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# **The Role of R&D Institutions in Technology Transfer and Dissemination: A Case of KISR**

by

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## Introduction

The role and the impacts of scientific knowledge, technological know-how, and research and development (R&D) on societal progress and advancement have been witnessed and, since the world War I. These impacts have been increasing tremendously during the last three decades. The status of any societal development depends mainly on the extents of introduction, utilization and dissemination of scientific and technological know-how. Such impacts have been elaborated, and witnessed more in the occident. It is believed that the divisional level of societal development, i.e., developed or developing relies primarily on the ability of any society to introduce, handle and employ science and technology into the various sectors of the economy (يوسف السلطان، مارس ٢٠٠٠).

The policy-makers in Kuwait have realized and acknowledged, since the 50's of the last century, the vitality and the necessity of employing science, technology and research and development in the socio-economic development plans. This concern was reflected by establishing, funding and nurturing of various scientific and technological and research organizations (يوسف السلطان، أبريل ١٩٩٨).

Kuwait Institute for Scientific Research (KISR), as one of the major scientific organizations in Kuwait, was established in 1967 to conduct applied research and train cadres in various fields of research. To achieve such objectives, KISR management were inclined and exerted various efforts to initiate and enhance science and technology capacity buildings in several areas and domains. The present research paper would illustrate example of KISR's experiences and endeavors in science and technology capacity building and technology transfer and dissemination by elaborating on a case study in plant tissue culture.

### Kuwait Institute for Scientific Research: Establishment, Mission and Achievements

Kuwait Institute for Scientific Research (KISR) was established in 1976 by initiatives, from His Highness the present Amir of Kuwait SHEIKH JABER AL-AHMED AL-SABAH who was then in charge of finance and Oil in Kuwait, when he requested the Arabian Oil Co. (Japan) to establish, finance and administer an applied research institution in Kuwait as part of Oil concession.

In July 1973, KISR has become national entity chaired by a cabinet Minister. KISR has witnessed several reorganization in both mission and administration. In 1981, law No. 28 was promulgated for further development of KISR objectives, management and outputs. (Al-Sultan, 1984).

Law No. 28 of 1981 states that the mission of KISR is the promotion of scientific and applied research, particularly in matters relating to industry, natural and food resources, and other primary constituents of the national economy, in an endeavor to serve the goals of economic, technological and scientific development, and to offer advice to the government on scientific matters and on science policy issues.

Consequently, the main objective is to conduct applied R&D closely linked to national needs, whether in the study of Kuwait's resource base, environment and means of diversifying the national economy, or in solving the problems of individual users in various sectors of the economy.

Research and development activities in KISR, as from 1978/79, clustered and executed via five-year research strategic plan.

### KISR Endeavors in Science and Technology Capacity-Building

As it has been mentioned earlier, KISR's mission is to conduct scientific research, technology development, technical consultancy and human resources development that serves the national needs and supports the economic and social development in Kuwait. Notwithstanding, such ambitions and responsibilities could not be fulfilled without availability of proper and advanced facilities and experienced manpower.

The following is an illustration of some of KISR's efforts in science and technology capacity building, and technology transfer and dissemination in an advanced technological know-how, i.e. plant tissue culture.

## **Plant Tissue Culture**

### **1. Agriculture, Scientific Research and Food Security**

Kuwait's agricultural production is low but expanding rapidly. A master plan for agricultural development was prepared by KISR and presented to concerned agency for implementation that will result in a quantum leap in agricultural production and partial food security in Kuwait. Since agricultural production is totally dependent upon plant production, efforts are directed toward horizontal expansion into new agriculture land as determined in the soil survey project and toward vertical expansion by implementing results of scientific research in planting better quality and high productivity crops. To achieve this expansion, research using existing and emerging technologies is needed to solve several problems. Low productivity varieties, saline soil and brackish irrigation water are few among many obstacles facing agriculture expansion.

The agricultural sector of the Kuwait is considered as provider of certain level of food security, employment, and recreational activities. Farming communities in Wafra and Abdally districts may play a major geopolitical role as border demarcation that can not be ignored in any future border dispute. One of the main objectives of Food Resources Division at KISR is the support of the agricultural and fishery sectors of the Kuwaiti economy. To achieve this objective, KISR is always seeking development, adaptation and implementation of the most recent technical advances, that shows great promise of successful implementation in Kuwait. Among these research areas is the plant tissue culture. During the past two decades, plant tissue culture science and technology had evolved and rapidly progressed from the basic research laboratories into commercial application and successful production of many plants and in many countries. The advocates of the agricultural sector expansion in Kuwait countries are trying to put the sector in a prominent position in the developmental plans for the purpose of achieving certain level of food security, greenery and environmental enhancement.

Plant tissue culture supports the agriculture sector via three major applications; mass propagation of desired plant varieties, variety improvement and elimination of certain plant diseases. Research in KISR is being pursued in all three areas with emphasis for the time being on mass propagation. Date palm is an important tree for the Gulf countries, since it is planted for the fruits and as ornamental tree. Thus, date palm has been receiving adequate attention at KISR. A strategy for date palm improvement utilizing tissue culture technology for propagation and new variety development was planned with a series of research projects that are executed in sequence or in parallel to achieve the objectives in most efficient manner. Other crops of interest for mass propagation are: native plants of Kuwait, trees of Zizyphus, olive, and pomegranate, ornamental and medicinal plants.

### **2. Achievements**

1. In February 1988, an action plan was initiated to develop research capabilities in the area of plant tissue culture at KISR with initial emphasis on date palm propagation. The action plan was based upon the Upper Management's favorable evaluation of the technology potential for commercial applications and advancement of agriculture in Kuwait.

2. A research scientist, with extensive experience in date palm tissue culture and documented achievements in the commercial application of plant tissue culture technology, was hired in October 1989 to design the research program and to prepare and defend research proposals, train the national manpower, design an integrated facility for tissue culture.
3. A number of Kuwaiti nationals received tissue culture training in-house and abroad in Germany, U.S. and England. Currently, a candidate is studying for her Ph. D. degree at Colorado State University after obtaining M. Sc. degree in tissue culture at University of Arkansas. Another candidate is studying for her M. Sc. at Biological Sciences Department, Kuwait University, under a joint supervision of a KISR senior scientist. The third candidate is receiving an on-the-job training and is a task leader in several on going projects. An in-house formal training course was offered as a part of the genetic engineering course organized by Food and Agriculture Organization (FAO).
4. A modern and fully equipped facility was erected and became operational in 1995. The tissue culture laboratory at KISR is the most modern laboratory in the Middle East and one of the largest world-wide.
5. Establishment of the tissue culture program. The tissue culture program is aiming at the full support of the agriculture sector and establishing itself as a center of excellence in the production of certain crop plants from tissue cultures. Crops such as date palm, ornamental plants and native plants are now being produced on a pilot scale

### **3. Objectives**

1. Establish KISR as a center of excellence in tissue culture research and development while developing date palm tissue culture technology.
2. Develop and or adopt tissue culture techniques for propagation of crop and ornamental plants to increase food production and help green Kuwait.
3. Emphasis should be made on the projects with potential commercial applications.
4. To develop tissue culture technologies for trees, desert plants and potato by the year 2002.
5. To implement the developed technologies for large scale propagation for large scale propagation of plants and prepare economic feasibility studies by the year 2004.
6. To develop the tissue culture technology services and contacts by the year the year 2004.
7. To assist in enhancing Kuwait's resource base, food security, economic activities and employment.

### **4. Rational for Strategic Focus**

Tissue culture propagation offers many and varied advantages depending upon the plant and the location. Among advantages of tissue culture propagation of plants are the following:

1. Rapid propagation of desirable varieties or new introductions that are in short supply.
2. Significantly lower cost of clonal plants to provide much greater economic efficiency for plantation establishment.
3. Enhanced availability of disease-free plants.
4. Better root development, with considerably greater ease of establishment, and lower attrition rate in the plantation.

5. Greater uniformity of high quality plants.
6. Opportunity to accelerate, selection and improvement through somaclonal variation.
7. Offer possibilities of establishing germplasm bank for maintenance of unique and rare germplasm.

## **5. Strategic Goals**

1. Transfer and develop tissue culture technologies related to propagation of plants such as date palm with emphasis on determination of genetic fidelity.
2. Intensively produce high quality date palm plants for determination of technical capability and commercial feasibility.
3. Develop methods for quality control of tissue culture produced plants.
4. Determine the economic feasibility of any technology developed and provide all technical details for effective and economic planning of the technology utilizing date palm as a model plant.
5. Develop methods for mass propagation of economically important plants, such as potato, fruit trees and native plants.
6. Employ tissue culture techniques for breeding salt-tolerant new plants.
7. Train manpower on technical details and administrative aspects of tissue culture research.
8. Transfer and follow-up the dissemination and implementation of technologies developed at KISR, at different governmental agencies and private enterprises.

## **6. Mode of Strategical Operation**

The strategy of such activities is to capture the three main advantages of tissue culture namely; mass propagation, disease elimination and plant variety improvement. Two major types of activities are being considered, they are Technical Services and Research Projects. The development of technical service capability is a two way-street in which research direction will be benefiting from the close interaction with the commercial sector and the technical services will be relied upon the advanced research and development capabilities. The technical know-how available in KISR in the area of tissue and cell culture can be offered as services to the commercial sector in many ways, such as:

1. Pre-production contract for tissue culture propagation of certain plant variety for which the technology is already available in -house. For example date palm, strawberry, potato, ornamentals.
2. Development of tissue culture technology for a new plant variety.
3. Assistance in designing commercial tissue culture production facility, training of personnel, providing basic data for feasibility studies.

KISR is a pioneering plant tissue culture in the Arabian countries. KISR can lead by being the first institute to provide such services, specially at the time being where countries of the region are looking seriously into a large scale implementation of the technology to develop their agriculture sector. The following are areas for emphases in the research projects of the strategic plan:

1. Date palm tissue culture technology development and Pilot scale propagation.
2. Potato tissue culture technology development for production of virus-free seeds.
3. Mass propagation of native desert plants by tissue culture.
4. Selection of genes and germplasm suitable for salt-tolerance breeding in three vegetables for Kuwait.
5. Micropropagation of virus-free strawberry.
6. Micropropagation of rubber plant as a model of indoor ornamental plants.
7. Development of tissue culture technology for Cidr (*Zizyphus* spp.).
8. Development of new date palm cultivars.
9. Evaluation and propagation of male date palm pollinators.

## 7. Dissemination of Research Outputs

Results of tissue culture research are classified into two categories as far as dissemination is concerned. None proprietary research results are published in technical journals and presented in scientific conferences. Implementation of research results starts as soon as the developmental stage is completed successfully. Semi-pilot and pilot scale implementation in production unit are the first two steps in the implementation. Marketing of the technology to the private and public sectors is depending upon data of pilot scale implementation which includes economic and financial feasibility study.

Marketing the right of technology implementation. Technologies that proved to have economic potential are marketed to establish and support national industries. KISR offers the following services as part of technology dissemination and marketing:

1. Full technical details of the process that have been developed and tested successfully at KISR.
2. Plant materials that resulted from the pilot-scale production units. These plant materials can be tissue cultures at different stages of differentiation or plants at different stages of growth.
3. Technical design (not structural) for facilities required for implementation of a production project, and a list of equipment specifications, chemicals, etc.
4. Selection and training of manpower required for the project.
5. Technical supervision on the project and trouble shooting during the initiation phase.

KISR offers all of the above for a fixed fee and a royalty on each plant produced. Fee determination is based upon the developmental cost and the financial / economical benefits of the commercial project.

The following are date on palm tree plants productions and values as produced and facilitated by KISR.

Production Year	Number of Palm Tree plants	Market Value (KD)
1998 / 99	20630	115887
1999 / 00	1319	6959
2000 / 01	9212	42717



2001 / 02	7185	38044
2002 / 03	11104	97225
Total	50189	302424

1 KD = 3,3 \$

### **8. Economic Data on Tissue Culture Projects at KISR.**

All tissue culture projects, as any other projects, are subject to committee review to assess their economical, social and environmental impacts. such review is carried out to assure and maximize the benefit of research results to the economy, social life and the environment of Kuwait. A brief economic data on two projects will be given here as examples.

Demand on date palm composed of two sectors. Demand for greenery projects is implemented by the Public Authority for Agricultural Affairs and Fishery Resources, and the demand for date production is by farmers in Wafra and Abdally (agriculture farms). This is in addition to small numbers for private home gardens and district parks. The part of the local demand on date palm for date production was determined on the assumption that each plant production farm may plant a minimum of 75 trees for the next five years. The total plant production farms in Kuwait was 1,600 in 2,000. This demand was estimated to be 24,000 palms per year. In addition to this demand, there is demand on tissue cultured date palm for date production dedicated farms and private gardens. The later part is estimated to reach 10,000 palms per year. Study of the market elasticity indicated that this demand is sustainable because of the following reasons:

1. Local production will replace importation of tissue cultured palms.
2. The expected expansion in planting date palms in greenery projects.
3. Establishment of large farms (more than 1,000 palms per farm) for date production.
4. Implementation of the agricultural master plan for Kuwait will require large number of date palms.

There is a good opportunity for exporting tissue cultured date palms into GCC and other date palm growing countries in the region.

The final economic analysis showed that a project to produce 70,000 palms per year is highly profitable.

### **9. National Economic and Social Benefits of Tissue Culture Research and Development.**

The agricultural master plans emphasized the expansion of date palm for the development of plant production and greenery in Kuwait. This expansion requires very large number of plants that can be produced only through tissue culture in large numbers and at a low cost and free of pathogens and insects. Local production of all these plants form basis for national profitability of the agriculture sector. Other quantitative parameters such as the introduction of a new industry into the plant nursery business, saving of funds allocated for importation of plants, support of the farming economics. Many

other non-tangible benefits may also be materialized such as improvement of the environment and sand storm control, all this is in addition to the enhancement of the national bride in planting stock plants that are produced locally.

## **Conclusion**

In KISR, the successful development of the date palm tissue culture technology and an efficient micro-propagation system lead into the initiation of potato tissue culture research. A long-term plan was established for tissue culture research at KISR to exploit potentials of tissue culture for vegetable, native plants and trees. This plan will set the stage for modern horticulture business in Kuwait and the GCC. It will provide a research base for public and private sector development of crop production. It will also provide the basis for expanding agro-production. With the national greening program is launched, it will also provide the research base for a nursery development of plants to serve the greenery needs, as well as assist the development of other important crop plants. If a substantial industry is developed it can also ultimately provide plants for the GCC as well as local demand. The output of this plan would serve as the scientific foundation for many potential developments that could ultimately be under taken by the public and private sector.

Furthermore, the successful impacts of date palm plant tissue culture research and development activities and dissemination of such technological know-how to the society have led to:

- enhancing of KISR's image as a national R&D center.
- Expansion of Kuwait's resource base.
- Increasing national food security.
- Diversification of the economy.
- Developing the private industry.
- Promotion of new jobs with different skills and specialization.
- Encouraging application of such technological know-how in Arab and other countries.

## المراجع

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