized or wasteful water consumption in agriculture, housing, and industry are other drains on this limited resource.

There are presently three sources of water in the U.A.E.: rain, ground water, and distilled water from the sea. From the average annual precipitation which the U.A.E. receives, 72 percent is lost to evaporation, 14 percent goes directly into the sea, and the remaining 14 percent goes into the ground water table. Since precipitation is very low, there is an annual shortage of 355 million cubic meters of water which must be obtained from subsurface sources (Ministry of Agriculture and Fisheries 1981). This affects the water table, causing a scarcity of water, dry wells, and hardships for farmers. This shortfall has encouraged the government to start upgrading irrigation and agricultural systems. In 1985, about 3,900 of the central region’s plantations were affected by water shortage problems.

In an effort to solve this as well as other problems facing farmers in the U.A.E., the government established the M.A.F. to redirect the nation’s agricultural resources. For ease of administration, the M.A.F. has divided the country into four major regions: south, central, north, and east. This division has provided better services to farmers as well as saving time when it comes to growing and harvesting their crops. The location of each region was chosen to include area farmers and to contain many agricultural areas. Each region has its own management and director. Besides this basic division, the regions are divided into smaller departments centered in a city which provides necessary equipment and support.

**FARM MANAGEMENT POLICY**

Government policies favor the distribution of agricultural land among the people free of charge so as to encourage higher yields of crops, better management, and increasing productivity. As a result of these policies, three types of farmers have been created: farmers by vocation, people who farm as a secondary occupation, and "hobbyist" farmers. The M.A.F. provides farmers with a variety of services and materials. If it were not for this free assistance, many farmers could not derive as many benefits from their land.

In addition to digging wells for farmers at the government's expense, the M.A.F. also provides loans for farmers so that labor can be hired, farms can be put on a sounder financial basis, and equipment and tools can be purchased. In 1982 government loans had risen. However these were reduced in 1983 due to drop in oil revenues and to a new policy of the M.A.F. to reduce the dependency of farmers on government support. Nevertheless, the government did designate funds for agricultural loans, for seed and fertilizer subsidies, and for tractors and related agricultural equipment.

Plowing is an important procedure in any agricultural area, and in the U.A.E., it is a service provided by the government. At present, the M.A.F. owns 173 tractors. In 1986, these machines worked an estimated 73,900 hours to cultivate 294,424 dunam (73,606 acres) (Ministry of Agriculture and Fisheries 1986). The
M.A.F. moreover provides seeds and chemicals to farmers at half price.

Finally, the government gives farmers free engines and will help to install and maintain these in order to offset high service costs due to a shortage of qualified mechanics.

IRRIGATING METHODS

Modern irrigation, in terms of what is being initiated and supported by the M.A.F., refers to providing sufficient water moisture requirements of crops. The older irrigation systems are unable to provide this under the current scarce water conditions of the region, and with the increasing demands for higher agricultural production, farmers have begun to replace the older systems with new, more efficient systems. The more modern irrigation methods include tank, bubbler, sprinkler, and drip irrigation.

The tank method requires a concrete storage tank for the collection of water after it has been pumped from underground. The farmer then irrigates his crops by either flooding the furrows or conveying water from the tank down mud- or concrete-lined canals. Although this latter method reduces loss through penetration into the ground, both means lose great quantities of water through evaporation due to the aridity. This type of irrigation for example consumes approximately 45,000 cubic meters of water per 2.47 acres per year, and it is estimated that 75 percent of this is lost (Anonymous 1983). Night irrigation occurs in some areas to reduce water loss through evaporation, but this is not practiced widely.

The bubbler method is new to the U.A.E. and is employed primarily to irrigate trees, especially fruit trees like mangoes. This system is estimated to consume only 19,000 cubic meters of water per 2.47 acre per year; a considerable saving compared to the tank system.

Sprinkler systems have been introduced on some of the U.A.E.'s larger farms in recent years. After experiments had been conducted at U.A.E. trial stations, farmers began implementing the system for irrigating crops such as wheat and melons. It consumes approximately 15,000 cubic meters of water per 2.47 acres a year.

The drip system of irrigation is common on U.A.E. farms and is encouraged by the M.A.F. It is particularly suited for irrigating vegetables like tomatoes and cucumbers and has its best applications in greenhouses. This method receives its name from how it irrigates plants; by dripping 2 to 20 liters of water per hour.

In 1983 the number of farms in the U.A.E. had reached 13,590, and of these, 911 farms used modern irrigation systems (Table 1). During 1984, there were only 677 farms under the direction of the M.A.F. In the al-Ain region for example, 1,101 farms were using drip or sprinkler irrigation (Emirate of Abu Dhabi 1985). By 1985, there were, 16,836 farms in the U.A.E., 1,778 of them using modern irrigation systems. These figures indicate 10.6 percent of all farms in the U.A.E. are using some type of modern irrigation. The task of meeting the costs of running such modern irrigation systems in the U.A.E. is formidable for most farmers, especially for those having a lower income. Thus, high expenses have promoted the M.A.F. to subsidize farmers by paying 50 percent of their irrigation costs.

Despite the high operating costs, the benefits which farmers reap from modern irrigation systems are numerous. The first among these are savings in water consumption. Experiments by the M.A.F. have found that citrus and fruit trees can grow to maturity using a bubbler system with a 25 percent saving in water when compared to normal irrigation methods. In the case of vegetables irrigated via the drip system, a 45 percent savings in water over normal irrigation methods was realized. This water efficiency was accompanied by an 87 percent reduction in labor, and vegetable yields increased by 193 percent (Najar 1984). In terms of productivity, watermelon production per 0.25 acre has increased—from 2.5 tons to 5 tons, and eggplant production increased from 2.45 tons to 4 tons per 0.25 acre.

The real merits of using the new irrigation systems can be divided into two
### TABLE 1

Number of farms using modern irrigation in the U.A.E. in 1983.

<table>
<thead>
<tr>
<th>Regions</th>
<th>Area of Farms Using Modern Irrigation (in dunam)</th>
<th>Number of Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sprinkler Bubbler Drip Total</td>
<td></td>
</tr>
<tr>
<td>West Abu Dhabi</td>
<td>--- --- 3,094</td>
<td>201</td>
</tr>
<tr>
<td>Southern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Abu Dhabi</td>
<td>21,000 --- 10,802 31,802</td>
<td>507</td>
</tr>
<tr>
<td>Central</td>
<td>765 2,121 904 3,790</td>
<td>134</td>
</tr>
<tr>
<td>Northern</td>
<td>2,480 351 490 3,321</td>
<td>40</td>
</tr>
<tr>
<td>Eastern</td>
<td>67 897 155 1,119</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>24,312 3,369 15,445 43,126</td>
<td>911</td>
</tr>
</tbody>
</table>


**NOTE:** One dunam equals 0.25 acre.

categories of benefits. The first of these, the short-range benefits, are realized by farmers as to how quickly they receive a return on their investment. Not only do farmers require less water to raise crops, which in turn reduces fuel costs for pumping, the farm also requires less labor to run. The quantity of fertilizer used is reduced since it can be mixed directly into the irrigation water where it will go directly to the crops instead of being spread in place where it is wasted. The second group of benefits is seen over the longer term and is of importance to the government and to the country in general. The entire country's water needs
DEVELOPING TECHNOLOGIES

Many future technologies are being formulated for the reduction of water consumption in irrigation. These experiments, for the most part conducted in al-Ain, are not only commissioned by the M.A.F. but also by private enterprise and universities. Examples are a distillation plant in Zekher which processes approximately 6 million gallons of sewage per day for uses in agricultural irrigation, and a U.S. experiment to irrigate wheat using sea water in Kalba city.

Other activities undertaken by the M.A.F. to develop new farming techniques for the country have come in the form of experimental farms. The number of experimental farms has increased in the last three decades.

Today, more than 15 agricultural trial stations have been established in the U.A.E. Included is the Saadiyat Island Project and the Kalba Experiment Station (al-Khabeer). The latter of these stations, located four miles south of Kalba city, is a new modern sea water farm project. This interesting project was established on one acre of land and is being used to grow halophytes. Recently, a new company, the Kalba Agricultural Company, has been incorporated as an equal partnership between Mr. Wood Prince and H. H. Dr. Sheikh Sultan bin Mohamed al-Qasimi, the ruler of Sharjah. It is their ambition to establish agriculture on the whole east coast of the U.A.E. by setting up new farms that are managed by local farmers.

The halophytes are grown for two purposes. First, they can be used as fodder for livestock after removing the salt. Second, the plant produces an oil which can be used for cooking. Montague Keen (1985) states: "The oil comprises around 30% of the seed weight and is of high quality, essentially identical to safflower." The project goal is to encourage the local population to utilize the available resources in order to create an income base using these modern agricultural techniques.

The government of the U.A.E. has also established typical farms throughout the country as to demonstrate less technical intensive ways of growing food. Such farms are found in Zayed Town, Abu Dhahi, and at Dibba. To meet the country's livestock fodder requirements and to encourage farmers to raise livestock, the M.A.F. is currently involved in six feed-growing schemes in the al-Ain region. Simultaneously, the M.A.F. is concentrating on additional wheat schemes in the same area (al-Oha, Seh al-Guraba, and Seh al-Miah). Finally, to improve the soil and render the land more fertile by counteracting further erosion, 8 afforestation projects are being supervised by the M.A.F.

MARKETING OF PRODUCE

With or without the aid of the M.A.F., in one form or the other, the moment of truth comes when the farmer brings his produce to the market. In developed countries, the farmer usually has someone to handle his produce so that he can manage the farm. In the U.A.E., however, the farmer not only manages the farm but also markets the produce. For example, after a farmer in Kalba city on the northeast coast of the U.A.E. has spent more than three months growing his crop of tomatoes, he then must drive 87 miles to Dubai City to sell his produce or possibly to Abu Dhabi some 156 miles away. The final result is that he must spend between two and five months in this situation before he can cash in on his crops, and when a surplus occurs in these vegetables, it directly affects the farmer's ability to grow vegetables the next year.

The problem begins in the winter when the market is glutted with produce. This forces farmers to sell a box of tomatoes weighing 10 kilograms (22 lbs.) for one dirham ($0.27). In some cases, the farmers cannot find a retailer to buy his produce. When farmers are unable to store the vegetables or fruit, they destroy it by either burning or burying it, thinking that it costs them less than trying to collect and market it.

Another problem facing farmers is in exportation because a great many obstacles stand in their way. First, the U.A.E.
is not a member of the Arabic Tranzat Agreement, which means that those wishing to export must pay export taxes on produce sent to countries such as Syria and Lebanon. Second, the quality of vegetables grown in the U.A.E. is not as high as in other countries because of the poor soil. Third, since there is no agency to pack the produce to be exported, the exporter must repack the vegetables they have bought from the farmer in a safer and more attractive way.

To solve this problem, the M.A.F. advised farmers to diversify their production, especially when it came to products like tomatoes, eggplant, okra, and cucumbers. Without realizing it, most farmers would grow the same kind of vegetables as their neighbour because of the good price they heard their neighbour received. As a result, every farmer grows the same vegetables at the same time, causing production to increase and prices to drop.

The manufacturing of surplus produce is another area in which the M.A.F. has lent support resulting in advances which benefit agriculture. As in other countries, canning or packaging surplus produce is a solution. In the Abu samrah region of al-Ain, there is a factory which packs vegetables. This factory cost D. H. 30 million ($8.15 million) to build and produces 27 tons of packed vegetables daily. This production is to increase by 30 percent yearly.

There are however, some problems facing this type of manufacturing in the U.A.E. First, the packing of some vegetables is not continuous. Vegetables are only grown from two to five months, meaning that for the rest of the year, there will be insufficient produce for processing. This seasonal problem can be solved by storing large quantities of vegetables so they can be packed during the summer or by reducing the factory’s labor force during the summer. The second problem is that the major vegetables to be used in this factory, such as tomatoes, are not as easily packed because they are soft and sometimes the skin color of the vegetable is not the same as the color of the flesh.

GREEN HOUSE AGRICULTURE

Another means of resolving the problem of canned produce is by growing selected crops in greenhouses. Greenhouse agriculture, also called “covered agriculture,” is a method which protects seasonal crops from either off-season weather conditions or from seasonal temperature extremes (Fig. 5). One example of this would be growing warm-season crops like the negra bean, cucumbers, and chili in a greenhouse during the summer by providing them protection (in the form of shade and lower temperatures) against the summer heat. Generally, these greenhouse keep temperatures low (77°F) and reduce the humidity inside to provide suitable growing conditions for the vegetables. Through development and support from the government, the number of greenhouse in the U.A.E. has risen to 1,039 extending over an area of about 426 dunam (106.5 acres).

Of the many types of greenhouses currently available in the U.A.E., the three types most commonly employed are normal greenhouses, used during the winter; cooled greenhouses, used in the summer; and tunnel greenhouses, used in both summer and winter. The normal greenhouse, which is the same as those commonly found in other countries, has the advantage of giving substantial protection against rain and harmful cold. Cooled greenhouses are used in the summer when the air and soil are hot. Exhaust fans remove hot air from inside the house which is replaced by air cooled while passing over cold water. These have the advantage of reduced interior temperatures and controlled humidity for better growing conditions. Tunnel greenhouses are constructed of movable tunnels which can be placed anywhere in a field and then relocated later. These have the advantage of lower costs ($1,622 or D.H. 6,000 per dunam) and of being relocatable. Greenhouse agriculture utilizing the drip irrigation method has more advantages for soil and water resources. It also requires less fertilizer and less labor while increasing yields.
However, as with any plan or technology, there are always some disadvantages. One such problem is that repeated cultivation of one kind of crop in the same place for many seasons causes soil diseases. Another problem is the initial high cost of production in cooled greenhouses. Finally, greenhouse agriculture in general requires highly skilled management concepts.

Water desalinization stations have been built in most of the U.A.E. and fresh water produced presently covers increased needs. Water consumption however, is still increased, irrigation continues without a fixed system, and some individuals show an extravagant use of water. Eventually, some parts of the U.A.E. may not have enough water to cover their future needs.

Through the work of the M.A.F., new irrigation farming techniques providing modern methods of farming which conserve water as well as labor have been introduced into the U.A.E. In some areas it will take time for the M.A.F. to reach these farmers and get them accustomed to the new agricultural methods. Fortunately, modernization of agriculture is not only a government aim since most
farmers wish to achieve higher production and receive more benefits from their farm holdings.

Although the M.A.F. does its best to discover ways of achieving better production, a variety of problems must still be taken into consideration such as the U.A.E.'s topography, soil, and cultural traditions. Despite these, in a few years, the new agricultural methods will be in common practice in a major part of the agricultural regions of the U.A.E..

CONCLUSION

The U.A.E. has 1.6 million people living in the desert with limited water resources. For them, each drop of water is literally counted. With an increasing population, there is a growing need for food and water. The government has been trying to decrease water consumption in any way possible. Agriculture consumes vast amounts of water, and the government tries to minimize this by utilizing modern systems of irrigation. Since the old ways of irrigation have caused the land to be void of trees for some period, the government has had to spend more money to acquire more water to protect the land and vegetation. All the while, the U.A.E.'s pressing need for water grows.

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