iied

Drylands Programme

Issues Paper no. 65

Agricultural Development in Kuwait: Prospects and solutions for improving production and reducing land degradation

Samira A.S. Omar
Tareq Madouh
Sarah Al-Sayed Omar

December 1996

Agricultural Development in Kuwait: Prospects and solutions for improving production and reducing land degradation

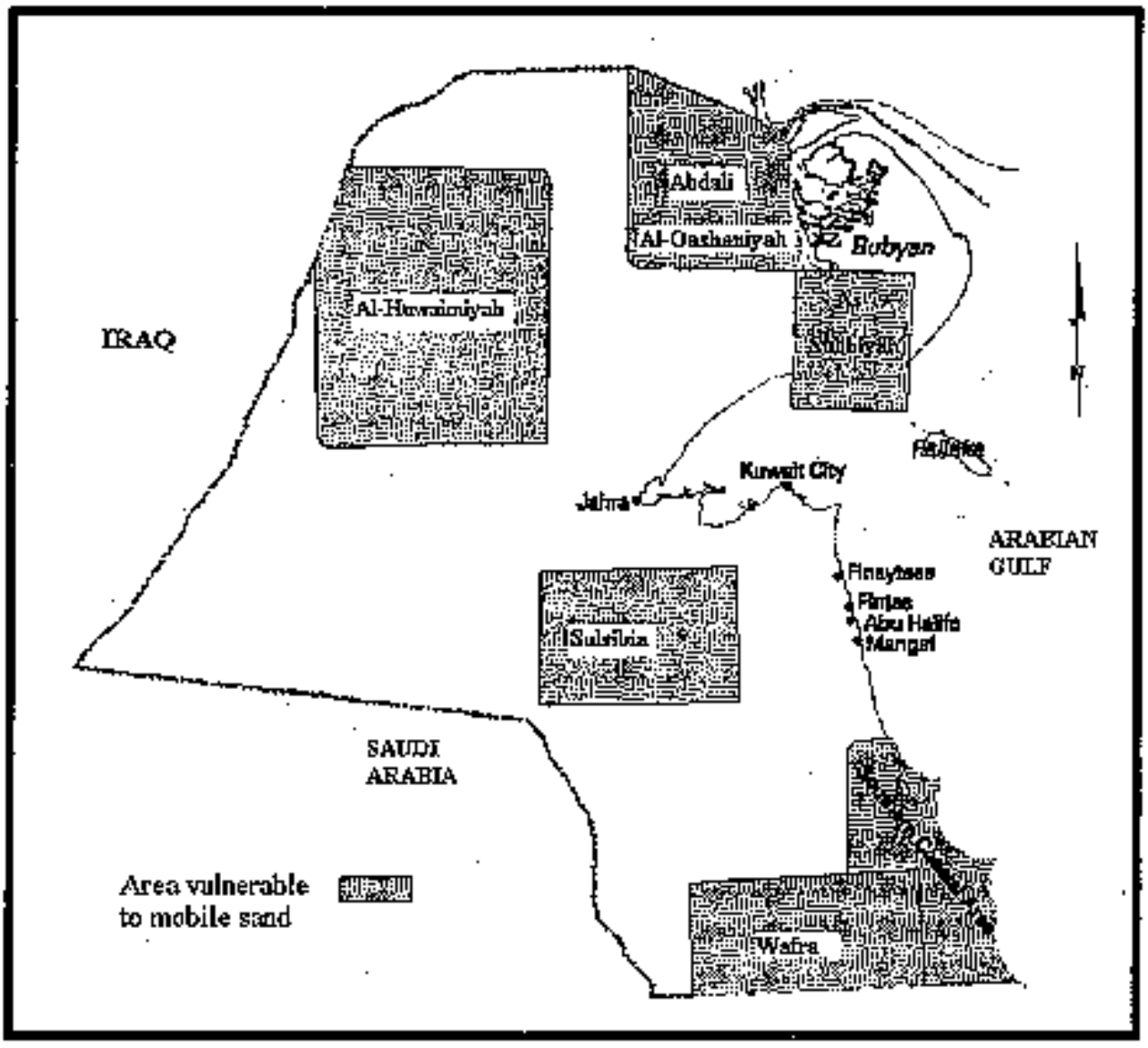
Samira A. S. Omar, Tareq Madouh and
Sarah Al-Sayed Omar

Dr Samira Omar works for the Kuwait Institute for Scientific Research as a research scientist in the Aridland Agriculture Department. Since she joined the institute in 1973, she has developed numerous projects related to arid land agriculture, range management, soil and land-use assessment, resource conservation and environmental policies. At present, she is the project leader of a soil survey carried out for the state of Kuwait. Sara A. S. Omar works at the Ministry of Electricity where she is responsible for preparing technical studies on management of underground water and for supervising the development of wells. Mr Tareq Madouh is involved in the Greenery Development and Environmental Enhancement of Kuwait in the same institute as Dr Samira Omar.

Contact address: Dr Samira Omar, Kuwait Institute for Scientific Research, Aridland Agriculture Department, PO Box: 24885, 13109 Safat, Kuwait. Tel/Fax: +965 4834 198.

CONTENTS

Figure 1 - Map of Kuwait



Scale: 1:93000

ABSTRACT

Agricultural production in Kuwait faces formidable obstacles, as the environment is harsh with high temperatures, hot winds and periodic sandstorms. The annual rainfall cannot sustain dryland farming and the main source of irrigation water is groundwater with salinity that varies from 3000-9000 ppm. The supply of irrigation brackish water is declining due to improper irrigation methods applied by farmers. Moreover, many agricultural areas are affected by sand encroachment resulting in low crop yields and high production costs. The invasion of Kuwait in 1990 caused the destruction of much agricultural infrastructure and accelerated the process of desertification. Agriculture in Kuwait is currently at a crossroads. Full recovery will not be achieved unless some hard decisions are taken by the private sector and the government. A strategy is needed to address a number of key issues to:

- create reasonable level of food-self sufficiency in selected commodities,
- resolve the current land tenure problems,
- increase productivity of horticulture and livestock,
- improve marketing system,
- optimise use of water,
- rationalise subsidies,
- strengthen infrastructure of research institutions,
- apply advanced technology,
- develop education and extension opportunities.

This paper presents an overview of agriculture in Kuwait and suggests remedies for proper use of resources to improve agricultural production.

INTRODUCTION

Kuwait imports over 93% of its food supplies which absorbs a large share of the earnings received from the country's major export - petroleum. Food demand continues to increase as a consequence of the increase in Kuwait's population from 467,339 in 1965 to 2,132,971 in 1990[1].

The ability of plants to survive in Kuwait is low because the climate is harsh, rainfall is extremely limiting (annual average of 105 mm), and water for irrigation is highly brackish (3,000->9,000 ppm TDS [2]). Prior to the invasion in August 1990, local production of plants and animals fulfilled the following percentages of Kuwait's needs: 20% of certain vegetables, 3% of animal feed, 6% of sheep meat, 1% of beef and veal, 30% of milk products, and 50% of poultry (broilers and eggs). The area under agriculture had increased from 2482 ha in 1983 to 4727 ha in 1987, mainly in the coastal areas such as Jahra, Fintas, Finaytees, Mangaf, Abu Halifa and Failaka (Fig. 1) and more recently in Wafra, Abdali, Sulaybia and Sabaheya.

Crops are grown not only in open fields, but also in protected environments such as greenhouses. Animals are produced in intensive units, e.g. poultry farms in Shagaya, as well as in "experimental" intensive lots and on trial holding units. Coastal fisheries are limited. Marine fish and shellfish are heavily exploited in areas where fishing is permitted (3 miles off shore).

Most greenhouse and protected crops are irrigated by drip systems, using fresh water from ground water or desalinisation plants. High temperatures are controlled by cooling pads and fans, but sand and dust accumulate on cooling pads, and thereby reduce their efficiency. Crops in open fields are irrigated with brackish water and exposed to sand accumulation. Both sand encroachment and dust storms constitute a

[1] This figure decreased sharply during the occupation and war of liberation but has now (1994) grown back to about 1.5 million.
[2] TDS: Total Disolved Salts.

major hindrance to agricultural development and rank only second to shortage of water.

This paper presents an analysis of agricultural constraints, evaluates future prospects and suggests opportunities and measures to improve agricultural development in Kuwait.

WATER RESOURCES

The available water resources of Kuwait are limited and constitute a severe constraint not only for agricultural production but also for other beneficial uses including watering of municipal gardens. Water in Kuwait comes from desalinated sea water, underground water, recycled industrial and municipal waste water and treated industrial waste water.

Fresh water is mainly produced through desalination plants (about 95%), and the remainder from groundwater aquifers. Due to the limited capacity of reservoirs, water consumption is more or less equivalent to water produced through desalination plants. Desalinated sea water blended with brackish underground water is used primarily for domestic purposes.

Ground water is found in the Dammam Kuwait Group and Upper Kuwait limestone layers. Salinity is in order of 4000 mg/l (Abusada, 1988). For the last few decades, water supplies have been intensively explored and exploited both in the Kuwait Group and the Dammam formation. Natural recharge coming through the saturated aquifers originated in Saudi Arabia is estimated to be in the range of 15-20 mg/d (Al-Sayed et al., 1981) whereas approximately 60 mg/d of ground water are used in the major agricultural areas, Wafra and Abdali (Akbar & Puskas, 1992). Brackish water, mixed with distilled water is currently used for cattle rearing, dairy farms, landscaping, households, greenery and agricultural production. Ground water aquifers, mainly from the Kuwait Group, are deteriorating in agricultural areas due to over exploitation and improper irrigation techniques. The water quantity has fallen to less than half and levels of salinity risen from less than 4000 to over 9000 ppm. Unless a rational plan is adopted by the government and improvements made to

irrigation techniques, farmers will have to consider alternative sources of fresh water to irrigate their crops (e.g. desalinated sea water).

Recycled or treated industrial and municipal waste water are another source of available water. Three treatment plants have been developed to treat municipal water at Ardiya, Rekka and Jahra (Fig. 1). The average daily flow rate being treated at the Ardiya plant is about 32 mg/d, at the Rekka plant, 11 mg/d and at the Jahra plant, about 7 mg/d. Approximately 7 mg/d treated effluent from the Rekka plant is presently being used to irrigate plants along the motor ways in the Fintas and Jahra farm areas to provide greenery to the landscape (Hussain, 1993).
Treated industrial waste waters are another important source of water in Kuwait which comes principally from the Shuaiba Industrial Area (SIA). Treated municipal waste water is one of the best sources of water for afforestation and greenery projects because the salinity is relatively low (1300-2400 ppm TDS), and the water contains both organic and inorganic material with some nutrient value. Data from 1989-90 show that treated municipal and industrial waste water available for afforestation and greening of Kuwait represent about 18% of the total supply (Robert et al., 1982).

LAND USE PATTERN IN AGRICULTURAL AREAS

In Kuwait, non-urban lands are owned by the government. Agricultural lands can be leased to users for 25 years at a nominal rent provided no less than 50% of the land is used for cultivation. The majority of the Kuwaiti people who practise farming are city dwellers who engage in farming as a challenge for personal satisfaction and even as a hobby. There are very few Kuwaiti labourers who actually work on farms.

The land use pattern for three agricultural areas in Kuwait - Abdali, Sulaybia and Wafra - are presented in Table 1. The information summarised in the table is based on recent (1992) aerial photo interpretation. Nine major land use classes were identified: central pivot, basin cultivated land, furrow cultivated land, plastic tunnels, greenhouses, orchards, fallow land, afforestation, and rangelands. Lands that are transitional between and among farms are also presented in Table 1.

Table 1: Land use pattern in three agricultural areas in Kuwait

Land Use (ha)	Abdali	Sulaibya	Wafra	Total
Central/lateral pivot	13	3194	8	3215
Basin cultivated	7565	88	2767	10421
Furrow cultivated	4203	192	1107	5502
Plastic tunnels	1008	13	393	1416
Greenhouse land	107	1386	134	1628
Orchards	83	733	130	946
Fallow (uncultivated)	6609	710	1697	9016
Farmland covered with mobile sand	NA	NA	770	770
Total agricultural land	19588	6316	7009	32914
Transitional	3679	NA	2361	6039
Rangelands	8233	34113	NA	42346
Afforestation	-	2477	-	2477
Other uses	-	13094	-	13094
Total Area	31500	56000	9370	96870

The total agricultural area in Kuwait is 32,914 ha, out of which 9,016 ha is uncultivated. Mobile sand covers most non-cultivated areas, rangelands and transitional lands. Results of the aerial photo interpretation indicated an expansion of the agricultural area since 1987. The total productive agricultural area in Kuwait was 23,898 ha in 1992 whereas it was only 4,727 ha in 1987. The land-use assessment conducted in this study reveals that a large share of agricultural land is still uncultivated by farmers. There is thus a need to improve land-use patterns and maximise the productive potential of non-cultivated lands.

CREEPING SAND IN AGRICULTURAL AREAS

Most of the agricultural areas in Kuwait are located downwind from the mobile sand belt and are therefore affected by wind-driven sand. This can contribute to desert encroachment whereby reclaimed agricultural areas become covered by sand. It also

has an impact on soil characteristics because the wind deflates the fine material within the soil and therefore alters its sand constituents. Huge quantities of sand accumulate on fences commonly used by farmers to protect their farms from sand encroachment. Sand also creeps onto roads leading to farming areas particularly in Wafra. Continual dredging of the accumulated sand is required especially during the summer, resulting in an increase in the costs associated with agricultural production.

All agricultural areas in Kuwait are subjected to sand transport and accumulation. An aerial photo of the south-western portion of Wafra agricultural area showed mobile sand encroachment on farms that originated from the Al-Huwaimlyah belt and stretching in a NW-SE direction for about 170 km, its width ranging from 20-50 km (Fig. 1). Similarly, Al-Sulaibya area (south of Kuwait Bay) which is covered with smooth sand sheet deposits, is also vulnerable to sand encroachment threatening farms, water fields, oil fields, range research stations and others. The accumulation of sand can be clearly observed around constructions, on the roads and inside farms. A similar situation is found to the north, in the Abdali agricultural area, which lies within the Burchan sand dunes (Fig. 1).

MEASURES TO HALT SAND ENCROACHMENT ON AGRICULTURAL AREAS

The methods used to stabilise sand dunes in agricultural areas vary in nature, function, durability, efficiency and constraints. Testing and application of these techniques meet with varying degrees of success as a result of technical and/or environmental factors. The choice of a particular technique is dependent on the prevailing environmental factors, goals to be achieved and technical as well as economic feasibility.

Mechanical methods are the most commonly used techniques to control sand encroachment in agricultural areas. They are based on the principle that placing an obstacle in the way of blowing sand will influence the lines of flow and reduce the wind speed. A fence or some other obstacle such as a soil ridge causes turbulence and reduction in wind speed, leading to the deposition of sand. Mechanical techniques to combat mobile sand, fix sand dunes and protect installations have been based on construction of fences made of corrugated non porous materials locally

known as "Chinko". The efficiency of these fences is determined by their location and orientation. At Sulaybia Field Station research site several impounding fences have been constructed and proved successful in depositing the sand within the area of the fence itself. However, some of the fences were constructed close to rare plant colonies, such *Gynandriris sisyrinchium* in Sulaibya, and sand has covered the plants and altered species composition. It is essential to evaluate the ecosystem components of an area before building up fences, if losses in biodiversity are to be reduced.

Palm reed fences with a checkerboard pattern are another successful mechanical technique commonly used in agricultural areas such as Wafra and Abdali. Mechanical fences proved to be viable but maintenance is continuously required. Impounding fences for example, have to be raised from time to time to ensure their continued effectiveness. Other mechanical techniques used in agricultural areas include surface stabilisation by covering mobile sand and dunes with synthetic fibres, petroleum products and chemical compounds, but their efficiency has not yet been confirmed.

Biological control measures are also used to control mobile sand encroaching on agricultural areas. One or two rows of trees such as *Tamarix sp.* or *Eucalyptus sp.* are usually planted as windbreaks. The efficiency of the outer shelter belts is controlled by many factors such as plant porosity, height and density. Any gap in the shelter belt causes compression of wind flow and hence, increase in the wind speed and acceleration of wind erosion in the farm. Inner lines of trees are important for successful open field plantation.

Many native plants in the desert such as *Rhanterium epapposum, Panicum turgidum, Haloxylon salicornicum, Cyperus aucheri* and others act as natural barriers to mobile sand. These plants when kept protected from overuse such as grazing and uprooting by humans, can reduce sand encroachment of vulnerable areas and costs of maintenance. Unfortunately no serious measures have been taken by the government to halt the problem of desertification and most of the desert plants are overused, and land degradation is accelerating greatly.

THE GULF WAR IMPACT ON THE DESERT AND AGRICULTURAL DEVELOPMENT

The Gulf Crisis in 1990/91 resulted in extensive destruction of the soil surface and its biotic components. The damage included the following:

1- Destruction of vegetation by heavy military vehicles, equipment for removal of mine fields, ammunition demolition and disposal;

2- Soil erosion resulting from troop movements, the construction of defensive fortifications and subsequent rehabilitation activities such as the Explosive and Ordinance Disposal Program / EOD;

3- Exposure and desegregation of near surface sediments that resulted from the digging of trenches, bunkers and other defensive positions;

4- Landscape disruption resulting from the establishment of the strategic defensive systems, e.g. bend walls, barbed wire, heaped excavated materials, trenches and bunkers, military wrecks;

5- Soil compaction due to heavy transport by military trucks, tanks and other types of heavy equipment;

6- Soil and marine pollution as a result of spilled oil and fallout of mist and soot, demolition of unexploded ordnance and dumping of military remains and contaminated materials; and

7- Bedrock fracturing due to demolition and explosion of ammunition in the desert.

The results of all these combined activities are the degradation of vegetation, the acceleration of soil erosion, and an increased drift of sand and sediments during intensive rainfall. Hence, the risk of local floods may increase, there is rising wind erosion, a fall in the soil infiltration rate, increase in pollutants of both land and sea, and changes in the physical property of the bedrock.

Moreover, agricultural activities came to a complete standstill during the crisis. Infrastructure and farmers' assets were destroyed during the military conflict especially near the border with Iraq. All the supplies were pillaged, the farms were littered with mines and unexploded bombs, and the soil was contaminated with oil. The agricultural work force fled shortly after the invasion, given the threat of full scale hostilities (Omar et al., 1993). Likewise the fisheries sector suffered heavy damage during the invasion and the Gulf War. It lost 91% of the fishing vessels and the loss or damage to offices, surveillance and research vessels, harbours and market installations were severe.

The period from 1991-1996 has witnessed a massive rehabilitation programme for the national economy. Agriculture and fisheries however, have ranked low in the rehabilitation process in relation to the oil sector, construction and commerce rehabilitation.

FUTURE PROSPECTS FOR AGRICULTURE

The contribution of agriculture, including fisheries, to the national economy of Kuwait is insignificant, amounting to about one percent of non-oil GDP. Since oil is still the dominant sector, the prospect for increasing this share does not look promising. However, the growth rate of agriculture in the pre-invasion period was much faster than the rest of the economy. Between 1983-1989, the combined increase in the value of agriculture and fisheries was 150% compared with only 11% for the rest of the economy. During the five years (1982/83-1986/87), the breakdown of agricultural GDP was 67% livestock production, 23% crop production and 10% fisheries (KISR 1994). Before the invasion, the self sufficiency ratios were 100% for shrimp, 50% for fish, 60% for green fodder, 45% for table eggs, 51% for white meat, 24% for vegetables, 20% for fresh milk 6% for sheep meat and 1% for beef and veal, while all other agricultural products were all imported.

CONCLUSIONS AND RECOMMENDATIONS

Shortage of water is a major obstacle to agricultural development in Kuwait. Ground water exploitation in agricultural areas such as Wafra and Abdali should be stopped

from any further depletion and exploitation. Farmers with the assistance from the government should ration water and suggest alternative sources for farm use (such as use of fresh desalinated water in agricultural areas). Irrigation technology should be improved and encouraged by the government. This will result in fewer soil salinity problems and less salinity seepage to the water table and aquifers.

The desert of Kuwait suffered greatly from the Iraqi invasion and its consequences. The top soil layer is damaged and hence soil erosion increased, accelerating the process of desertification. Encroachment by mobile sand into agricultural areas is a phenomenal obstacle that limits outdoor crop production and reduces the efficiency of controlled production methods (by affecting the evaporative cooling systems). No serious attempts have been undertaken by the government to control mobile sand encroachment in agricultural areas.

Rehabilitation of the desert from the destruction of warfare requires careful planning that should consider the susceptibility of different components of the desert ecosystem. Any further activities in the desert including the Explosive and Ordinance Disposal (EOD) programme conducted by the Ministry of Defence should be carried out very carefully in order to prevent further damage to the fragile desert ecosystem.

Many development plans have been introduced by the government but only few that deal with halting the problem of desertification and little progress has been made in implementing their recommendations. What is needed is an action plan that takes into consideration all the environmental constraints and the country future policy for food and agricultural production. The following recommendations are suggested as elements for a short-term and long-term action plan that could solve agricultural problems related to water resources, sand encroachment and land degradation:

<u>In the short-term</u>

- Control of activities in the surrounding agricultural areas such as uprooting of woody shrubs and heavy grazing;

- Developing of large scale wind break shelter belts of native and exotic plant species that can tolerate the harsh climatic conditions and require a minimal amount of water;

- Use of treated waste water in afforestation and shelter belts projects;

- Establishing inner lines of trees in farms;

- Enforcing laws and establishing controls for managing the rangeland;

- Stabilising and improving soil conditions and fertility;

- Use of fresh desalinated water in agricultural areas and the abandonment of brackish ground water.

In the long-term

long-term strategic plan is also needed to develop sustainable agriculture and to secure self-sufficiency taking into account the following principal guidelines:

- To establish targets for self-sufficiency in certain commodities which are important to the national diet such as fresh water, liquid milk, fish, poultry, meat, eggs and selected fruits and vegetables (tomatoes, cucumber, onion, green pepper, and eggplant). A special emphasis should be placed on vegetable production;

- Use of fresh water should be encouraged with proper irrigation techniques to minimise waste;

- Restoration programmes are necessary to recover fisheries and shrimps from excessive exploitation;

- The use of treated industrial and sewage water should be maximised for production of greenery and afforestation;

- Land deteriorated through the action of sand encroachment or saline water used for open field irrigation should be reclaimed;

- Subsidies should be provided to support for high quality products and to achieve partial self-sufficiency;

- Efficient marketing systems that take into account external competition must be developed;

- Better provision of all agricultural education programmes and support to agricultural research and extension;

- An evaluation of laws and regulations needs to be made with new laws enacted as required; in particular, rangeland use and management of pastures needs to be regulated to reduce soil erosion and sand encroachment;

- Long-term land-tenure regulations need to be established, such as 50 year leases, to encourage Kuwaitis to invest in agriculture;

- An integrated strategic agricultural plan is needed for sustainable agricultural development which ensures participation of farmers, NGOs and decision makers.

BIBLIOGRAPHY

Abusada, S.M. (1988). The essentials of groundwater resources of Kuwait. Earth Science Department, Environment and Earth Science Division, Kuwait Institute for Scientific Research.

Akbar,A. and Puskas, K. (1992). Water Availability. Kuwait Institue for Scientific Research, Kuwait.

Al-Sayed O.S., Al-Yaqubi, S.A. and Seny, Y. (1981). Geology and groundwater hydrology of the State of Kuwait. Proceedings of the First Symposium on the future Development of Water Resources in the Gulf and Arabian Peninsula. Kuwait 3-5 March, 1981. Journal of the Gulf and Arabian Peninsula Studies. Kuwait University.

El-Prince, A.M. and M. Abdal. (1992). Soil Survey and Associated Activities for the State of Kuwait. SPP-11. Kuwait Institute for Scientific research. KISR.

Foda, M,; F. Khalaf; I. Gharib; M. Al-Hashash; and A. Al-Kadi. (1984). Assessment of sand encroachment and erodibility problems in Kuwait. Kuwait Institute for Scientific Research, Report No. KISR1297, Kuwait.

Hussain, N. M. (1993). Country paper on the greening of Kuwait. Symposium on the Greening of the GCC countries held on October 26-28, 1992. Tokyo, Japan. Kuwait Institute for Scientific Research.

KISR, (1992). Agricultural Development Master Plan. Progress Report. AG-67. Aridland Agriculture Department. Kuwait Institute for Scientific Research. Submitted to the Public Authority for Agriculture and Fisheries.

Omar, S.A. (1990). Dynamics of range plants following 10 years of protection in arid rangelands of Kuwait. Journal of Arid Environment. 21:99-111.

Omar, S.A., Abdali, F.K., Baroon, Z., and Z. Al-Mousa. (1993). The gulf crises impact on the natural, environmental food, and human resources of Kuwait. Country paper presented at the Inaugural Conference on Women's Vision of Science and Technology for Development. Third World Organization for Women in Science. Cairo, Egypt. 10-13 January, 1993.

Omar. S. A., I. El-Bagouri, Y. Anwar, F. Khalaf and A. Nassef. (1988). Measures to control mobile sand in Kuwait. EES-78. Final Report Vol.(1):Environmental assessment and control measures. Kuwait Institute for Scientific Research. KISR2760.

Rahman, MA., (1993). Tree plantings and afforestation in the rangeland of Kuwait. In Omar. S.A., Razzaque, M. and F. Al-Sdirawi. 1993. Range management in Arid Zones. Kegan Paul International.

Razzaque, M. A., Taha, F.K, Riley, J. Abdal, M. and M.D. Husseini. (1990). Proposal on Development Study for the Agricultural Sector (plant and animal production) in Kuwait. AG-67. Aridland Agriculture Department. Kuwait Institute for Scientific Research.

Razzaque M.A. and M. Abdal. (1992). Development Study for the Agricultural Sector in Kuwait. AG-67 (89-04-06) Amended Proposal. Submitted to Public Authority for Agriculture and Fisheries and Kuwait Foundation for the Advancement of Sciences. Kuwait Institute for Scientific Research. KISR 4076.

Robert, B.D., Epison, L., J.A., and Lund, E. (1982). Report by a world health organization of consultants on utilization of treated waste water in Kuwait. WHO, Copenhagen, Denmark.

iied

Drylands Programme

The Drylands Programme aims to contribute towards more effective and equitable management of natural resources in semi-arid Africa. It has built up a diverse pattern of collaboration with many organisations. It has a particular focus on: soil conservation and nutrient management; pastoral development; and land tenure and resource access. Key objectives of the programme are to: strengthen communication between English and French speaking parts of Africa; support the development of an effective research and NGO sector; and promote locally-based management of resources, build on local skills, encourage participation and provide firmer rights to local users.

It does this through four main activities: collaborative research, training in participatory methods, information networking and policy advice to donor organisations.

International Institute for
Environment and Development
3 Endsleigh Street
London
WC1H 0DD

Tel: (+44 171) 388 2117
Fax: (+44 171) 388 2826
E-mail: drylands@iied.org

ISSN 1357-9312