RESEARCH DIRECTORATE
ANNUAL REPORT 2014
Private Non-Profit Organization Established in 1976
Financial contributions mainly from Kuwaiti Shareholding Companies (KSC)
KFAS Board of Directors
Chairman

His Highness the Amir of the State of Kuwait,
Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah

Members of Previous Board until October 2014

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Dr. Abdulmuhsen M. Al-Medej
Mr. Ali A. Al Baghli

Prof. Faiza M. Al-Kharafi
Dr. Adel K. Al-Sabeeh
Mr. Osama M. Al Nisf

In October 23rd of this year a new Board of Directors was formed comprising
the following members:

Dr. Yousef Hamad Al-Ibrahim
Mr. Mustafa Jasem Al-Shamali
Dr. Salah Abdul Latif Al-Ateeqi

Prof. Faiza M. Al-Kharafi
Mr. Hani Abdulaziz Hussain
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Shafiq A. Al-Awadi
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Aseel Khalaf
Yousef Aleneze
Mohammed Shaker
Mirvete M. Samara
Nadia H. Masri
Hadia M. Saker
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The Director General's Message
THE DIRECTOR GENERAL’S MESSAGE

As a unique premiere national organization tasked with promoting and supporting science, technology and innovation for the sustainable development of the state of Kuwait, the Kuwait Foundation for the Advancement of Sciences (KFAS) is favourably positioned to act as a positive catalyst to explore possibilities; engage potential stakeholders; facilitate effective progress in knowledge (science) and technology. KFAS aspires to act as an incubator of ideas that supports and engages with future sustainability leaders (scientists, researchers, academicians and youth), Kuwaiti Shareholding Companies, relevant private and public sector entities and Non-Governmental Organizations (NGOs) partners to disseminate and utilize the useful research outcomes. KFAS focuses and sustains its limited resources and unique status to make a difference in all its activities and funding awards.

The strategy of the the Research Directorate (RD) at KFAS is effectively targeted towards operational programs that address the second strategic thrust for enhancing and integrating Research & Development (R&D) capacity amongst Kuwait’s scientific institutions. The pro-active support for collaborative and interdisciplinary research has gained momentum in recent years, sustained by national and international partnerships with renowned scientific institutions and organizations. The introduction of bi-annual Call for Proposals resulted in greater number of new applications for research grants from the academic sector, governmental organizations, Ministries, Kuwaiti Shareholding Companies (KSC) and NGOs. This not only reflects an outstanding response by the scientific community but also emphasizes KFAS’ keen initiative to enhance scientific development by providing new channels to explore frontiers of knowledge while addressing priority areas of national significance.

During 2014, KFAS-funded research attained its goals by addressing issues of national priority and enriching research capacity building towards significant scientific and technological progress. KFAS also supports research conducted by the Dasman Diabetes Institute (DDI), which was established by KFAS in 2006, in areas related to cure, training and awareness. Scientific workshops and seminars were aimed at facilitating educational and research capacity-building, mutual exchange of knowledge and learning about cutting edge research in areas of relevance. Multi-institutional research in renewable energy and joint thematic research have sought to address crucial challenges facing the nation. This year, a special project under the Water and Energy Program, ‘Building Integrated Solar PV for Kuwaiti Homes’ received a grant of K.D. 1,963,580, thus setting a major impetus for future research undertakings in similar areas of national concern. KFAS’ aggregate contribution since inception reached K.D. 40mil (USD 120mil) for 939 research projects. The hosting of the Global Research Council (GRC) Regional Meeting (MENA Region), in which issues related to building education and research capacity and research funding for scientific breakthrough were discussed, also marks another milestone during the year. KFAS contributions were also directed towards the development of national research infrastructure at Research & Higher Education (HRE) institutes in order to support the scientific community in conducting high impact research in their respective fields, ranging from diverse scientific disciplines.

At the international level, significant progress was made to identify and prioritize research areas towards the national interest of Kuwait. This has led to the development of a number of signature and pioneer projects, in which local and international research institutions will be working together to address these challenges. This high level of international collaboration was made possible through the contracted Memorandum of Understandings between KFAS and renowned international institutions, such as Massachusetts Institute of Technology (MIT) and the London School of Economics (LSE).

The achievements realized this year reflects KFAS commitment in fulfilling its role and its focused effort to make a positive contribution to science, technology and innovation system and culture in Kuwait. Such achievements would not have been possible without the immense contributions by the Kuwaiti Shareholding Companies that have supported our scientific mission for the progress of our nation.

Dr. Adnan Ahmad Shihab-Eldin
RESEARCH DIRECTORATE (RD)

The Research Directorate aims at enhancing and integrating research and development capacity in and among Kuwaiti Scientific Institutions to address national development priorities. RD also actively engages with Office of International Program (OIP) at KFAS and the Dasman Diabetic Institute (DDI) by supporting their research activities. Through the RD, KFAS initiates proactive focused programs in areas of national priorities such as water, energy, and environment. Focused programs under this strategic thrust will favor integrated multi institutional efforts (public and private sector, and international institutions) that solve significant problems, and/or create opportunities for further research and technological applications.

The bi-annual call for proposals was first introduced in 2013 in order to expedite and effectively administer the research grant system and to ensure funding goes to best proposals in priority areas. The first call for proposals usually takes place in April/May and the second call usually takes place in October/November. According to the new policy, applications for research grants are first reviewed by the Research Evaluation Committee consisting of key staff members within the RD. The Committee ensures that relevancy of received new grant applications with respect to the announced research areas is maintained and analyzes final evaluation reports of the referees to recommend a decision on the grant request. In 2014, the Research Funding Council (RFC) was formed, comprising of the Director General, the RD Director and external experts from national institutions. Some of the main functions of the RFC include providing guidance with regards to research priority areas, prioritizing proposals eligible for research grant and taking a funding decision on proposals that have completed evaluation and their budget requirement meets the RFC’s criteria.
1. SCIENTIFIC PROGRAMS

Research Grant Program

The broad objective of the Research Grant Program is to participate in promoting effective scientific research by enhancing the research capacities of the Kuwaiti youth and supporting advanced scientific research, particularly those with significant relevance to the State of Kuwait. This program is the main portal through which all research grant applications are received (applied, basic, national and industrial research), evaluated, funded and monitored. KFAS also encourages collaborative long-term research ventures by national institutes that are undertaken in coordination with international academic and scientific organizations.

The main activities undertaken under the program in 2014 can be summarized as follows:

- The Research Grant Manual was revised with updated information.
- All new research proposals received under the ‘Call for Proposal’ cycles (12th November 2013 to 30th January 2014 and 15th April 2014 to 15th June 2014) were scrutinized and evaluated.
- A four-day (April 7-10) workshop on research grant writing was conducted at KFAS by Prof. Annette Fitzpatrick, Research Professor in Epidemiology and Senior Faculty Investigator, Collaborative Health Studies Coordinating Center at the University of Washington. The main purpose of this workshop is to build local research capacity in terms of writing of a good research proposal to increase the chances of awarding research grants. Prof. Fitzpatrick introduced some of the core concepts, study designs and suitable methods for conducting successful research in biomedical and clinical science. It provided hands-on guidance to the participants on how to plan out the overall contents of a well-written grant proposal, develop convincing objectives and well-organized background for the topic of research, apply comprehensive principles of methodology and develop a budget that reflects the content of the project. The workshop culminated with the commendable responses by the participants in actually scripting their own research proposals. A total of 90 medical personnel from Kuwait University, Ministry of Health and the Dasman Diabetes Institute attended the workshop.
- Participated in the second “Science, Technology and Innovation International Cooperation Network between European Union and the Arab Gulf Countries” (GCC INCONET), hosted by Dasman Diabetes Institute.
• Identifying the areas of collaboration with the Kuwait Ministry of Health to support scientific research collaboration and initiating the process to formulate a memorandum of understanding.

• Exploring areas of research collaborations and research funding mechanisms with the German Diabetes Association.

• Submitted a winning bid to host the MENA Global Research Council (GRC) Meeting at KFAS. This meeting was held on 9th-10th November 2014 and attended by participants from 10 countries (KSA, Bahrain, Qatar, Oman, Egypt, Jorden, Japan, U.S.A and Germany) to discuss MENA’s initiatives on research funding for scientific breakthroughs and building education and research capacity. The outcome and recommendations of the meeting will be used as input to the next annual GRC meeting to be held in Tokyo, Japan on 27-28 May 2015.

• Participated in the Seventh Annual Conference of the Arab Forum for Environment and Development (AFED) in Jordan and participated in discussions on various topics and issues related to food security in Arab countries. During the event, AFED launched the annual report.

**Environment Program**

This Program aims to facilitate advanced environment research and multi-disciplinary research in national priority areas, as well as to support innovative research solutions. It strives to develop a long-term strategic plan on environmental sustainability in order to accomplish sustainable development in State of Kuwait. It also ventures to assist in setting effective long-term activities to introduce environmental sustainability concepts in the curricula of colleges and schools. Some of the major activities that took place in 2014 under the program were as follows:

• Local experts from Kuwait University, Kuwait Institute for Scientific Research, and Kuwait Environment Public Authority, along with the concerned RD staff members, undertook the following tasks:
  - Determine priority scientific topics in the areas of environment, water and energy.
  - Identify the Terms of Reference for new projects initiated by KFAS and review received proposals to ensure that they conform with the requirements, prior to sending them for scientific evaluation.
  - Provide feedback on some proposals received under the program.
  - Draft an annual plan to hold seminars and workshops on scientific subjects and enlist names of experts in related areas.
  - Recommend dissemination of results of some selected completed projects in priority areas, funded by KFAS, for the information of stakeholders and concerned parties.
  - Discuss new ideas to energize program activities.

• A seminar was held at KFAS pertaining to the KFAS funded project “Mapping and Monitoring of Soil Moisture over Kuwait Desert Environment” on June 5, 2014 during the World Environment Day. Dr. Hala Al-Jassar, who is assigned as the project leader, presented the project undertakings and results.

• Representatives from the Environment Program group participated in the “Global Workshop for the Production of Fungal Flora” held at Kuwait Institute for Scientific Research.

• Concerned staff from the Environment Program also participated in the workshop, “Building Capacities to Prepare National Strategies and Action Plans to Combat Desertification”, held at the EPA headquarters.

• A closed seminar was hosted at KFAS (24-25 November 2014) in collaboration with the Water and Energy Program and with the participation of the air conditioning companies and Prof. Dr. Abdullatif bin Nakhi, a member of the Scientific Committee of the Water and Energy Program, to discuss issue related to refrigerants.
• Program representatives attended the Seventh Annual Conference of the Arab Forum for Environment and Development (AFED), held in Jordan. The Annual Report prepared by the forum was also launched at the event. This event was partially funded by KFAS, through the Environment Program.

• On 17-18 December, a workshop was hosted at KFAS on “Food Security and Climate Change in the State of Kuwait”. It concluded with a number of valuable recommendations.

Water and Energy Program

The main objectives of this program are to promote the development of research capacity within Kuwaiti scientific institutions and to establish links between relevant institutions dealing with water and energy research. The program also aims to support pilot projects that focus on improving production efficiency and optimal utilization of water and electricity. The important activities of the program in 2014 can be summarized as follows:

• RD Director presented two research papers at the Unified Gulf Building Code Forum, which was held on 27–28 January, 2014. The two papers were entitled: “Pilot Projects of Solar Cells Applications in Kuwait”, and “Compliance of High-rise Office Buildings with the Building Code in the Tropics”.

• A seminar was sponsored under the program, entitled, “Side Cooling for Energy Conservation and the Environment”. The Seminar was organized by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) - Kuwait branch, and was held on 20-21 April 2014 at the Faculty of Engineering and Petroleum at Kuwait University, in collaboration with the Water and Energy Program.

• A lecture was organized, entitled, “Nanotechnology: Current and Future Applications in the Energy, Oil, Water and Live Sciences”, delivered by Prof. Mohammed Sharif Iskandarani on May 5. The lecturer presented the results of the Amiri grant project, which was funded by KFAS. He highlighted on the technology and its current and future applications. Copies of the 2011 KFAS award winning book authored by him - “Nanotechnology for a Better Tomorrow” were distributed to the participants.

• A Memorandum of Understanding (MoU) was signed between KFAS and the Ministry of Electricity and Water as a strategic partner for pilot projects funded by the KFAS in the field of water and energy. The MoU aims to lay the foundation and principles that enable KFAS to share part of the Ministry’s savings achieved through the application of KFAS funded pilot projects and thus recover full or part of the cost of the project in a reasonable time. Such fund recovery would allow KFAS to invest in other pilot projects of national importance.

• A research paper, entitled, “Achieving Energy Efficiency through Artificial Lighting” was presented by the Assistant Director of the Water and Energy Program at the Fourth Kuwait Conference for Electricity and Water, held on May 14, 2014.

• KFAS Director General delivered a working paper, entitled, “The Role of KFAS in Encouraging Initiatives for Electricity and Water Conservation” at the Conference on Energy and Water Efficiency in Kuwait, organized by MEED ON 2-4 June, 2014.

• KFAS supported the installation of photovoltaic cells at the Al- Zahra Cooperative Society (with a total capacity of kWp 780), as part of a pilot project entitled “Energy Efficiency and Photovoltaic Systems Pilot Applications for Selected Co-Operative Society Supermarkets.” Additionally, all technical and legal formalities were completed for the signing of a contract with KISR on the use of solar energy as an alternative energy source to provide 150 houses with electricity. The project is expected to be implemented within three years.

• KFAS distributed 1,000 copies of the documentary entitled, “Drinking Water in Kuwait - A Continued Suffering,” produced by the program in 2010 to raise awareness on water conservation among all sections of the Kuwaiti society.
• Participated in the student summer training session conducted by KISR, "Innovation Day Camp", under the supervision of "Injaz-Kuwait". The Energy Program contributed in the reviewing of the science projects exhibited by the high school students of the American International School.

• A seminar entitled "Air-conditioning Systems using Environmentally Friendly Gases" was held on 24-25 November 2014. A number of international experts and representatives of the air-conditioning companies and relevant government entities participated in it. A White Paper was drafted as a final report, which included all recommendations of the seminar. The White Paper was distributed to all concerned institutions and companies in Kuwait to utilize and ensure compliance with the requirements of the United Nations programs on the gradual reduction of gases, which negatively affect the ozone layer.

2. FUNDING SCIENTIFIC RESEARCH

Contributions from Kuwaiti Shareholding Companies (a percentage of their net profit) constitute KFAS’ research fund, which is utilized to sustain and promote national research. There are specific rules and regulations that govern the research grant award process. Research project proposals are solicited from local academic, public and private institutions within the State of Kuwait.

Research Project Submission (Proposal)

The Research Directorate receives applications for grant awards from local institutions in the form of research proposals. All research proposals should provide clear and descriptive account of the research that is proposed, including the research objectives, budget, methodology, output, citations, etc. along with duly filled KFAS forms and CVs of the main researchers involved in the project. Researchers may refer to ‘The Research Grant Manual’ for any clarifications on the procedures, evaluation standards or project execution. Applicants’ adherence to the guidelines will facilitate and expedite the evaluation and grant award process.

Research Project Evaluation and Funding Mechanisms

The mechanism of evaluating research proposals was subject to changes over the years since KFAS’ inception. The aim was to secure a better, comprehensive and scientific decision-making process to support the research project. The process of evaluation comprises of three inter-dependent stages: (a) preliminary evaluation by the Research Directorate (review of the general format, the administrative and financial aspects); (b) inviting referees and experts for scientific evaluation of the project; and (c) the decision-making stage wherein the proposed project is recommended for support, modifications or rejection.

In order to expedite the different processes and expand the information database, the Research Directorate set up a network of local, regional and international scientific peer-reviewers as well as in-house experts in specific scientific disciplines. The entire process of evaluation was based on standard international criteria approved by RD, especially with reference to technical, administrative and financial data, scientific merit and relevance to the country.
The Principal Investigators as well as the affiliated institutions are, to a great extent, responsible for the smooth functioning of the evaluation and funding mechanisms. A carefully revised project proposal containing all the required details, prior to submission to the Research Directorate, will undoubtedly expedite the implementation of the procedures, thus advancing to the next level, namely, the project execution process. The review process adopted by RD is in accordance with international scientific standards and regulations (Fig. 1).

**Research Project Evaluation Process**

Following the review process and the approval for research funding, a contract is signed by KFAS and the beneficiary institute(s), in accordance with the stipulated conditions (Fig. 2). Henceforth, RD monitors the progress of the project until its completion, reviewing all the interim reports submitted by the project leader. Periodical payment schedule is activated only on compliance with the proposed objectives.

During the reporting year, RD received 57 project progress reports, 42 published scientific papers and 42 final reports.
3. DOCUMENTATION & DISSEMINATION OF SCIENTIFIC INFORMATION

This activity, which is significant to all RD programs, pertains to recording of vital scientific information pertaining to researchers and their expertise in scientific disciplines as well as research accomplishments undertaken on periodical basis. Concerted efforts were directed towards establishing an excellent network of information for the benefit of the scientific community for referential purposes. Hence, focus was on developing an efficient research database system, as well as printing, publishing, documenting and automated archiving of pertinent scientific information.

The main objectives of RD under this activity are as follows:

• Provide technical and documentation support to RD.

• Create appropriate opportunities for interaction with organizations, researchers and experts outside KFAS.

• Expand the information base on KFAS and its research-sponsoring activities at the local and international levels.

The Research Directorate kept track of important publications of research reports and encouraged researchers to disseminate their research results in leading international journals.

Final Reports: At the conclusion of a research project, the project leaders submit a comprehensive report to RD, documenting in detail the project objectives, methodologies, final results, scientific applications and the concluding recommendations. The valuable information is reviewed, published and archived by RD for future references and distribution to concerned parties.

Annual Report: Every year RD publishes the Annual Report, both in English and Arabic, which chronicles the scientific accomplishments, research trends and directions, statistics and information on all KFAS-funded research projects that were implemented during the reporting year.

Distribution: RD distributed scientific reports to top local organizations, Kuwait Shareholding Companies, academic institutions, regional and international organizations, embassies in Kuwait as well as Kuwaiti cultural attaches abroad. The Annual Report is circulated to local and international scientific communities, government authorities, academic institutions, as well as diplomats world-wide.
PEER-REVIEWER INSTITUTIONS

United States of America
Columbia University
United States Department of Agriculture (USDA)
University of Illinois
Utah State University
Baylor College of Medicine
Baylor University
Broad Center of Wisconsin
Boston University
California Lutheran University
Carnegie Mellon University
Colorado School of Mines
Columbia University
Cornell University
Desert Research Institute
Illinois Institute of Technology
Iowa State University
James Madison University
Jet Propulsion Laboratory
Johns Hopkins Hospital
Johns Hopkins University
Lehigh University
Louisiana State University
Louisiana Tech University
Massachusetts General Hospital
Massachusetts Institute of Technology
Mayo Clinic
McLean Hospital
Miami University
Montana State University
Mount Sinai Hospital
National Center for Atmospheric Research
North Carolina State University
Northeastern University
Ohio State University
Oregon State University
Purdue University
Rutgers Business School - Newark and New Brunswick
St. Cloud State University
State University of New York
Texas A&M University
Texas Christian University
Texas Tech University
The Children’s Hospital
The College of William and Mary
The Ohio State University
The Pennsylvania State University
The University of Akron
The University of Oklahoma
The University of Texas at Austin
The University of Texas at Dallas
The University of Texas MD Anderson Cancer Center
Tufts University
United States Department of Agriculture
University Hospitals Case Medical Center
University of California Los Angeles
University of California Santa Barbara
University of California, Berkeley
University of California, Irvine
University of Colorado at Boulder
University of Connecticut
University of Delaware
University of Florida
University of Georgia
University of Kansas
University of Maryland
University of Miami
University of Nebraska-Lincoln
University of Nevada
University of New Hampshire
University of North Carolina School of Medicine
The University of North Carolina at Chapel Hill
University of North Dakota
University of Notre Dame
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Texas El Paso
University of Texas Pan-American
University of Washington
University of Wisconsin-Madison
Virginia Polytechnic Institute & State University (Virginia Tech)
Washington University
West Virginia University
Western Michigan University
Woods Hole Oceanographic Institution
Worcester Polytechnic Institute
York University

Canada
ChemTec Laboratories
Concordia University
McGill University
McMaster University
Memorial University of Newfoundland
Université du Québec
University of Alberta
University of British Columbia
Vancouver
University of Calgary
University of Ontario
University of Toronto
University of Victoria
University of Waterloo
York University

United Kingdom
City University London
Duke University School of Medicine
Loughborough University
Oxford Institute for Energy Studies
Royal Holloway University of London
Teesside University
The Open University
University College London
University of Bath
University of Birmingham
University of Cambridge
University of Central Lancashire
University of Leeds
University of Southampton
University of Sussex
University of Warwick

World Renewable Energy Congress

Ireland
Dublin Institute of Technology,
National University of Ireland
Teagasc Food Research Centre
University College Dublin

Portugal
Universidade Nova de Lisboa
University of Porto

Spain
Institute of Natural Resources and Agrobiology of Seville (IRNAS)
University of Valladolid

France
Euro-Mediterranean Information System (EMWIS)

Belgium
Ghent University
Royal Military Academy of Belgium
University of Mons

The Netherlands
Eindhoven University of Technology

The Netherlands
Delft University of Technology
TU Delft University of Technology
VU University

Germany
Leibniz Universität Hannover
Niedersächsisches Institut für Wirtschaftsforschung
Technische Universität Darmstadt
University of Heidelberg
University of Kassel
University of Leipzig

Brazil
University of Vermont

Argentina
Universidad Tecnológica Nacional

Sweden
Chalmers University of Technology
Karolinska Institutet
Lund University
Mälardalen University
Örebro University
Stockholm University
Swedish University of Agricultural Sciences
University of Gothenburg

United Kingdom
City University London
Duke University School of Medicine
Loughborough University
Oxford Institute for Energy Studies
Royal Holloway University of London
Teesside University
The Open University
University College London
University of Bath
University of Birmingham
University of Cambridge
University of Central Lancashire
University of Leeds
University of Southampton
University of Sussex
University of Warwick

World Renewable Energy Congress
STATISTICAL PROFILE
1. Annual Statistical Indicators (2014)

During the fiscal year, KFAS funded 40 new research projects under three major programs, namely, the Research Grant Program, Environment Program and Water & Energy Program. The total funds approved by KFAS for the new projects in basic and applied research amounted to K.D. 5,189,676.378.

Table 1 depicts the distribution of funds allocated to newly approved research projects under the major programs.

Table 1. KFAS’ Contribution to New Research Projects (2014)

<table>
<thead>
<tr>
<th>Program</th>
<th>Projects</th>
<th>Amount in KD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant</td>
<td>28</td>
<td>853,691,728</td>
</tr>
<tr>
<td>Environment</td>
<td>7</td>
<td>637,864,650</td>
</tr>
<tr>
<td>Water and Energy</td>
<td>5</td>
<td>3,698,120,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>40</strong></td>
<td><strong>5,189,676.378</strong></td>
</tr>
</tbody>
</table>

The following Table enlists the beneficiaries of the newly approved funds during the fiscal year 2014:

Table 2. Beneficiaries of the New Research Grants (2014)

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Projects</th>
<th>KFAS Contribution (K.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait Institute for Scientific Research</td>
<td>6</td>
<td>2,502,819.650</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>1</td>
<td>1,622,500.000</td>
</tr>
<tr>
<td>Kuwait University</td>
<td>10</td>
<td>708,169.000</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>2</td>
<td>84,500.000</td>
</tr>
<tr>
<td>Dar Al Athar Al Islamiyyah</td>
<td>1</td>
<td>75,167.000</td>
</tr>
<tr>
<td>Gulf University for Science and Technology</td>
<td>6</td>
<td>61,520.000</td>
</tr>
<tr>
<td>Arab Open University</td>
<td>3</td>
<td>35,325.000</td>
</tr>
<tr>
<td>Sheikh Jaber Al Ahmad Al Sabah Nuclear Medicine and Molecular Imaging Center</td>
<td>1</td>
<td>19,900.000</td>
</tr>
<tr>
<td>Arab Gulf University, Bahrain</td>
<td>2</td>
<td>16,800.000</td>
</tr>
<tr>
<td>Florida Institute of Technology, U.S.A.</td>
<td>1</td>
<td>14,558.000</td>
</tr>
<tr>
<td>University College London, U.K.</td>
<td>1</td>
<td>9,210.000</td>
</tr>
<tr>
<td>Public Authority for Applied Education and Training</td>
<td>1</td>
<td>8,250.000</td>
</tr>
<tr>
<td>American University of Kuwait</td>
<td>1</td>
<td>7,628.000</td>
</tr>
<tr>
<td>FAWSEC Educational Company</td>
<td>1</td>
<td>6,425.730</td>
</tr>
<tr>
<td>University of Glasgow, U.K.</td>
<td>1</td>
<td>6,608.000</td>
</tr>
<tr>
<td>Arizona State University, U.S.A.</td>
<td>1</td>
<td>5,926.000</td>
</tr>
<tr>
<td>Australian College of Kuwait</td>
<td>1</td>
<td>4,370.000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>40</strong></td>
<td><strong>5,189,676.378</strong></td>
</tr>
</tbody>
</table>
2. Key Performance Indicators (2014)

The Research Directorate continued to devote its efforts to promote quantitative and qualitative outcomes in scientific research and technological development. The Directorate’s activities were aimed at ensuring adequate peer-review mechanism, improving proposal/project processing time, promoting quality research, encouraging scientific publications and enhancing young researcher skills as well as supporting joint national and international scientific collaborations.

Following are RD tasks/activities that were accomplished during the fiscal year:

- New research grant applications received and processed - 105
- New research project contracts executed under the three programs - 40 (Figure 3).
- Research projects monitored (follow-up) - 170 (Table 3).
- Payments released during the year - 130, total amount - K.D. 4,486,458.796 (Table 4).
- Research grant awarded to beneficiaries (Table 5).
- Project progress reports received and evaluated - 57 (Table 6).
- Final project reports received and assessed - 42.
- Scientific papers (KFAS-sponsored research) published in international journals - 42.
- Scientific experts/consultants contacted - 979.
- Peer-reviewers/consultants who participated in scientific evaluation - 379.
- Research proposals rejected after scientific evaluations - 33.
- Research proposals cancelled upon project leaders’ request - 5.
- Joint research collaborations - 11.

Table 3. Research Projects by Scientific Program & Status

<table>
<thead>
<tr>
<th>Program</th>
<th>New</th>
<th>Ongoing</th>
<th>Completed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant</td>
<td>28</td>
<td>53</td>
<td>22</td>
<td>103</td>
</tr>
<tr>
<td>Environment</td>
<td>7</td>
<td>20</td>
<td>14</td>
<td>41</td>
</tr>
<tr>
<td>Water and Energy</td>
<td>4</td>
<td>14</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>39</td>
<td>87</td>
<td>42</td>
<td>168</td>
</tr>
</tbody>
</table>

Table 4. KFAS Research Grant Payments Released in 2014

<table>
<thead>
<tr>
<th>Program</th>
<th>No. of Payments</th>
<th>KFAS Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant</td>
<td>89</td>
<td>1,775,238.256</td>
</tr>
<tr>
<td>Environment</td>
<td>21</td>
<td>2,319,537.378</td>
</tr>
<tr>
<td>Water and Energy</td>
<td>20</td>
<td>391,683.162</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>130</td>
<td>4,486,458.796</td>
</tr>
</tbody>
</table>
Table 5. Major Recipients of Research Grant Payments in 2014

<table>
<thead>
<tr>
<th>Institutions</th>
<th>No. of Payments</th>
<th>KFAS Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait Institute for Scientific Research</td>
<td>40</td>
<td>1,060,329.204</td>
</tr>
<tr>
<td>Kuwait University</td>
<td>32</td>
<td>1,067,990.506</td>
</tr>
<tr>
<td>Public Authority for Applied Education &amp; Training</td>
<td>10</td>
<td>80,670.000</td>
</tr>
<tr>
<td>Gulf University for Science and Technology</td>
<td>8</td>
<td>46,438.000</td>
</tr>
<tr>
<td>Arab Open University</td>
<td>3</td>
<td>31,793.000</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>3</td>
<td>31,375.000</td>
</tr>
<tr>
<td>FAWSEC Educational Company</td>
<td>3</td>
<td>10,615.728</td>
</tr>
<tr>
<td>Others</td>
<td>31</td>
<td>2,157,247.358</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
<td>4,486,458.796</td>
</tr>
</tbody>
</table>

Table 6. Progress Reports Reviewed in 2014

<table>
<thead>
<tr>
<th>Program</th>
<th>Number of Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Grant</td>
<td>33</td>
</tr>
<tr>
<td>Environment</td>
<td>17</td>
</tr>
<tr>
<td>Water and Energy</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
</tr>
</tbody>
</table>

During the fiscal year, KFAS funds were diverted to multi-institutional research projects in applied sciences that address national concerns, as well as research that have vital implications on the State and its diverse sectors, undertaken by national academic and scientific institutions.

![Figure 3. Distribution of Newly Funded Projects by Programs (2014)](image-url)
3. Comparative Indicators (2012-2014)

Despite the drop in the number of projects funded in 2014, there was a sharp rise in institutional research grants (Figure 4), signifying KFAS’ strategic support for projects addressing priority areas of national concern (energy, water and environment). Two such projects were, ‘Building Integrated Solar PV for Kuwaiti Homes’ by KISR (K.D. 1,963,580) and ‘New Generation Brine Desalination and Management for Efficiency, Reliability and Sustainability’ (USD 5,500,000), undertaken by MIT and KU.

Joint-thematic, multi-institutional and multi-PI research initiatives have promising prospects for the future of a nation, as they are coordinated efforts to address urgent issues of national concern, as well as scientific, environmental and technological challenges. Therefore, KFAS continued to sustain the momentum this year also by providing ample support for collaborative projects (Figure 5), namely, joint scientific initiatives and multi-institutional scientific undertakings, both at the national and international levels.
4. Cumulative Indicators (1978-2014)

Cumulative figures reiterate KFAS’ continued support for more than three decades towards the advancement of the sciences, particularly, national scientific research. Since the inception of KFAS, the total contributions have amounted to KD 39,357,723 for 939 research projects.

KFAS’ role is rooted in its mission to support overall national development and enhanced technical and scientific progress in the nation. Over the years, KFAS has upheld its noble vision with the implementation of relevant programs, projects and activities that sustain institutional development, whether academic or research or centers of excellence within the State of Kuwait.

Table 7. KFAS Contribution to Institutional Research (1985-2014)

<table>
<thead>
<tr>
<th>Institutions</th>
<th>KFAS Contribution</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of projects</td>
<td>%</td>
<td>Amount in KD</td>
<td>%</td>
</tr>
<tr>
<td>Kuwait Institute for Scientific Research</td>
<td>333</td>
<td>35</td>
<td>17,126,539.650</td>
<td>44</td>
</tr>
<tr>
<td>Kuwait University</td>
<td>283</td>
<td>30</td>
<td>10,475,472.000</td>
<td>27</td>
</tr>
<tr>
<td>Public Authority for Applied Education &amp; Training</td>
<td>72</td>
<td>8</td>
<td>1,105,064.000</td>
<td>3</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>32</td>
<td>3</td>
<td>893,896.000</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>219</td>
<td>23</td>
<td>9,756,751.730</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>939</td>
<td>100</td>
<td>39,357,723.380</td>
<td>100</td>
</tr>
</tbody>
</table>

Under the Assigned Research Funding Program, 17 projects were supported since 1978, 14 projects in Social Sciences, 2 in Engineering Sciences and 1 project in Biological Sciences. The project on Dictionary of the Holy Quran is ongoing.

Table 8. Total Funds for Assigned Research Projects (1978-2014)

<table>
<thead>
<tr>
<th>Area</th>
<th>Completed</th>
<th>Ongoing</th>
<th>Total</th>
<th>KFAS Contribution in K.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>270,676</td>
</tr>
<tr>
<td>Engineering Sciences &amp; Technology</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>97,721</td>
</tr>
<tr>
<td>Social Sciences &amp; Humanities</td>
<td>13</td>
<td>1</td>
<td>14</td>
<td>3,113,230</td>
</tr>
<tr>
<td>Environment</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>80,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>3,561,627</td>
</tr>
</tbody>
</table>

KFAS shall continue to steer forward towards excellence in Science and Technology and sustainable development within the State of Kuwait and the region.
FUNDLED RESEARCH PROJECTS
Research Grant Program ................................................................. 28
Environment Program ................................................................. 102
Water & Energy Program .............................................................. 136
RESEARCH GRANT

Completed Projects 22
Ongoing Projects 53
New Projects 28
SCIENTIFIC & TECHNOLOGICAL ADVANCES SET

PROMISING PROSPECTS FOR THE STATE OF KUWAIT

Nanotechnology research reiterated the promising potential of modern technology and its favorable implications on the petroleum industry, as local engineers reported on successfully upgrading polypropylene and preparing nanomembranes and nanocomposites with good mechanical properties, chemical resistance, as well as excellent thermal stability and permeability. The successful synthesizing of specially designed polycondensed aromatic hydrocarbons for optoelectronic applications was reported this year. One study in Nanoscience designed a new and efficient technique and applied it to compute the value of the topological index of some nanostructures, while another proposed to synthesize novel polymers with relevant impact on plastic electronics.

Investigations into the subsurface environment/temperatures examined the potential of ground-source cooling in the desert in order to quantify the severity of climate with respect to energy use in heating and cooling of buildings. Simulations and experimental work documented vital results of circuit performance of non-isolated converters in the context of voltage and current stress and switch silicon utilization.

Studies in education explored the prevailing educational system, capacity-building of the graduating youth, learning effectiveness of children, knowledge productivity and e-learning readiness or context-dependent learning and new instructional approaches to enhance learning skills. The goal of one project focused on the development e-learning software in math and science. Symbolism in Kuwaiti literature, Kuwaiti cinema, cross-cultural communication patterns of university students constituted other topics of study. Prevalence of violence against women in Kuwaiti society, Kuwait’s heritage and female labor force were some societal concerns addressed during the year. Researchers proposed to develop computer applications in Arabic exclusively for people with special needs. In biometrics, innovative methods were used to study the thermal imagery for human face recognition. Cross-sectional population-based studies probed the public attitudes/behavior towards road safety, sun and skin cancer, journalistic views and iodine status among primary school children and pregnant women.

During the fiscal year, medical scientists identified novel clinical and immunologic phenotypes and disease-causing genes. Research in molecular biology and microbiology established new protocols and techniques in lab experimentations. Other investigations included people’s perception towards mental healthcare, obesity and drug use, the effects of cancer therapies, fresh approaches in prevention and management of cancer, prevalence of bTB and links between cytokine profiles and bone health. The first systematic maternal-fetal exchange study of transport characteristics of the trace elements in a human diabetic model recorded some notable findings. Experimental trials deduced encouraging results with direct implications on the quantitative and qualitative development of the poultry and cattle industries.

KFAS-supported student research delved into issues pertaining to the real estate market, Kuwait’s ecosystem, regional climate variability, food packaging technology, etc. Research also featured the economy and economics of the country, best practices in innovation and entrepreneurship and investment policies. Business case-study notes were compiled for use as teaching resources as well as references materials at universities. For the first time in Kuwait, the Center of Excellence at Kuwait University developed a comprehensive database on the private sector and constructed economic and financial micro and macro indicators for periodical calculations and observations. Studies emphasized the need to enhance quality management, corporate governance and talent management for overall development of local institutions/organizations and business enterprises.
COMPLETED PROJECTS

Preparation and Characterization of Polypropylene Nanocomposites and Nanomembranes Reinforced with Halloysite Nanotubes and Layered Silicates (2009-1504-01)

S. Lahalih, E. Ghloum, A. Rashid, M. Attar, H. Al-Jabli, A. Jaleel and M. Tabtabaei
Kuwait Institute for Scientific Research

Abstract

The main objective of this research is to utilize nanomaterials to upgrade the properties of polypropylene (PP) and prepare and characterize thin films of PP nanocomposites and nanomembranes using halloysite nanotubes (HNT) and layered silica clay (Ma-Si). Volume I of the final report covers the results on the extrusion and mechanical and physical properties of the nanocomposites. Volume II covers the results on preparation, evaluation and characterization of nanomaterials/PP mixed-matrix membranes and composite nanofiltration membranes. Post extrusion processing of extruded PP nanocomposites with HNT and Ma-Si loadings ranging from 0.0% to 15% is essential to produce microporous mixed-matrix membranes with high fluxes. The post extrusion process included annealing, cold-stretching, followed by hot-stretching, and finally heat-setting the stretched film. Moderate and combined cold and hot stretching with stretch ratio of about 0.8 was essential in order to produce a very permeable mixed-matrix membrane. Excessive cold and hot stretching resulted in membranes that had lower fluxes. As the loading of HNT and Ma-Si increased from 0.0% to 15% in the nanocomposite film, the flux of methanol increased from 9.4 kg/m2h to 766 kg/m2h and from 9.4 kg/m2.h to 175.2 kg/m2.h, respectively at a pressure of 145 psi. Water vapor transmission (WVT) for the same HNT and Ma-Si
samples increased from 1.17 g/m²h to 89.9 g/m²h and from 1.17 g/m²h to 52.7 g/m²h respectively at 38°C. Precursor films with no post extrusion processing are dense with zero methanol flux at 950 psi for all blends. Methanol fluxes in commercial Celgard 2400 ranged from 212-830 kg/m²h. Preliminary tap water flux using MD System in 15%HNT, 15%Ma-Si and Celgard 2400 were 10.69 kg/m²h, 8.01 kg/m²h and 9.46 kg/m²h respectively. Water flux of 3.5%NaCl in 15%HNT and Celgard 2400 were 9.31 kg/m²h and 8.66 kg/m²h respectively. Scanning electron microscope (SEM) images showed slit-like formations and micro-shredding and more voids occurred in the post extrusion processing of the various nanocomposites, and it was more pronounced in case of HNT than in case of Ma-Si-loaded samples. The mean pore diameter of post extrusion processed mixed-matrix samples with 0.0%HNT, 0.9%HNT, 15%HNT and 6.0%Ma-Si loadings were: 0.0297, 0.0214, 0.0366 and 0.0236 Qm respectively. Celgard 2400 mean pore size is 0.0430 Qm. Composite NF membranes [CA/(PP/HNT)] gave water flux of 6.22-16.68 kg/m²h and %Mg++ rejection of 92-98 for 2%MgSO4 solution.

Finally, polypropylene and the nanomaterials (HNT and Ma-Si) mixed-matrix nanocomposites were hydrophobic and, upon post extrusion, they possessed high porosity and had good mechanical properties, good chemical resistance, excellent thermal stability and good permeability. These qualities made these mixed-matrix films good membrane distillation membranes and form good composite nanofiltration membranes with other polymers.

KFAS Contribution:  K.D. 49,100
Total Budget:  K.D. 174,180

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**Potential for Ground-Source Cooling of Building in the State of Kuwait – Phase I**

(2009-1508-02)

F. F Al-Ajmi  
Public Authority for Applied Education & Training

**Abstract**

In Kuwait and many other dry desert climates, the summer season is long with a mean daily maximum temperature of 45°C. Air-conditioning systems in domestic buildings consume approximately 80% of total electricity generation. A hybrid cooling technique that would reduce domestic cooling demand would have environmental and economic benefits in Kuwait. In most countries, developing hybrid cooling techniques to reduce domestic cooling demand is a key objective but also poses a particular challenge in dry desert climates, such as that of Kuwait. Ground cooling, which is a passive cooling technique, could help meet this objective. However, the purpose of the present research, which is the first phase of this project, is to investigate the environment and properties at several points below the ground surface to a maximum depth of five meters. An existing model (Labs 1989) was used to make hourly predictions of the underground environment as a function of depth below the ground surface and time of year for three site locations in Kuwait: Alwafra, Alabdely and Kabed. The model had an accuracy of approximately ±1°C. This model will be used for several nearby subsoil environment applications, including an earth cooling pipe model and underground buildings.

In this research, the degree-day technique for quantifying the severity of climate with respect to energy use in heating and cooling building spaces was applied to compare the aboveground (atmospheric) to subsoil environments with particular application to Kuwait. The effects of different soil surface treatments (dry ground surface, wet surface and wet and shaded (with grass)) for lowering subsoil temperature were experimentally investigated. It was determined that subsoil surfaces under wet and wet and shaded with grass surfaces improved ground cooling potential and increased subsoil condition performance, which can be advantageous for subsoil applications, such as earth cooling pipes. In the second phase, the cooling ability of EAHE, as a means to ventilate a building space and reduce domestic energy consumption during summer and winter seasons, will be investigated. The second phase of this project will be scheduled and conducted depending on the results and findings of the first phase of this research.

KFAS Contribution:  K.D. 22,950
Total Budget:  K.D. 22,950
Studies of Primary Immunodeficiency Syndromes  
(2010-1302-05)  

W.Al-Herz  
Ministry of Health  

Abstract  
Primary Immunodeficiency diseases (PIDs) include a heterogeneous group of conditions that affect the development and/or function of the immune system resulting into increased risk of infections, autoimmunity and malignancies. In the last years, advances in genetics and cell biology have permitted to define the molecular basis and the pathophysiology of several new forms of PIDs. We have identified six families with novel clinical and immunologic phenotypes and identified 4 new disease causing genes. Our work has also led to identify TTC7A as the culprit gene causing multiple intestinal atresias that is associated with combined immunodeficiency. Moreover, we continued to work on better characterization of PID status in Kuwait to better understand peculiarities about these conditions in our population. We were also able to model reticular dysgenesis with induced pluripotent stem cells, and identify possible novel therapeutic intervention. Furthermore, we studied the occurrence of autoimmunity in Dedicator of Cytokinesis 8 (DOCK8) deficiency, which is a relatively new PID, in an attempt to understand the cellular basis of the disease.  

KFAS Contribution: K.D. 64,300  
Total Budget: K.D. 68,300  

The Consistency between PAAET Graduates and the Requirements and Government Strategic Planning  
(2011-1111-02)  

A. Taqi  
Public Authority for Applied Education & Training  

Abstract  
Kuwait, as other developing countries, suffers from two main obstacles: the growing number of job hunters and the State’s ambition for development. The Public Authority for Applied Education and Training, the University of Kuwait, and the private universities annually celebrate the graduation of thousands of Kuwaiti students and bring them to the labor market. However, the private sector is dominated by foreign labor while government sector remains suffering from jobs needed to be fulfilled with expatriates. Many people are watching this complex equation, while others are discussing it. The crisis is due to the lack of vacancies to accept students in higher education, or the increasing long period for offering jobs to young researchers, and the career level which is not based on scientific principles. There is an urgent need to boost the cultural development of the State of Kuwait, develop the capabilities of the youth, keep abreast with the scientific developments and to provide a scientific database and field-documented data to address the diverse problems. The data for this exploratory study was collected from three major categories: 1,000 persons from public and private organizations, 1,000 persons from Business and Education colleges in (PAAET), and 10,000 graduates from the two colleges employed in different sectors.  

KFAS Contribution: K.D. 29,860  
Total Budget: K.D. 29,860
Isolation and Characterization of Lactic Acid Bacteria for Development of Cattle Probiotics Phase I
(2011-1207-09)

Kuwait Institute for Scientific Research

Abstract

Dairy farms in Kuwait are facing extremely arid and harsh conditions that induce animal stress and tend to reduce energy reserves that weaken the immune system making the animal more susceptible to disease and increase animal mortality. The relatively high rate of calf mortality is attributed to enterotoxaemia, diarrhea, and pasteurella pneumonia. Very large quantities of antibiotics are fed to animals; a real danger has arisen as a result of the abuse of antibiotics of producing antibiotic-resistant bacteria that can cause disease in humans and animals. The main objectives of this research project were to isolate probiotic lactic acid bacteria (LAB) for utilization as an alternative to antibiotics in cattle production to control enteric pathogens, enhance productivity and improve food safety. The project involves four key tasks: Mobilization; Sample Collection, Microbial Isolation, Characterization and Identification of LAB; Determination of Antagonistic Activity of LAB using in vitro Tests; Determining their Tolerance to Acidic pH and their Resistance to Bile Salts and Antibiotics; and Reporting. Over 80 presumptive LAB were isolated from cattle samples collected during the four seasons. Subsequent preliminary biochemical identification of these isolates by Analytical Profile Index (API) and further confirmation by deoxyribonucleic acid (DNA) sequencing showed that these LAB strains belonged to seventeen LAB strains. Ten representative strains were chosen and were screened for their probiotic potential through in-vitro assessment of their tolerance to acidic pH, bile salts, and antibiotics. The strains were also examined for aggregation and co-aggregation ability, bacteriocin production, antagonistic activity against selected enteric pathogens, and attachment to mammalian cell.

In summary, the tests produced very promising results, suggesting that L. fermentum, L. plantarum, L. rhamnousus, and L.casei have good potential for utilization or the development of probiotic and feed additives to control disease in cattle production.

KFAS Contribution: K.D. 69,200
Total Budget: K.D. 123,824

The Prevalence of Plasmid-Mediated Quinolone Resistance and Its Association to Extended-Spectrum Beta-Lactamases and AmpC Class Beta-Lactamases in Kuwait
(2011-1302-04)

A. Dashti
Kuwait University

Abstract

The world is facing a serious problem of emergence and spread of antibiotics-resistance bacteria, such as bacteria harboring extended-spectrum β-lactamase (ESBLs). Infections with such bacteria limits treatment options, with high morbidity and mortality rates. Studies on bacterial genetic mutations causing antibiotics resistance reported different spreading patterns in different geographic regions and countries. In Kuwait, the prevalence and dissemination of plasmid-mediated quinolone-resistance
in the Enterobacteriaceae family, especially in Klebsiella spp. and E. coli, and its association with ESBLs and/or AmpC-type enzymes has not been studied before. This study was conducted to use molecular biology techniques to determine the extent and pattern of antibiotics resistance clonal spreading in Kuwait.

A total of 1082 non-duplicate clinical samples were collected from three major Kuwaiti hospitals (Amiri, Kuwait Oil Company (KOC) and Yiaco Adan hospitals). Conventional microbiological tests were used to analyze the above samples, including VITEK2, Disk Diffusion, disc approximation test, double disc synergy method, MicroScan analysis and E-tests. These were used to identify the bacteria and determine antibiotics resistance patterns when present (more than 35 antibiotics). Then, molecular techniques were performed to find genetic determinants of antibiotics resistance, including multiplex PCR, pulsed-field gel electrophoresis (PFGE) analysis, DNA sequencing and transconjugation experiments. The results were analyzed according to the 2012 CLSI guidelines. The analysis of the gels was performed using the BioNumerics software (version 7.1). Cluster analysis and phylogenetic trees were subsequently analyzed.

All bacteria included were ESBL-producing bacteria, consisting of 832 E. coli, 100 Acinetobacter spp. and 150 Klebsiella spp. The bacteria found were Escherichia coli, Klebsiella pneumoniae, Klebsiella oxytoca, Proteus mirabilis, Enterobacter aerogenes, Enterobacter cloacae, Citrobacter freundii, Serratia fonticola, Acinetobacter baumannii and Pseudomonas aeruginosa. The majority (95.2%) of a subset of 83 E. coli O25b-B2-ST131 harbored at least one bla gene with blaCTX-M-15 being the most prevalent. Sporadic cases had other genes like blaCTX-M-2, blaCTX-M-56, qnrB1 and bla CMY-2. We identified for the first time the appearance of blaCTX-M-2 in the Middle East and blaCTX-M-56 outside the Latin American countries; the latter also contained qnrB1 and blaCMY-2 genes and carried IncF1 plasmids.

Molecular results of the Acinetobacter isolates showed the presence of A. baumannii isolate Kw5, which was confirmed through detection of the blaOXA-5I-like gene and sequencing of the rpoB gene. The Kw5 isolate was found to be positive for the blaOXA-23-like gene, which explained its resistance to carbapenems. In regards to Klebsiella spp., we found a diabetes-related foot ulcer infection caused by an Ambler class A ESBL-producing K. oxytoca, Y20, that was resistant to several antimicrobial agents including chlorhexidine which is commonly used as an antiseptic agent in the hospitals of Kuwait. The resistant genes detected were blaCTX-M-15, blaTEM-1, blaSHV, aac(6′)-Ib-cr, blaOXA-1 on a class I integron integrase (intI1) gene, containing qacE gene which encodes quaternary ammonium compound-resistance protein QacE. To the best of our knowledge, this is the first time to report a chlorhexidine-resistant K. oxytoca worldwide. Transconjugation experiments were performed in few antibiotics-resistant cases. For example, for the E. coli, mating experiments were performed using E. coli J62-2 (RifR) as a recipient strain. Results revealed that only one of the transconjugates contained qnrB1 and blaCMY-2 genes and one contained qnrB1 and blaCTX-M-56. On the other hand, the transconjugation experiments did not yield any transconjugates with the resistance pattern in the Klebsiella spp. after two experiments.

The results of this study highlighted the extent and pattern of antibiotics resistance in Kuwait, with molecular detection of several resistance genes such as qnrA, qnrB, qnrS, O25, NDM-1, CTX-M2, CTX-M15, TEM, SHV and others in 1082 bacteria of different spp. (E. coli, Acinetobacter, and Klebsiella spp.). Other species, which have also been collected and preserved in our research laboratory, which will be processed in a future project.

KFAS Contribution:  K.D. 73, 390
Total Budget:  K.D. 90,140

Publications:
Nitrogen Containing Supramolecular Nanomaterials for Organic Electronics

(2011-1413-02)

B. Alameddin
Gulf University for Science & Technology

Abstract

We report the syntheses of specially designed polycondensed aromatic hydrocarbons (PAHs) for optoelectronic applications. We have successfully synthesized two tribenzo[fjijrst]pentaphene derivatives bearing arylamine groups, which were thin film deposited by spin coating and tested as p-type semiconductors in field effect transistor (FET) devices. The results have revealed that the hole mobilities are strongly affected by the aggregation of the aromatic core due to π-π stacking. To better understand the way these molecules self-assemble, a computational study has been carried out to see the effect of changing the size and shape of the aromatic core on its π-stacking interaction. Our current results have been reported in two top-ranked peer-reviewed journals where one article has already been published while the second has been recently submitted.

KFAS Contribution: K.D. 20,000
Total Budget: K.D. 20,000

Innovation and Incubators Powerful Tool for Modern Economy Based on Knowledge

(2012-1103-01)

A.H. Muhammad
Kuwait University

Abstract

Innovation is the process of making change, difference, and novelty in products and services, to create economic and social benefits such as entrepreneurship. Innovation will create new jobs and catalyze broadly shared economic growth. The aim of this paper is to investigate and identify key factors of innovation and entrepreneurship that facilitate the outcomes of successful implementation of business incubation programs. To achieve the aim, the research uses a mixed-method approach consisting of review of the literature, survey questionnaires, case studies, and international interviews. The research findings suggest a roadmap of best practices for innovation and entrepreneurship worldwide. The adoption of such elements will add value to the economic development in Kuwait and others GCC member states. The research adds to the body of current literature on sustainability of innovation and entrepreneurship as powerful tools for a modern economy. Policy-makers, governments, and practitioners will benefit from the knowledge of experiences of worldwide successful implementation of innovation and incubator programs.

KFAS Contribution: K.D. 9,800
Total Budget: K.D. 9,800

Publications:


• Exploring The importance of Incubators in Stony Brook, Hanadi Mubarak AL-Mubaraki, Michael Busler (Conference paper).

• Beyond Incubators Mechanisms: Innovation, Enonomic Development and Entrepreneurship, Hanadi Mubarak AL-Mubaraki, Michael Busler (Conference paper).
Developing Teaching Materials for Management Development Programs at Kuwait University – Phase III  
(2012-1109-01)

M. Al-Salman  
Kuwait University

Abstract

The Case Research and Teaching Unit finished its 4th phase of the case research project, “Developing Teaching Materials for Management Development Programs in Kuwait”. As per the proposal, the following ten case studies have been completed:

1. Al-Dar for engineering & Contracts Inc. and Teaching Note  
2. Cinescape Online Booking System and Teaching Note  
3. Al-Sayer Group Company and Teaching Note  
4. Boubyan Bank and Teaching Note  
5. Kuwait Institute for Scientific Research and Teaching Note  
6. KOTC and Teaching Note  
7. Mabanee Company and Teaching Note  
8. AlSeef Hospital Teaching Note  
9. Information Systems at State Audit Bureau and Teaching Note.  
10. Warba Projects for General Trading Co. and Teaching Note.

The ten case studies, along with teaching notes, have been registered at the European Case Clearing House (ECCH), a world-leading distributor of case materials and internationally renowned expert in case teaching and learning. The case studies are available on the website for reference by faculties:  
http://www.cba.edu.kw/newcba/CRTU_Cases_Completed.aspx for their research and academic purposes.

KFAS Contribution: K.D. 20,000  
Total Budget: K.D. 32,420

Arabic Learning Disabilities Development Project  
(2012-1109-03)

J. Everatt  
Center for Child Evaluation & Teaching (CFCET) in collaboration with University of Canterbury, New Zealand

Abstract

The objective was to provide a diagnostic, standardized test battery to be used in all Kuwaiti schools to diagnose LD children. Statistical psychometric method (psychometric study) was used. The purpose was to develop two psychometric batteries and to identify their components, to diagnose the derivational morphology, spelling, reading and dictation of children.

The research was applied on a variety of samples as follows:

• Reading and spelling battery: the first exploratory sample consisted of 259 children. The second exploratory sample consisted of 206 children. As for standardization, the sample consisted of 1258 students aged 7-11 years, male and female from all Kuwaiti areas.
• Spelling and morphological awareness battery: the first exploratory sample consisted of 252. The second exploratory sample consisted of 252. As for standardization, the sample consisted of 1253 aged 7-11 years, male and female from all six Kuwaiti areas.

Tools: Reading and spelling test battery represented in single word reading-sentence, the reading fluency test - reading comprehension fluency test - passage reading comprehension test - word spelling test-choice of correct spelling test, spelling and morphological awareness test for children represented in discrimination between real (meaningful) word spelling, and discrimination between unreal (meaningless) word spelling - word series and derivational morphology.

Results:

1. Reading and spelling battery: there is correlation between all sub-tests of each battery. The interpersonal relations between tests were mostly based on two factors more than 70% of contrast in single word reading test, passage reading fluency test and spelling factor (word spelling test-choice of correct spelling). All the sub-tests of that battery achieved high consistency rates between 0.85-0.95. According to this result, the test measures have been concluded. The measures depended on three criteria: i.e. second degree, standard degree and the modified standard degree.

2. Spelling and morphological awareness battery for children: there is a correlation between the sub-tests in each battery. The interrelations between the tests are based on two factors explaining more than 70% of the contrast: spelling test that distinguish between real words and non-words. The second factor is morphology (test of derivational morphology and the test of derivational conclusion). As for the test of word series, it was based on two factors. AU sub-tests of this group have achieved high consistency levels between 0.86-0.97. According to this result, the test measures have been concluded. The measures depended on three criteria: i.e. second degree, standard degree and the modified standard degree.

Building Database and System of Economic & Financial Indicators for the Private Sector in Kuwait (2012-1110-03)

J. Haji
Kuwait University- Center of Excellence

Abstract

This project aims to build a comprehensive database and economic and financial indicators for private sector in Kuwait. Private sector includes seven main sub-sectors: Banking and financial intermediation, activities of investment companies, insurance, manufacturing, real estate, food and other services. Database was constructed using available published data and through field surveys and interviews of key businessmen. Data collection followed the process of classifying, correcting, updating and forecasting unavailable data. A comprehensive economic and financial micro, sectoral and macro indicators were constructed for each sub-sector and listed companies in Kuwait Stock Exchange. These indicators were calculated on periodical frequency such as quarterly, semi-yearly and yearly according to availability of data and nature of the indicators. Input–Output table for private sector for the first time was compiled and constructed, then tens of sectorial indicators along with SAM were calculated. Also, the project included econometric models and quantitative and qualitative methods to calculate new indicators such as: productivity, efficiency indices, foreign investment indicators, consumer confidence, business confidence, economic stability, doing business risk and others. The quantitative and qualitative indicators are linked with the aims and polices reported in the five-year plan.

KFAS Contribution: K.D. 1,050,000
Total Budget: K.D. 1,454,320
The Study of Shared Responsibility in the Educational System

(2012-1111-01)

Q. Al-Sarraf
Kuwait Society for the Advancement of Arab Children

Abstract

The project aims to investigate and conduct field study of the mechanisms and policies regarding decision-making in the area of education and to explore implementation of decisions. The study included a sample of speeches relating to education delivered by HH the Amir since taking office in 2006 until the end of 2012, as well as the legislative work done by the Committee on Education, Culture and Guidance in the National Assembly, the practice of decision-makers in the Ministry of Education and its technical cadre, the educational institution as such with all its different components in addition to the Kuwaiti family. The study has used a set of tools for collecting field data including interviews and questionnaires and content analysis methodology.

The study results exposed the bleak image of the educational scene in the State of Kuwait to the extent that the potential for joint responsibility and community participation in building a promising educational system is nil. The components of the educational system entail decisive directions and special sponsorship included in the Amiri speeches, parliamentary derelict performance, executive bureaucratic system that orbits on its own, rudderless educational institutions, and a family unit that has lost its effective role in building character in its youngsters as well as losing touch with the school in an attempt to build an outstanding education capable of meeting the needs of the society.

The study includes a set of reform proposals, which aims to improve the status of the current educational system in the State of Kuwait in light of its findings.

KFAS Contribution: K.D. 61,100
Total Budget: K.D. 80,212

Investigation of Road Safety and User’s Attitudes for Accidents Prevention Measures in Kuwait

(2012-1112-04)

H. Al-Saied
Public Authority for Applied Education and Training

Abstract

The research aimed at investigating and analysing the road safety in the light of accidents in Kuwait. The project also aimed at investigating road users’ attitudes and perception of the problems, identify possible countermeasures and policies to overcome these problems and investigate the attitudes and acceptance of these possible policies and measures, which can be considered in order to tackle these problems. Road safety problem in Kuwait is a multi-faceted problem that cannot be solved through one single project. Instead, a concerted set of measures and projects have to be devoted to sort out the problem. This research project is only a preliminary step to address this important problem and further research is recommended to achieve significant improvement.

The specific characteristics of socio-economic patterns as well as travel behaviour attitudes of road users in Kuwait make it a very interesting and unique area of research, which has its own characteristics and features. There has been a dramatic increase in the level of vehicle ownership and use in recent years. This increase, along with a distinct lack strong traffic regulations and enforcement, has led to a
situation arising where attitudes and behaviour towards road safety are very alarming. The first stage of the project dealt with review of relevant literature, which identified gaps in previous works. The second task related to a pilot survey, data collection and analysis. The results were analysed, assessed and discussed with expertise in traffic accidents and safety, as well as with the research team. A revised questionnaire was prepared and distributed. The main survey was carried out from September-November 2013 in order to avoid certain biases due to the summer holiday period and the month of Ramadan where a large number of people are on vacation. Out of a total of 700 questionnaires that were distributed, 427 responses were received.

During the main survey, all factors that affect safety, attitudes and potential measures to improve safety issues in Kuwait were taken into consideration. Socio-economic, attitudes and work commitment factors, all contribute to the behaviour and attitudes of road users in Kuwait, as the results show. In this research, four binary models were estimated for the investigation of attitudes to road safety in which the dependent variable represented the respondent as a “Safe Driver” or a “Non Safe Driver”. From the results, it appeared that safety parameter, “SAFETY” exhibited more likelihood of being associated with travellers as safe drivers, than the non-safe drivers. It highlighted the need for educational programs and schemes in order to improve drivers’ awareness of the importance of safety. In addition, results also showed that it is more likely that respondents who expressed disapproval of the statement “Driving without a valid driving license” to be safe drivers than those who expressed their approval of this statement. Moreover, high level of education was seen to be positively correlated with those who are safe drivers than non-safe drivers.

In addition, attending theoretical driving training as well as holding a driving licence seem to be associated with higher likelihood of being a safe driver (positive sign of the parameters in the models). The nature of jobs of travellers seemed also to affect them being safe or non-safe drivers, commercial workers were associated with a negative sign reflecting the likelihood of this category of travellers being non-safe drivers. In addition, in regards to the gender of respondents, female travellers showed a positive sign and were statistically significant, which indicated that they were more likely to be safer travellers. The coefficient of “How often do you fill petrol in your car” exhibited more likelihood of being associated negatively with being a safe driver. This might be a result of this factor reflecting the amount of driving respondents do. Respondents were asked on what type of policies they think were most effective in reducing accident rates/severities. From the results presented in this research, it can be seen that applying the law (i.e. enforcing the law) was the main effective policy that respondents thought when enforced will reduce the accident rates or severities on the road. Enforcing the law accounted for about 15.94% of the total responses surveyed. Speed cameras installation at some location was the second policy that the respondents thought will be effective in curbing the accident rate or the severity on the road, this accounted for 13.16% of the total responses. About 12.24% and 9.70% of all responses indicated that other effective road safety policies would be to increase violation and police presence on the road respectively. About 7% of all responses indicated that education will be an effective road safety measure in reducing accident rates and its associated severity on the road users. Other respondents indicated that issuing fines or points on the licence will also be an effective, implementing signals or visible road makings or good roads, and restriction on mobile use can be effective in accident reduction. Only about 4% of responses supported withdrawing driving licence from a person as an effective policy in reducing the accident rates.

Further surveys and studies are urgently needed in the area of road safety and measures to reduce road safety in Kuwait. Limitations to this study include the limited number of responses; greater number of completed surveys could have enhanced the validity of the results. Additionally, respondents and road users lacked the experience to this type of studies. It is important to carry out more studies such as this one in order to enhance data collection and travellers’ experience with this type of survey.

KFAS Contribution: K.D. 50,100
Total Budget: K.D. 50,100
Non-Isolated Converters for Wide-Input Extreme Step-Down Applications

(2012-1508-03)

A. Sabzali
Public Authority for Applied Education & Training

Abstract

This research work presents several new topologies of single-switch non-isolated high step-down dc-dc converters with wide conversion gain and reduced semiconductor voltage stress. Most of the proposed topologies are derived from the conventional inverse of SEPIC (Zeta) converter. The proposed topologies can operate with larger switch duty cycles compared with the existing single switch topologies, hence, making them well suitable for high step-down voltage conversion applications. With extended duty-cycle, the current stress in the active power switch is reduced, leading to a significant improvement of the system losses. Moreover, the active power switch in some of the proposed topologies is utilized much better compared to the conventional Zeta and Quadratic-Buck converters. The principle of operation, theoretical analysis, and comparison of circuit performances with other step-down converters is discussed regarding voltage and current stress and switch silicon utilization. Finally, simulation and experimental results for a design example of a 50-W/5-V at 42-V input voltage operating at 50-kHz are provided to evaluate the performance of the proposed converters.

KFAS Contribution: K.D. 14,500
Total Budget: K.D. 14,500

Topological and Physiochemical Descriptors of Nano Structures

(2012-1513-02)

T. Al-Fozan
Kuwait University

Abstract

This project is on Cheminformatics. Cheminformatics is a new subject and is a combination of Chemistry, Mathematics and Computer Science. Cheminformatics studies quantitative structure-activity (QSAR) and structure-property (QSPR) relationships that are used to predict the physical and chemical properties of chemical compounds. Some popular QSAR /QSPR topological indices are Wiener and Szeged index. These indices are computed applying brute-force methods using distance matrix. Since 1988, there has been an open problem “Is there an algorithm for general graphs that would calculate the Wiener index without calculating the distance matrix?” It remains unsolved until now. Szeged Index is another popular QSAR /QSPR topological index and does not have any universal algorithm. In this project, we have designed an efficient computing technique to calculate topological index such as Wiener index, Szeged index etc. We have also demonstrated the significance of this strategy by applying this technique to compute the value of the topological index of some nano structures such as H-Naphthalenic Nanosheet, C4C8(S) Nanosheet. We claim that we completed the project successfully by achieving all the project objectives.

KFAS Contribution: K.D. 27,320
Total Budget: K.D. 27,320
Publications:


International Standards of Quality, Environment, Safety and Occupational Health, and How to be Implanted in the National Organization

(2012-3111-01)

H. Al-Amir
Uhod Real Est. Co.

Abstract

The purpose of this project was to determine the root causes that hinder the application of international standards of quality, environment, safety and occupational health, and how to be implanted in the national organizations. Quality management and environmental management are business practices that may benefit companies. According to the ISO Survey of Management System Standard Certifications (1999-2012), 421 Kuwaiti companies have been certified ISO 9001 and 100 Kuwaiti companies have been certified ISO/TS 14001 on 2012. Therefore, it is necessary to study and analyze the impact of that certification on their performance. Survey study was undertaken by distributing a questionnaire and monitoring external audit to ISO adopters companies in Kuwait. The project focuses on different aspects of motives and benefits of ISO certification. The statistical evidence and the analytical background and cross country experiences have been done to achieve the goal and objectives of the research. The paper finds that certified companies were more concerned by internal reasons like improving processes or products than by external reasons like pressure from customers or imitation of competitors. In addition, the certification process had generated more internal benefits than external ones. Management system standards have enjoyed enormous success over the last years. However, national organizations lack the certification and implementation of the European Foundation for Quality Management (EFQM), and Japanese Kaizen Standards (JKS), both of which are considered the basic units of construction of a National Kuwaiti Excellence Model (NKEM). Main findings dissemination has implications for administrative organization of quality systems, top management, and public policy-makers.

KFAS Contribution: K.D. 16,000
Total Budget: K.D. 16,000

Talent Management within Small Business in Kuwait

(2013-1103-02)

H.M. Al-Fadhli
Al-Awlama Company

Abstract

Small business sector in Kuwait is one of the most influential sectors in the economy, which is facing many challenges and difficulties. Kuwaiti government supports the small business sector in several ways
and encourages entrepreneurs to establish their own business. The importance of talent management is considered as the secret behind the success of many companies around the world and talented employees are the main source of success of any company. This study attempted to study and analyse the implementation of talent management within the small business sector in Kuwait to find out what is happening on the ground and come up with recommendations that can help small businesses to be able to locate, develop and retain talented staff. This research project had the following objectives:

- To identify new trends in talent management as it pertains to small businesses.
- To assess the size of the gap in the availability of talented employees in the small businesses sector in Kuwait.
- To conceptualize a framework of talent management for small business.
- To determine the most effective ways to locate, develop, and retain talented employees to close the talent gap in the small business sector in Kuwait.
- To determine the basic differences for the effective application of talent management concept in the small business sector, relative to large companies in Kuwait.
- To suggest possible improvement in talent management process.

KFAS Contribution:  K.D. 8,500
Total Budget: K.D. 10,500

Improving Student Writing by Integrating Computer-Aided Instruction with Face-to-Face Pedagogy
(2013-1109-01)

J. L. Testerman
Gulf University for Science & Technology

Abstract

The present analysis examines whether differences in instructional approaches – specifically, whether and how Achieve 3000 (Achieve 3000 and Empower 3000 are interchangeably in this paper) has been used as part of the total course – relate to the differences in acquisition of the spectrum of English language skills. A control instructor devised non-Achieve oriented lessons toward attaining the same course objectives. Variations occurred in the extent to which nine instructors used all components of Achieve3000 and related educational methods for writing and article selection. These variations tallied with differential levels of student achievement measured by Achieve3000 Lexile gains and Accuplacer reading comprehension and writing score increases. Instructors using all five components of Achieve3000 (pre-reading poll and writing, article reading, multiple choice questions, post-article poll and writing and thought question) had students experiencing greater increases in Lexile scores. Additionally, instructors using a comprehensive structured instructional style – including all five components of Achieve3000 in conjunction with frequent or timed writing exercises and instructor-guided article selections – had students with greater Lexile gains. Differences in instructional style can be associated with theories of reinforcement, authoritarianism and cultural understanding. The greater increases determined in the present study, especially match the tenets of reinforcement theory, suggesting that the more opportunities for learning occur and are practiced within a given time frame, the greater are the advances in learning. The more highly structured instructional style (using all Achieve components, frequent and timed writing in-class writing exercises, and instructor-guided article selections) appeared to provide fundamentally more learning reinforcement, corresponding to greater gains in Lexile scores and Accuplacer results. Implications could be to encourage instructors toward the more highly structured style, while maintaining recognition of the need for professional pedagogical discretion for all highly qualified, experienced and committed instructors at the classroom helm.

KFAS Contribution:  K.D. 5,850
Total Budget: K.D. 5,850
Balance & Partiality in Journalistic Processing within Journalistic Speech in International Issues in Kuwait Weekly Newspapers: Practical Study on Al-Taleea and Al-Harakah Newspapers within the Period

(2013-1112-03)

M. Al-Rajhi
Kuwait University

Abstract

This research aims to identify matters of interest in Kuwaiti weekly newspapers, journalistic interviews and the extent of balance and bias in the treatment of this art for domestic issues within the State of Kuwait. While applying the content analysis tool, the newspapers «Al-Taleea», which represents the liberal trend, and the «Al-Harakah» that represents the Islamic movement in Kuwait for the period from January 2007 until December 2010 were surveyed. Following were the conclusions arrived at:

- There was no balance between each of the two newspapers in question in the rate of interest of journalistic interviews. The researcher found that during the study period, the number of journalistic interviews published by «Al-Harakah» newspaper was 92, versus 48 published in «Al-Taleea», and the number of press speeches that dealt with domestic issues in the State Kuwait were currently 104, 64 in «Al-Harakah», compared to 40 in «Al-Taleea» newspaper.

- The results showed that there was a balance in both papers in terms of attention to political and social issues, which amounted to 30.8% for the first and 21.2% for the second, while less attention was given to issues of economic, sports, environmental, religious and health, in spite of its importance.

- In terms of the balance in the treatment of cases, results indicated higher than the proportion of the press speeches that offer a guaranteed negative (43.3%) compared to the low percentage of speeches that provide a guaranteed positive (14.4%).

KFAS Contribution:  K.D. 4,000
Total Budget:  K.D. 4,000

The Perceptions of Mental Care in Kuwait: A Qualitative Study

(2013-1302-05)

N. Scull
Fawzia Sultan Rehabilitation Institute

Abstract

Ten adult Kuwaitis (5 men and 5 women) participated in the in-depth semi-structured interviews regarding their perceptions of mental health care in Kuwait. The interviews were analyzed using grounded theory and the emergent theory identified stigma as being the overarching theme, supported by cultural factors, Islamic beliefs, and therapist characteristics. More specifically, participants described a relationship between the stigma of mental health care and prominent Kuwaiti cultural factors such as familialism, gossip, and the importance of reputation. Participants also discussed how Islam informs their perceptions of mental health care and ideal therapist characteristics that would possibly help reduce stigma. Implications on mental health care in Kuwait in the light of the World Health Organization’s (WHO) Mental Health Action Plan and directions for future research are also discussed.

KFAS Contribution:  K.D. 3,900
Total Budget:  K.D. 3,900
The Prevalence, Perceptions, and Patterns of Performance of Enhancing Drug use among Gym Users in Kuwait

(2013-1302-06)

N. Scull
Fawzia Sultan Rehabilitation Institute

Abstract

The goal of this study was to determine the prevalence, perceptions and patterns of PED use among gym users (N = 200) in Kuwait and involved two sequential phases. During Phase 1, questionnaires were distributed to 6 randomly selected gyms in Kuwait which included demographic and lifestyle questions, and also included the Body Image Questionnaire (BIQ). The predictors of PED use among gym users were determined using a binary logistic regression analysis. During Phase 2, semi-structured interviews were conducted with 5 Kuwaiti adult male PED users, and 1 physiotherapist and personal trainer who specializes in sports rehabilitation. The interviews were analyzed using a combination of Grounded Theory and Discourse Analysis techniques. Taken together, both quantitative and qualitative analyses demonstrated that young adult Kuwaiti males who are single and also smokers are at the highest risk of developing PED dependence. The psychosocial factors associated with PED use in Kuwait and possible prevention and remission strategies are also discussed.

KFAS Contribution: K.D. 3,550
Total Budget: K.D. 3,550
On Lie Algebras of Type $E_6$

(2013-1413-02)

S. Al-Dhafeeri
Public Authority for Applied Education & Training

Abstract

The aim of this project is to give a transparent and explicit construction of Lie-algebras of type $E_6$ over a finite field $K$ of characteristic 2. This goal has been completely achieved and as a result of this project a paper entitled “On Lie algebras of type $E_6$” is prepared and needs to be polished and revised before sending to a peer-refereed journal of high impact factor for possible publication.

An outline of the construction: We start with a 6-dimensional vector $V$ over $F_2$, equipped with a non-degenerate quadratic form $Q$ of minimal Witt-index. Let (1) denote the associated bilinear function $(x|y) = Q(x+y) + Q(x) + Q(y)$, $\Omega = \{0 \neq x \in V | Q(x) = 0\}$, $|\Omega| = 27$.

$W = \{g \in GL(V) | Q(x^g) = Q(x) \text{ for all } x \in V\}$

$W$ is a 3-transposition group generated by its 36 reflections i.e. by the transformations $\sigma_v, v \in V$ and $Q(v) = 1$. $\sigma_v$ is defined by $x^{\sigma_v} = x + (x|v)v$

Then $\sigma_v cW$

We introduce the notation of $E$-sets i.e. $\Delta$ is a subset of $\Omega$ is called an $E$-set if $(x|y) = 1$ for all $x, y \in \Delta, x \neq y$

We prove that:

1. $E$-subsets of $\Omega$ have size less than or equal to 6.
2. There exist exactly 72 $E$-subsets of size 6, and $E$-subsets of size 6 form a base of $V$.

We construct a representation of a Lie-algebra of type $E_6$ over $F_2$ as a subalgebra of $GL(A) \leq \text{End}_2(A)$ where $A$ is a 27-dimensional vector space over $F_2$ with base $e_v, v \in \Omega$.

Let $\Delta$ be a subset of $\Omega$ be an $E$-subset of size 6, $S = \sum_{x \in \Delta} x$ and $\sigma = \sigma_6$.

Set $M(\Delta) \in \text{End}_{F_2}(A)$ such that:

$M(\Delta) = \begin{cases} x^\sigma & \text{if } x \in \Delta \\ 0 & \text{otherwise} \end{cases}$

We have shown that the transformations $M(\Delta)$, $\Delta$ is an $E$-subset of size 6 generate a Lie-algebra of type $E_6$ and of dimension $6 + 72 = 78$.

The advantage of this project is that it paves the way for an easy and effective construction of the corresponding Chevalley-groups $E_6(q)$, $F_4(q)$ and $^2E_6(q)$ where $q$ is a power of 2, and explicit Chevalley generators for these groups could be constructed using the results of this project. This will be the subject of a separate project.

KFAS Contribution: K.D. 8,875
Total Budget: K.D. 8,875
An Assessment of the Real Estate Market in the State of Kuwait and the Expected Future Behavior

(2005-1103-03)

A.Al-Othman
Union of Kuwaiti Banks, Kuwait Institute for Scientific Research

Project Progress - Abstract

This study aimed to assess the real estate market in the State of Kuwait and to outline an effective long run policy for real estate management that would help to establish the Kuwait real estate exchange market analogous to the Kuwait stock exchange market. Estimation of the demand and supply for real estate properties by segments and forecasting future demand and supply were also investigated and presented. In addition, the study tested for a bubble in the real estate market and its effects on the prices, as well as the possible economic impacts if a crash in real estate market occurs (a burst of the bubble). The study, moreover, investigated the financial linkages between real estate sector and local banks to develop a set of indicators and criteria that would improve banks real estate properties management and reduce the real estate loans default risks. A further output of the study was the real estate database management system that maintains up-to-date real estate transactions from the Ministry of Justice (2000 to the present) and allows decision-makers and planners at the Kuwait Banking Association to analyse the market.

KFAS Contribution: 51,500 K.D.
Total Budget: 127,940 K.D.
Composting Poultry Waste  
(2006-1207-10)  
S. Al-Ghawas  
Kuwait Institute for Scientific Research  

Project Progress - Abstract:  
In this applied research, on a pilot scale, with a leading local poultry company (KUPCO), a three-stage composting process was perfected to deal with their organic waste. The initial stage was the undisturbed layering of dead birds, bird manure, and acquired municipal yard waste at a ratio of 1:1:2, respectively; this combination provided an ideal C:N ratio of 30:1. The matrix had an initial moisture content of about 65%, and due to the heterogenic particle size of the yard waste, it remained aerobic with oxygen content above 5%. At this stage, the matrix temperature rapidly reached the lower thermophilic in the 50°C range, where in 20 to 25 d all parts of the chicken carcass were unrecognized. The second stage involved the frequent back and forth turning of the composting matrix between the back-to-back bins of each composting chamber to invigorate the composting process by additional aeration while simultaneously replenishing the evaporated water and mixing the materials. This was carried out by the use of a front skid loader. During this stage (15 d), the composting matrix temperature increased to the higher thermophilic range of >65°C and often more than 70°C. This ensured the sterilization of the generated materials from any waste-associated pathogenic agents. The third stage involved sieving the materials to remove large undecomposed woody yard waste pieces, and then allowing the composted materials to continue the transformation process with the occupational turning and watering until the composting process was completed. The Dewar self-heating apparatus was successfully used to determine compost stability, which was indicated highly stable in 128d, including during the curing stage and after fine sieving. The duration could be reduced to less than 100 d if proper equipment and trained staff were available on demand. The generated compost quality test were in line, with the exception of its salinity status due to the use of brackish groundwater in maintaining the matrix moisture content. Nevertheless, the bio-assay test using radish plants and commercial potting soil as control indicated that the generated materials were as good. Furthermore, the economic assessment revealed that the composted materials was generated at a cost of 8 to 10 KD/m3, which could be further reduced at higher production levels and with proper equipment and trained staff.  

KFAS Contribution: 41,200 K.D.  
Total Contribution: 142,260 K.D.  

High Resolution Mapping and Positional Cloning of Metastasis Suppressor Genes in Colorectal Cancer  
(2006-1302-07)  
F. Al-Mulla  
Kuwait University  

Project Progress - Abstract  
Colorectal carcinoma is a common malignancy. It is the most common malignancy in Kuwait and the third most common in the West. Metastatic relapse in early stage colorectal cancers, remain poorly understood. In this project we have genomically profiled 116 colorectal cancers from Kuwait and the West in an attempt to identify and map metastasis suppressor regions using high resolution microarray-CGH. This is the most sophisticated study ever conducted to date, aimed at identifying patients with risk of cancer relapse by genomic profiling of their primary tumors.  

Total150 cases of Formalin Fixed Paraffin Embedded (FFPE) CRC tissue from patients and matching
normal tissues are used in this study. The CRC for these patients were graded and staged accurately. DNA was extracted from 150 cases of FFPE tissue and the corresponding normal tissue. 116 of the 150 CRC cases were successfully profiled using high resolution 244K human microarrays from Agilent. We have refined the search for metastasis suppressors by carefully subdividing the cohort into Microsatellite instable and stable CRC. Furthermore, we have included in the algorithms analysis of the CRC subsites, BRAF and Ki-Ras gene mutations. This addition to the work is important because other confounding factors associated with metastatic progression can be excluded.

KFAS Contribution:  K.D. 174,200
Total Budget:  K.D. 226,200

Investigation on Some Aspects of the Biology and Ecology of the Endemic Ocypode Crab Leptochryseus Kuwaitense in Intertidal Mudflats of the State of Kuwait

(2009-1207-02)

A. Behbehani
Kuwait University

Project Progress – Abstract

The studies on the mud crab Leptochryseus Kuwaitense have generated new scientific information about the biology and ecology of this endemic species. The density of the crab is estimated to be 10-12 crabs per m2. Density varies temporally being greater in the spring, early summer, and autumn with maximum value being in October and minimum value being in January. The overall male-female sex ratio is ratio of 1.4:1. Morphometric studies have shown that males are much larger than females.

The reproductive season is prolonged with high percentages of ovigerous females being present during December, January, February and March with another occurrence of high percentage of ovigerous females in August. Ovigerous females comprised 10.2% of the population. Fecundity is high reaching approximately 30,000 eggs in larger females. The smallest ovigerous female had a carapace width of 22.96 mm. The external features of the male gonopod development indicate that the onset of sexual maturity of the male is at 28mm carapace width. Electron Microscope images show that full gonopod maturity is reached when the male crab attains a carapace width of 31.57 mm.

Observations on the behavior of the crab have shown that they are active both during the day and night since their activity is more related to the tidal and the lunar cycles. An interesting finding is that, during the reproductive season, parents build a brooding chamber by covering one of the burrow entrances with mud. By this, the young will be protected from being washed away and from predators during high tides.

The electron microscope images of the mouth parts show that these parts lack teeth and featherlike in structure indicating that they are fit for the feeding mode of the crab which is scraping microscopic algae from the mud surface. The initial analyses of the digestive tract contents indicate that these crabs feed on a variety of microscopic algae including diatoms and cyanobacteria.

KFAS Contribution:  K.D. 34,450
Total Budget:  K.D. 34,450
European and US Policies towards Inward Investment from the Gulf in Strategic Industries

(2010-1103-03)

M. Thatcher
London School of Economics and Political Science

Project Progress - Abstract

The research in this period has involved three major tasks. First, it has examined individual cases of Sovereign Wealth Fund (SWF) investments in the UK and US in more detail. These show important variations both across the two countries and within them. The research has traced different processes in particular cases, and how and why some became politically controversial whereas others met few policy obstacles. It has found that how SWF investment are presented or ‘framed’ is important, notably whether they are treated as an economic governance question or one of ‘national security’. If the former applies, then such investments are usually accepted, whereas if the latter applies, then obstacles arise. The research is examining whether there are systematic factors that account for which ‘frame’ applies or whether this is highly contingent and if so, contingent on which factors. Second, information about the legal and regulatory frameworks that apply in other countries, such as France, Germany and Italy, has been collected together with data about SWF purchases. These allow wider comparisons within Europe. Third, the first Policy Brief has been completed, which compares legal and regulatory frameworks in the EU, UK and US. It shows that the EU and UK have treated SWF equity investment as a question of economic governance, and especially free trade and movement of capital, and introduced few specific restrictions on SWF investments. Frequently they have often accepted and even welcomed SWF equity investment. The position has differed in the US, where the nature of the issue has been contested, between being one of free trade or national security issue. This has led to the US imposing much stronger legislative monitoring and restrictions.

KFAS Contribution: € 139,616
Total Budget: € 139,616

Design and Development of E-Learning Software for Math and Science of all Intermediate Grades

(2010-1110-03)

N. Marafi
Ministry of Education in collaboration Regional Centre for the Development of Educational Software (ReDSOFT)

Project Progress - Abstract:

The Regional Center for Development of Educational Software started the implementation phases approved by ReDSOFT as follows:

The basic components and reference documents were provided, including student’s textbooks and teacher’s guides, and other relevant documents. The team analyzed the science and mathematics curricula for grades (6, 7, 8, 9). The overall goals referred to the level and the developmental characteristics of students of that level and the teaching goals of the topic areas the educational software proposed to deal with. All these components represent the overriding parameters of the scientific and educational requirements needed to design and develop the targeted software. Various brainstorming sessions, based on the parameters derived from the analysis phase, were conducted with the project team. In accordance with the technical and electronic content standards were adopted by ReDSOFT. An E-learning storyboard was designed for each educational activity, taking into consideration the
nature of the content and in accordance with guidelines. Editing and proofreading was completed for all activities as well as reviewing audio files. Audio and video engineers at ReDSOF completed recording the dialogue, and sound effects for 42 units in mathematics and 22 units in science. All graphic design and background designs for all units of math and science, animation files for all units of math and science and programming of all educational activities were completed. An educational demo was produced, followed by the initial Beta Version submitted for revision and feedback prior to the production of the final version.

The main committee and the working groups reviewed and approved the analysis of science and mathematics curricula for grades (6, 7, 8, 9), prepared by ReDSOF. A workshop was conducted for the math subcommittee members to discuss several issues. Various meetings were held with the teams to discuss the completed E-learning storyboards and to reach consensus so that the achievement of the project objectives is well served. A number of educational activities (356) were undertaken in math (2627 educational slides) and 165 in science (479 slides). The number of interactive assessment modules in math and science were 42 and 22 respectively.

ReDSOF also initiated the design and development of the following:

- Three applications entitled «Kuwait Science for intermediate school level” to access on tablets and smartphones that run on iOS and Android. The applications include all the activities of the e-content developed in science.
- Three applications entitled «Kuwait Math for intermediate school level” to access on tablets and smartphones that run on iOS and Android. The applications include all the activities of the e-content developed in science.
- Re-program and upload the e-content of all developed math and science activities on the Kuwait E-Learning Portal (Seraj).

**KFAS Contribution:** K.D. 170,000  
**Total contribution:** K.D. 807,300

**Transport of Some Essential Trace Elements across the Human Placenta in Diabetic Pregnancies in Late Gestation**  
*(2010-1302-03)*

**N. Moorkath**  
Kuwait University

**Project progress - Abstract:**

The work schedule had to be re-structured taking into account the technical difficulties and nearly 100% failures in getting successful perfusions in placentae from diabetic patients. As per the revised approved plan, 15 successful perfusions of severely diabetic (10g Glucose/L) model perfusions have been accomplished as per the revised tasks mentioned in the project proposal. We are the first to do a systematic maternal-fetal exchange study of transport characteristics of the above elements in a diabetic model human placentae so far and no research group has ever attempted such a unique project using human tissues in vitro so far as well. As per the project tasks outlined, placentae from control patients were perfused with known quantities of chromium, manganese and vanadium with antipyrine as reference marker and the fetal vein outflow as collected every 30 seconds for 5 minutes. Then the perfusates were replaced with hyperglycemic load of 27.25 mmol/L of glucose or double the normal amount of glucose in humans and perfusions with hyperglycemic perfusates done as in the case of control perfusion with normoglycemic load. We report data from 15 successful perfusions with normoglycemic load and 15 perfusions with hyperglycemic load though we had to perfuse more than 25 placentae to obtain successful outcome in 15 perfusions based on parameters...
such as perfusion flow match, absence of leaks, absence of LDH in fetal perfusates effluents, etc. as guideline parameters to assess successful or valid perfusions (Schneider et al, 1972; Nandakumaran et al, 1981, 1984). The perfusates were analyzed to determine concentrations of trace elements as well as Antipyrine, the internal reference marker and the results obtained are detailed. Further studies to elucidate whether the trace elements manganese, vanadium and chromium can compete or alter the transport characteristics of other elements are currently underway. Full length papers in a reputed obstetrics & gynecology scientific journal (J of Maternal- Fetal neonatal medicine) has been accepted and is in press and we have published abstracts on chromium, vanadium and manganese transport in the Health Science Center Poster Conferences.

KFAS Contribution: K.D. 77,090
Total contribution: K.D. 78,090

A Study of Mechanisms Involved in the Acceleration of Bone Healing in Head and Spinal Cord Injured Patients: A Clinical and Experimental Study
(2010-1302-04)

F. Khallaf
Kuwait Institute for Medical Specialization, Ministry of Health

Project Progress - Abstract

In the clinical part of current study, we compared the results of two groups of patients with long bone fractures associated with head injury (50) and spinal cord injury (13) to patients with only long bone fractures (60). The results showed that patients with concomitant long bone fractures and head or spinal cord injuries had statistically significant accelerated healing rate with exuberant and florid callus formed, compared to patients with long bone fractures only. The study also showed that all long bone fractures in patients with severe head injury or spinal cord injury united and healed without a single case of nonunion. While nine (13%) of the long bone fractures in only long bone fracture patients ended by atrophic nonunion and five (7.2%) of these fractures went into delayed union, indicating that the presence of severe head or spinal cord injury associated with long bone fractures ensures their union and healing.

From results of the hormonal bioassay of blood samples from patients and healthy subjects recruited in this study, we found consistent and statistically significant higher levels of parathyroid hormone, growth hormone, and corticosteroids in patients with severe head injury with concomitant long bone fractures, which may suggest a possibility of hormonal or neuro-hormonal mechanism to explain accelerated healing of long bone fractures in patients with associated severe head injury. The results of higher levels of adrenalin and noradrenalin hormones in patients, with long bone fractures only, may reflect a relative inhibition of the sympathetic nervous system in head injury patients with or without long bone fractures, which may lead to mobilization of undifferentiated mesenchymal stem cells to peripheral circulation to induce accelerated abundant healing of long bone fractures, indicating a combined neuro-hormonal mechanism to explain accelerated healing.

In the experiments upon animals, the results of 24 femoral unions (100%) with moderate to abundant union callus formation in 24 rabbits finished the follow-up for 6 weeks after femoral osteotomy, k-wire intra-medullary fixation and inflicted head injury in 12 rabbits and spinal cord injury in 12 rabbits and the results of the control where 12 rabbits have been operated with femoral osteotomy and fixation only, with 6 (50%) out of these 12 rabbits ended by non-union at the femoral osteotomy site, we think a possible more expected union with florid callus formation of femoral osteotomy in rabbits with associated inflicted head or spinal cord injuries.

Twenty-four rabbits finished the 6 weeks follow-up after surgery of femoral osteotomy, fixation and sera allografts from rabbits with head injury (12) and from rabbits with spinal cord injury (12). Nine
(37.5%) ended up by nonunion. The numbers of femoral osteotomies union and nonunion are very similar to the results of the control group. This may indicate that sera from rabbits with head injury and spinal cord injury contain no specific protein or humeral factor as growth factor to stimulate bone healing and accordingly, they have no effect on bone healing. This may again suggest a possible mechanism, which could be responsible for acceleration of fractures healing in head or spinal cord injuries of altered nerve signaling pathway in which a possible physiological central suppressive mechanism on bone healing and remodeling is obliterated due to brain or spinal cord damage. It remains the part of the study related to measure the stem cells on the patients’ sera and the effects of these sera on the stem cell cultures.

**KFAS Contribution:** 58,600 K.D.
**Total Budget:** 88,300 K.D.

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**The Efficacy of Using Computer Assisted Language Learning Software as a Major Component of a University EFL Program**

(2011-1110-02)

C. Daniel
Gulf University for Science and Technology

**Project Progress - Abstract**

The development of adequate English language skills to ensure student academic success presents a significant challenge to universities with large populations of EFL students. These universities spend large amounts of money to provide students with remedial English instruction in an attempt to develop the speaking, listening, reading and writing skills required to succeed in an English language based university program. Computer Assisted Language Learning (CALL) has faced on-going resistance within the language teaching community, primarily due to a lack of understanding and lack of relevant experience with such software. The goal of CALL is not to replace the teacher but to provide students with the required frequent repetition over an extended period of time to allow long-term learning to take place. This study examines the efficacy of using CALL software as a component of a university language EFL program with the use of a mixed methodology experimental-control group design. Results of this study showed that students using Dyn-Ed software to supplement their ESL studies had significant improvements in their post-test Accuplacer score, as well as significant improvement in ESL Listening and English Language Use Accuplacer ESL subtests. Statistically significant improvements were also noted in post-test CELF-4 core scores and post-test scores on the CELF-4 Concepts and Following Directions and Recalling Sentences subtests. In addition, measures of self-efficacy beliefs related to English language skills were higher in the experimental group. Student interviews were generally positive with most students in the experimental group responding favorably to the addition of the software to their course curriculum. In this study, instructors were not actively involved in the use of the software. However, instructors did observe improved speaking skills in those students that were using the software. These findings are relevant for university EFL programs, as well as, secondary school EFL programs. Future studies should be done with a larger number of participants in both university and secondary school programs. In addition, future studies should involve the instructors, especially in the use of Records Manager data as a way to monitor student progress and to identify individual student strengths and weaknesses.

**KFAS Contribution:** 9,085 K.D.
**Total Budget:** 9,085 K.D.
The Legal Status of Petroleum Development Agreements in International Law and the Problem of Characterization: A Proposed Way Forward

(2011-1112-01)

M. Al-Saeed
Public Authority for Applied Education and Training

Project Progress - Abstract

The main objective of the project is to develop a theoretical and practical model for the legal characterization of upstream petroleum development agreements. The project team aims to find an effective legal solution to one of the most important legal problems affecting petroleum development agreements in the twenty first century, in particular and the international investment regime as a whole. The problem concerning the precise nature and legal character of upstream petroleum development agreements has been a long-standing issue in international arbitration and claims practice. It is a problem which has been further complicated by the historical evolution of such agreements from the old concession type agreement through to the production-sharing contracts of the 1970s to present day service agreements. The problem of legal classification (or characterization) in essence, derives from the semi-public or public-private nature of such agreements, with the host State on the one hand and a private enterprise on the other, as parties to the agreement. This is more commonly known as the public-private dichotomy of petroleum development agreements.

This dichotomous character raises the key question, which system of law to apply to the agreement in the absence of a choice of law clause: public law or private law, national law or international law? The project team will, first of all, undertake a literature review on the topic, followed by critical review and analysis of the historical and evolutionary background to the problem of characterization of petroleum development agreements in arbitration and claims practice. It will then examine in detail the legal nature of the problem while commenting on the possible impact on characterization of the increasing convergence of national law and international law, public law and private law in arbitration and claims practice. The project’s main objective is to develop and to propose a legal new formula for the characterization of petroleum development agreements. The project’s theoretical and practical objectives are, therefore, designed with this important aim in mind, and with a view of making an original contribution to the development of knowledge in this important field of study.

KFAS Contribution: K.D. 4,800
Total Budget: K.D. 4,800

The Role of Social Service in Fulfilling the Demands of Social Development in the State of Kuwait

(2011-1112-04)

A. Alawadhi
Association of Social Workers

Project Progress - Abstract

The study aims at the following:

• Knowing the role of social service in fulfilling the demands of social development in the State of Kuwait.

• Effectuating the activities of varied social service as part of developmental services.
• Supporting the social service establishments and its developmental role in the different sectors of the society.

• The optimal use of the human energy for societal development.

• Employing the role of effective social service in improving the capabilities of the society while seeking to address the demands for social development.

• Supporting the social worker in directing their knowledge framework, training and updating them to raise their professionalism.

The current study adopted the analytical, descriptive method. A sample was randomly selected from the public and private sectors. A questionnaire, which addressed project goals, was compiled after discussions and interviews with concerned social workers and officials, families and youth in order to keep up with changing social scenarios and developments. Psychometric calculation was undertaken to test the stability and validity and applied on a random sample, consisting of approximately 1225 males and females, distributed across the public and private sectors. It consisted of 200 individuals, 500 social workers, 500 youth working for governmental and private social organizations, as well as 25 Kuwaiti families who required services from the public and private sectors. So the problem of the current study focused on the role of the social service in the institutions of the State of Kuwait, in fulfilling the demands of social development and the effect of the same on the Kuwaiti citizen. The study also presents the relevant methods for training of social workers for effective services. Several questions are raised pertaining to the role of social service in fulfilling the demands of social development in the State of Kuwait institutions. The study works out a theoretical framework to address the goals and adopted scientific method in defining related terms and procedures. The project surveys diverse topics of societal concerns ranging from standard of living, to health, economy, culture, education, housing, work, social security, etc.

The proposed model of training programs is expected to enhance the role of a social worker in the society, effectively resulting overall social development. The study records in detail the procedural steps implemented in the field study, qualitative analysis, social development plan and the results of the field study.

KFAS Contribution: K.D. 48,720
Total Budget: K.D. 48,720

Use of Estimated Average Glucose and Adipokines as Screening Tests for Categories of Glucose Intolerance - The Kuwait Adipokines and Derived Average Glucose Study (KADAGS)

(2011-1302-01)

N. Abdella
Kuwait University

Project Progress - Abstract

Mainly as a result of rising prevalence of obesity, Type 2 diabetes mellitus has emerged as a leading cause of morbidity and mortality among the adult Kuwaiti population. In a previous study on a relatively young adult Kuwaiti population below 50 years of age, the frequency of type 2 diabetes, impaired glucose tolerance and impaired fasting glucose was found to be 14.8% using the 1997 American Diabetes Association diagnostic criteria. Based on the World Health Organization and similar reports, the projected estimates for prevalence of Type 2 diabetes by the year 2010 is expected to show a striking tendency to higher prevalence of the disease in Kuwait and other Gulf Co-operation...
Countries. Recently, the American Diabetes Association (ADA) included HbAlc testing as part of the diagnostic criteria for diagnosis of diabetes in non-pregnant individuals without haemoglobin variants. The ADA, European Association for the Study of Diabetes (EASD), International Diabetes Federation (IDF), and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) have also recommended that A1c-derived Average Glucose (ADAG) or estimated average glucose (eAG) should be reported as measures of long-term glycemic control so that HbAlc could be expressed in the same units as day-to-day glucose monitoring units used by patients. Therefore, it is of particular interest to evaluate the practical utility of using these new diagnostic modalities on the main categories of glucose intolerance, study the associations with the risk factors for glucose intolerance in a Kuwaiti population that has a relatively high prevalence of haemoglobin variants. We presented the preliminary data from 196 subjects that have been recruited for this study. The initial results confirm that HbAlc and eAG are better markers for the diagnosis of diabetes (area under the ROC curve for HbAlc and eAG = 0.928, compared to 0.692 for fasting glucose). Future plans include recruitment of more study subjects and performance of more assays for analytes we proposed to study. We conclude that the project is on course to meet the stated objectives.

KFAS Contribution:  K.D. 116,959
Total Budget:  K.D. 116,959

Studies on the Role of a Novel Nervous System-Induced Immune System-Released Activating Agent (ISRAA) in Mouse and Human Brain Cell Cultures
(2011-1302-02)
A.Mousa
Kuwait University in collaboration with Arabian Gulf University, Bahrain

Project Progress - Abstract
The Immune System-Released Activating Agent (ISRAA) was recently described as a nervous system induced factor inducing immune responses in the spleen. The aim of this study was to examine the effect of ISRAA on growth regulation of embryonic brain cells in the form of proliferation and differentiation of neurons and astrocytes. A standard procedure for primary culture preparation was employed from El 5 balb/c mice embryonic brains. Cells were grown and treated with 50pg and 50g of ISRAA or left without treatment. MTT and TUNEL assays were respectively used to examine the proliferative and apoptotic effects of ISRAA. The morphological differentiation was examined by immunocytofluorece and confocal microscopy. Results showed significantly higher proliferation when cells were treated with 50pg ISRAA compared to untreated cells (p<0.0001) with no detectable apoptosis. On contrary, treatment with 5Qg ISRAA depicted decreased proliferation with positive apoptosis. Furthermore, treatment with 50pg induced profound differentiation of astrocytes, but not neurons compared to unstimulated cells. Thus, ISRAA may play a role in the development of the brain cells via its proliferative effects and differentiation of astrocytes representing a cytokine activity for ISRAA since it was previously shown to act as an immune modulator and herein as a growth regulator.

KFAS Contribution:  K.D. 71,100
Total Budget:  K.D. 71,100
Genetic Study of Early Onset Breast Cancer in Kuwait  
(2011-1302-06)  
F. Al-Mullah  
Kuwait University  

Project Progress - Abstract  
Worldwide, breast cancer is the most common cancer in women. Susceptibility is thought to be polygenic and the risk tends to increase in women with positive family history of breast cancer.  

Breast cancer in Kuwait seems to have a stronger tendency for familial clustering. Furthermore, many women are diagnosed with breast cancer at a relatively early age, so that the mean age of diagnosis in Kuwait is almost eleven years younger than in other comparable populations. Both of these factors suggest that at least one gene of major effect is operating to produce familial clustering of breast cancer, early-onset of breast cancer, or perhaps both. Current diagnostic and unpublished data do not support a major founder effect for the BRCA1/BRCA2 genes, especially with the fact that most breast cancers diagnosed in Kuwait and the region are estrogen receptor positive. We show evidence of success in term of technological implementation and identification of pathogenic mutations in familial breast cancer.  

KFAS Contribution: 168,200 K.D.  
Total Budget: 168,200 K.D.  

Characterization of Point Defects in Heavily Doped Zn Te:Cu Thin Films Prepared by Magnetron Sputtering  
(2011-1413-01)  
F. El Akkad, S. Razee and Y. Abdulraheem  
Kuwait University  

Project Progress - Abstract  
ZnTe is an important material for applications in the field of opto-electronic devices, particularly LED’S and solar cells. Despite the large amount of work already published on ZnTe thin films, relatively little is known about the opto-electronic properties of films by RF sputtering and even less is known about the effect of Cu doping. In a previous report, we have studied the effect of preparation parameters on some of the physics properties of highly doped RF sputtered ZnTe:Cu thin films. In the present project, we propose a detailed study of the electrical and luminescence properties of this type of films besides studying their structural, morphological and chemical properties. The characterization tools used in this proposal will be Hall effect, conductivity, optical transmission luminescence, DLTS, AFM, FESEM, XRD and XPS measurements. The aim of the project is to provide a closer view of the physical properties of RF sputtered ZnTe: Cu films and to identify the electrical and luminescence «signatures» of the point defects that control the performance of ZnTe:Cu-based opto-electronic devices.  

KFAS Contribution: K.D. 95,300  
Total Budget: K.D. 95,300
Production Management of Solution Gas Drive Partially Naturally Fractured Reservoirs

(2011-1504-02)

F. Qasem and I. Nashawi
Kuwait University

Project Progress - Abstract

Flow behavior of naturally fractured reservoirs is quite different from that of conventional reservoirs. Most of the techniques used to interpret the recovery performance of naturally fractured reservoirs (NFR) utilize analytical models based on simplified assumptions. One of such assumptions is uniform distribution of fractures in the reservoir, which never holds true for most of the NFR. Naturally fractured reservoirs always have fracture flow networks which are more or less irregular, discontinuous or clustered. A naturally fractured reservoir with such spatially non-uniform distribution of fractures can be called partially naturally fractured reservoir (PNFR). Interconnectivity, length of penetration and intensity of fractures are the important attributes, which determine their contributions in the overall fluid flow. Fracture intensity, identified as the key factor in characterizing the PNFR, is believed to be directly related to the reservoir productivity. Important mechanisms that affect the recovery efficiency of PNFR are expansion of fluids and rock, gas-oil gravity drainage, molecular diffusion and re-infiltration of drained oil at the down structure matrix blocks. In PNFR, the fractures may not be all open to vertical flow, thus providing a partial capillary continuity only. Therefore, shape and the effect of secondary gas-cap formed in the PNFR may be quite different than that in the conventional reservoirs. In view of all this, PNFR provide considerable challenge in studying their recovery performance by natural depletion or gas injection. The first objective of this proposed research is to improve the understanding in the area of PNFR. The second objective is to study the recovery performance of PNFR under solution gas drive and gas injection for the purpose of pressure maintenance. Specifically, in case of solution gas drive (primary depletion), the effect of fracture intensity and liquid withdrawal rate on the recovery performance will be investigated. Whereas, in the case of gas injection (pressure maintenance) the effect of fracture intensity and gas injection rate on the recovery performance will be investigated. The proposed research is very important for Kuwait and other Gulf countries because most of the giant oil/gas reservoirs are partially fractured. This study is expected to set forth and describe conditions that would help in better management and exploitation of these hydrocarbon resources.

KFAS Contribution: K.D. 21,000
Total Budget: K.D. 21,000

Oral Microbiology Laboratory New Prospects for Research on Oral Infection

(2011-5502-01)

E. Honkala
Kuwait University

Project Progress - Abstract

A number of methods and techniques pertaining to oral microbiology laboratory research are now available in the lab. Protocols were standardized under stringent experimental conditions, results were meticulously documented in lab notebooks. Methods were validated in terms of repeatability and accuracy. All protocols have been systematically organized in a common folder in the lab.

Detailed protocols for culture and identification of anaerobic and facultative anaerobic bacteria associated with periodontitis and caries were prepared. Research assistants in the lab were trained...
Elaborate biosafety instructions were posted on the wall in the lab. There are currently 29 bacterial strains of different species, all belonging to the oral cavity. Pure culture stocks of all bacteria were prepared in 20% skim milk and preserved at -80°C freezer.

A static biofilm model for monospecies and multispecies culture has been standardized. So far, biofilm culture has been limited only to periodontitis-associated bacteria. However, the methodology could well be applied to other oral species, e.g. caries-associated bacteria by researchers at the faculty. Biofilm quantification by crystal violet staining and by qRT-PCR have also been established.

**Publications:**


**Replacement of the Old General Facility Equipment to Serve Research in Spectroscopy and Sorptometry**

(2011-5508-01)

K. Al-Qattan
Kuwait University

**Project Progress - Abstract**

The objective of the project is to make available the various spectroscopy techniques to researchers, and graduate students in Kuwait University to pursue research and graduate studies. The facility can also be used by other users outside the university as consultation work for nominal charges.

The project envisaged replacement of the following old General Facility equipment in the Faculty of Science with state-of-the-art equipment:

- Atomic Absorption Spectrophotometer.
- UV-Vis NIR Spectrophotometer.
- Ionchromatograph Mass spectrometer.
- Differential Scanning Calorimeter (DSC).
- Inductively Coupled Plasma optical emission spectrometer (ICP-OES).

All the equipment was received during the current year and have been installed and spectroscopic measurements carried out.

**KFAS Contribution:** 190,000 K.D.
**Total Budget:** 235,000 K.D.
Stock Structure of Carcharhinus Limbatus along the Arabian Gulf: Implications for Research and Management

(2011-6207-01)

D. Almojil
University of Cambridge, U.K.

Project Progress – Abstract

Knowledge of population structure and reproductive behavior is important when designing effective plans to protect threatened species. The Black-tip shark Carcharhinus limbatus and the spot-tail shark Carcharhinus sorrah are reef sharks that have been heavily fished along the Arabian seas since the 1980s. The increase in demand for shark fins raises concerns about the local stocks of these species. Therefore, in this study I investigate the population structure of C.limbatus and C.sorrah along the Arabian seas. I then explore traits that influence mate choice in C.sorrah. Lastly, I study historical trends in the abundance of shark populations in the region.

Fieldwork was conducted in six countries (Kuwait, Bahrain, UAE, Oman, Yemen and Pakistan), where 1141 tissue samples of C.limbatus and 530 of C.sorrah were collected. Moreover, 78 pregnant C.sorrah were processed to determine their burden of metazoan parasites. Also 220 fishermen were interviewed to find their perceptions of changes in shark abundance. Microsatellites were used to genotype all samples for the population and the paternity analysis. In the lab, twenty-six microsatellite loci were developed specifically for this study, using the MiSeq technology.

Results from interviews of fishermen argue for a shifting baseline syndrome among local fishermen. More interestingly, these interviews have highlighted differences in the fishing intentions between local and foreign fishermen. Local fishermen reported depletion in the local populations of sharks but foreign fishermen reported no change. Finally, reports by local fishermen of frequency of encounter and depletion in abundance were accurate. Accuracy was supported by the correspondence between differences in the scale of the reported depletion (among the three shark species) with differences in the life cycles of these species.

KFAS Contribution: US$ 43,812
Total Budget: US$ 104,853

The National Accreditation Program in Kuwait: Its Development, Implementation and Impact on Quality Improvement in Public Hospitals

(2011-6302-01)

Muna Alkhabbaz
Liverpool School of Tropical Medicine (LSTM), U.K.

Project Progress - Abstract

After the first phase of data collection (base-line), which included conducting staff and patient surveys, staff and patient focus group discussions and interviews with quality directorate personnel, the second phase of data collection took place (follow-up), which included conducting staff and patient questionnaires 16-18 months after the first survey. Data entry was done, followed by detailed analysis of base-line and follow-up staff and patient questionnaires. Analysis compared between hospitals with limited implementation of accreditation (LIA) and hospitals with broad implementation
of accreditation (BIA). It also compared the progress of LIA hospitals from base-line stage to follow-up stage, as accreditation was implemented during this period.

Data analysis showed that there was a difference in the quality of health care services between BIA and LIA hospitals at base-line, in favor of BIA hospitals. With the implementation of accreditation in LIA hospitals, the quality of care improved and the difference between LIA and BIA hospitals decreased. Actually LIA hospitals exceeded BIA hospitals in some of the measured quality dimensions, from both staff and patient perspectives.

The implementation of accreditation in Kuwait has a positive influence on the quality of health care services in the public hospitals from staff and patient perspectives. With the advance in the implementation of accreditation, it is expected that the quality of health care services will further improve. Continuous monitoring of patient satisfaction is an important aspect of accreditation programs, as patients are the center of any successful health care services.

**KFAS Contribution:** £22,000  
**Total Budget:** £22,000

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*(2012-1112-07)*

**M. Nuruzzaman**  
Gulf University for Science and Technology

**Project Progress - Abstract**

This project proposes to investigate and analyze the dispute mediation role of the Gulf Cooperation Council (GCC). Created in 1981 as a sub-regional cooperation framework of the Gulf Arab states, the GCC has a mixed record of successes and failures in intra and extra-GCC dispute mediation, and its track record in this area is often below the mark compared to the institutional cohesiveness and resources at its disposal. This research proposal aims to carry out a comprehensive study on the dispute mediation policies, roles, and practices of the GCC, evaluate its successes and failures, and suggest new policy initiatives to enable the GCC to deal with conflicts more effectively as an honest and neutral dispute mediator.

**KFAS Contribution:** K.D. 6,000  
**Total Budget:** K.D. 9,500

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**The Role of Insurance Policies in Limiting the Traffic Conjunctions Resulting from Minor Accidents**  
*(2012-1112-08)*

**M. AlRamadhan**  
Kuwait Insurance Federation

**Project Progress - Abstract**

Traffic accidents in Kuwait are considered one of the reasons for traffic conjunctions. The growth rate of traffic accidents in Kuwait is increasing with time and an average reached 9.5% annually for the
period between 2000 and 2011; and exceeds the growth rate of vehicles which reached 7.5% annually for the same period. Most of the traffic accidents considered as minor accidents (damages only on vehicles involved in the accidents and no injuries and deaths). This study aims to find a mechanism or a way to deal with minor accidents in order to simplify the process to cut down the economic and social costs. This study will also suggest a fair tariff for compulsory insurance and for finding ways to reduce the number of accidents and help solve the traffic conjunctions.

KFAS Contribution: K.D. 59,320
Total Budget: K.D. 59,320

The Effect of Nutrition and Season of Breeding on Reproductive Performance of Naeemi Ewes

(2012-1207-01)

S. Abbas
Kuwait Institute for Scientific Research

Project Progress - Abstract

The fat-tailed sheep, especially Naeemi breed, is well adapted to local harsh climate, nutritional stress and endemic diseases, and they produce excellent quality lean meats. However, the reproductive efficiency of Naeemi ewes is lower than that of exotic breeds. Imbalanced nutritional regimes and seasons of breeding are the major constraints to the reproductive efficiency of Naemi ewes. The objective of this study is to examine the effects of premating dietary composition on the reproductive performance of Naemi ewes. High-quality roughage in Kuwait is too expensive relative to concentrates. Hence, it is essential to reduce the cost of the diet offered to the ewes to maintaining the optimum body condition, reproduction, and efficient use of feeds.

The study design involved the use of a total of 81 sexually mature ewes assigned to breeding during the autumn and summer with three rations consisting of three ratios of concentrate (C) to roughage (R), i.e., 70C: 30R, 80C: 20R, and 60C: 40R. A total of 36 and 45 ewes were used during the autumn and summer mating respectively. The variables of the studies were live weight changes, measurement of body length, wither height and chest girth, physiological responses and rumen fermentation patterns as influenced by dietary C:R ratios and seasons of mating. The conception rate of ewes and their overall reproductive performance are under investigation. The live weight, physiological responses, rumen conditions, and feed intake did not differ due to difference in dietary C:R ratios and seasons of mating. The conception rate was almost over 90% indicating excellent nutritional regimes and comfortable season of the mating of Naemi. The studies were in progress while preparing the report covering body condition score, physiology, rumen fermentation patterns, pregnancy and lambing rate.

KFAS Contribution: K.D. 62,030
Total Budget: K.D. 129,570
Epidemiological Studies on Cryptosporidiosis and Rotavirus Infection in Livestock in Kuwait

(2012-1207-04)

Q. Habeeb
Public Authority for Applied Education & Training

Project Progress - Abstract:

Cryptosporidium and rotavirus are enteric pathogens that damage the epithelial cells of the gastrointestinal tract of animals causing scours, which sometimes is fatal, particularly in newborns and pre-weaned animals. As there are no effective treatment, infection of livestock with these pathogens may have an important impact to farmers and owners; in addition, they are of public health importance and call the attention of health officials as zoonotic diseases. In poultry, cryptosporidiosis manifests itself in two clinical forms respiratory and intestinal disease. Infection of birds with this disease could lead to economic losses. In some instances, poultry may be a source of infection to humans. In Kuwait, little information is available on the epidemiology of cryptosporidiosis in farm animal, and no studies have been conducted in poultry. Also rotavirus infection has not been investigated in small ruminants and horses.

The main objectives of this research are: (i) to estimate prevalence, intensity and seasonality of cryptosporidiosis and rotavirus infection in livestock, including farm animals and poultry; (ii) to inform about the risk on infected livestock which may pose to public health; (iii) to record data on management policies which are hypothesized to be associated with Cryptosporidium and rotavirus infections.

The proposed study includes four major tasks: (1) Mobilization and preparation for work plan. (2) Collection of data and faecal/serum samples from farms/animal herds. (3) Testing the samples for Cryptosporidium and rotavirus. (4) Interpretation of the results and data, based on statistical analysis to give information on prevalence, intensity and seasonality of cryptosporidiosis/ rotavirus infection in livestock as well as on the relationship between management, demographic factors and infection with Cryptosporidium and rotavirus. Visits will be undertaken to farms/animal herds to collect data and faecal samples from cattle, sheep, goats, camels and horses to be tested for Cryptosporidium oocysts using microscopic, immunologic and molecular techniques. Faecal samples from sheep, goats and horses will be also tested for rotavirus antigen. In addition, serum samples from sheep and goats will be tested for antibodies against rotavirus. Sample size of each animal species is estimated according to the animal population in Kuwait: 381 from cattle, 384 from sheep, 384 from goats, 371 from camels, 341 from horses and 385 from poultry in farms kept under intensive system. In addition 10% of each flock of poultry, which are kept under extensive (free range) system, will be sampled as their population is unknown.

To establish programs for control of cryptosporidiosis and rotavirus infection in livestock, it is necessary to have data on the epidemiology of these diseases including prevalence, seasonality, geographical distribution and factors which facilitate their transmission. The outputs of the proposed study will be of significant for the veterinary authorities, owners and veterinarians as well as for public health officials since these diseases are zoonotic. The study will provide information to veterinary authorities about the epidemiology of these important diseases and the health problems and losses they may cause to public health officials, about the risk of infected- livestock may pose to public health. In the light of the results of this study and the information gained, recommendations can be given to owners to help them to protect their animals from infection with Cryptosporidium and rotavirus using proper management policies and hygienic measures.

KFAS Contribution: K.D. 63,743.750
Total Budget: K.D. 71,753.750
Identification and Characterization of Post-Translational Modifications in the Raf Kinase Inhibitory Protein: Implication for a Molecular-Based Therapy of Breast Cancer

(2012-1302-01)

M. Bitar and F. Al-Mulla
Kuwait University

Project Progress – Abstract

The four-fold aims of the project are: (i) to identify novel phosphorylated residues in RKIP and kinases that are responsible for their phosphorylation; (ii) to examine how RKIP function is modulated by its phosphorylation status; (iii) to determine the biological consequences of RKIP expression and phosphorylation by correlating expression and phosphorylation with breast cancer patient survival; and (iv) to determine the role of RKIP or phospho-RKIP in wound healing in the context of diabetes. Studies resulted in the generation of monoclonal rabbit antibodies specific for RKIP when phosphorylated at Thr-42. To assess the biological consequences of RKIP phosphorylation on Thr-42, we stably expressed wild type or its T42A mutated RKIP in cancer cell line 4T1 by retroviral infection. To investigate the effect of altered RKIP expression on breast cancer progression and metastasis, we turned to two near-isogenic mouse mammary tumor cell lines, 168FARN and 4T1, deriving from a single mammary tumor that arose spontaneously in a Balb/c mouse.

RKIP is a proven breast cancer metastasis suppressor gene. Since high MMP13 expressions correlate with poor breast cancer patients’ survival, it is possible that RKIP suppress breast cancer metastasis by regulating MMP13 expression. As a first step to determine whether MMP13 plays a role in RKIP-mediated repression of breast cancer metastasis, we interrogated publicly available DNA microarray expression data sets, in search of a correlation between RKIP and MMP13 expression in breast cancer samples. Two data sets were identified with large number of breast cancer patients exhibiting long-term survival data. We observed a strong negative correlation between RKIP and MMP13 expression. Since low RKIP expression in primary tumors was a strong positive predictive factor for prostate and breast cancer recurrences, we examined the prognostic value of different MMP13/RKIP expression combinations in breast cancers in which the expression of MMP13, RKIP and clinical outcome are available in published microarray expression data set. We found that high MMP13 and low RKIP were associated more significantly with poor survival within 5 years of primary diagnosis than either high MMP13 or low RKIP expression alone. Overall, our current data may advance the notion that RKIP and MMP13 can be used as a possible future therapeutic target in the treatment of breast cancer.

KFAS Contribution: K.D. 157,561
Total Budget: K.D. 157,561

Publications:

An Association Study of Genetic and Environmental Factors Affecting Multiple Sclerosis Incidence in Kuwait

2012-1302-02

R. Al-Temaimi
Kuwait University

Project progress – Abstract:

Multiple sclerosis (MS) is a chronic autoimmune neurodegenerative disorder that affects approximately 2.5 million individuals worldwide with a 2:1 female: male ratio at a typical age of onset between 20-40 years of age. MS is considered a debilitating life altering disease with an unpredictable clinical course. MS patients suffer from sudden attacks with a wide spectrum of motor, sensory, cognitive, and psychological dysfunctions. MS etiologic evidence reported so far is inconsistent and does not fully explain the pathogenesis of MS. Several genetic and environmental factors have been shown to associate with MS susceptibility exhibiting regional/ethnic patterns. Kuwait has become a high-risk area for MS, its prevalence has increased from 4.4 in 1990 to 85 cases per 100,000 individuals in 2014. The aim of our study was to screen Kuwaiti MS patients for possible environmental and genetic factors associated with the incidence of MS. We collected 148 MS patients and 68 healthy control volunteers to be included in the study that involved a questionnaire for environmental factors assessment and a blood sample for genetic and other immunochemical confirmatory assays. We found circulating plasma vitamin D levels to be low in both healthy and MS patients. MS patients’ dietary habits were also sub-optimal when compared to healthy controls suggesting inappropriate nutritional guidance towards maintaining a healthy life style. Dietary deficits included, poor fruit and vegetables consumption (p=0.01), poor fish consumption (p<0.001), and poor milk consumption (p=0.014); all of which are valuable sources for vitamin D, folic acid, and Omega-3 fatty acids all of which are crucial for a healthy nervous and immune systems. Other factors associating with MS in other MS populations such as smoking, sibling order and allergy did not associate with MS risk among Kuwaitis. Another finding is the association of neuronal diseases incidence in families of MS patients when compared to healthy controls (p = 0.006) drove us to investigate the MS genetic risk factors in Kuwaiti MS patients. We have successfully exome sequenced 41 MS patients and 25 healthy controls that are undergoing the process of analysis. A preliminary finding is the lack of association between MS incidence in Kuwait and the most common genetic factor for MS risk, the HLA-DRB1*1501 haplotype. This exciting finding suggests there are other genetic MS risk factors, possibly specific to Kuwait’s genetic background, that predispose to MS incidence when the environmental conditions are met. We hope to finalize the genetic analysis once more MS samples are exome sequenced to fully interrogate all possible genetic factors associated with MS incidence in Kuwait. Our goal is to establish specific MS screening tests, and emphasize preventive, palliative, and treatment options specific for Kuwait to better serve its MS patients.

KFAS Contribution: K.D. 147,000
Total Budget: K.D 147,000
Induced Pluripotent Stem Cells to Model Neurodegenerative Diseases: A Tool for Drugs Development

(2012-1302-03)

H. Yaseen
Kuwait University

Project Progress - Abstract:

The process of drug development requires extensive research and testing to ensure safety and effectiveness of any potential drug. Pre-clinical tests are performed usually on animal models and human cell lines. While access to certain human tissues, including neural tissue is very limited, modeling certain targeted diseases using animal models may not be efficient due to complex polygenetic nature of the disease (neurodegenerative diseases) and physiological and molecular differences between humans and the animals used for testing. Such limitations might account for unpredicted dangerous drug reactions in humans and prolong the overall drug development process. Induced pluripotent stem cells (iPS) might provide a potential tool to model neurodegenerative diseases and provide in-vitro model of such diseases that can be used to study the disease and in pre-clinical stages of drug development process. We have taken the first step towards the generation of iPS cells, we have isolated, cultured, and cryopreserved fibroblasts cells from skin biopsies. Additionally we have isolated, cultured and cryopreserved mouse embryonic fibroblasts (MEFs) which will be used as feeder cell layer for IPS cells after successful reprogramming. Ethical approval has also been obtained from the University and the Ministry of Health. Although administrative paper work and procedures to procure consumables and chemicals significantly delayed the progress of the project in its first year, we took our first steps in establishing the cell lines needed for induction.

KFAS Contribution: K.D. 55,837
Total Budget: K.D. 55,837

Establishment of National Unrelated Hematopoietic Stem Cell and Cord Blood Donor Registry

(2012-1302-04)

S. Al-Shemmari
Kuwait University

Project progress - Abstract

Many patients with malignant and non-malignant blood diseases can only be cured with hematopoietic stem cell therapy. However, the majority of the Arab patients who need stem cell transplantation cannot benefit from the international stem cell registries because of the lack of tissue compatibility and genetic differences. The purpose of this project is to establish a stem cell registry by recruiting enough donor pool to meet the national demand. During the first year of the project, validation of laboratory processes and procedures for the Human Leukocyte Antigen (HLA) typing by high resolution techniques (allelic level) were performed. To further confirm the quality of the HLA typing, external validation proficiency testing was established in collaboration with UCLA DNA exchange for HLA typing. The results of the external proficiency samples were successful for the year 2013-2014.

During the first year, donor recruitment was established. HLA typing for patients and related donors were performed to establish the haplotype segregations among the family members. Furthermore, to assess the willingness of the Kuwaiti nationals to participate in the national registries, a cross-sectional study targeted Kuwait University staff and students to assess knowledge, attitude and intention about
stems cells donation program. A total of 603 respondents participated in this study. The questionnaire covers four domains: socio-demographic characteristics, knowledge, attitude and intentions of the participant. The initial findings of this study were presented in the 10th International Donor Registry and World Marrow Donor Association (WMDA) in London, UK. The next phase of the project is to establish the HLA haplotype frequency estimation and genetic distance for the Kuwaiti population, in addition, to the national stem cell registry modeling and match rate projection.

KFAS Contribution: 513,198 K.D.
Total Budget: 513,198 K.D.

Associations of Telomere Length and Telomerase Activity in Patients with Acute Myocardial Infarction
(2012-1302-05)
Olusegun Mojiminiyi
Kuwait University

Project Progress - Abstract

Telomeres are the TTAGGG sequences at the end of chromosomes necessary for successful DNA replication and chromosomal integrity. When telomeres reach a critical length, the cell will not divide further and become senescent or otherwise dysfunctional. However, telomerase a reverse transcriptase enzyme prevents telomere exhaustion and chromosomal instability. It has therefore been a matter of speculation whether short telomere length is associated with increased risk of cardiovascular disease and early death.

We are aiming to test the hypothesis that short telomere length is associated with increased risk of myocardial infarction. The mechanism behind these findings could be that short telomere length is a marker of a systemic degenerative phenotype arising after years of exposure to cardiovascular risk factors, causing cellular damage and resulting in an increasing frequency of tissue mitosis and thereby shorter telomere length. This relationship might be mediated by insulin resistance and modified by single nucleotide polymorphisms (SNPs) in telomere binding proteins (TRF2, POT1) and TERT subunit. For that purpose, 200 patients with acute myocardial infarction and 200 apparently healthy control subjects will be recruited. Anthropometric measures will be recorded and levels of total adiponectin, insulin and sex steroids will be measured. Telomere length will be quantified using singleplex real time polymerase chain reaction. Due to the increased incidence of obesity in the Gulf region and particularly in Kuwait, we shall be able to find a link between telomere length and obesity associated states (cardiovascular diseases - myocardial infarction).

The spectrum of laboratory and clinical data that we will obtain will help us to identify targets for prevention and control of acute myocardial infarction related to obesity.

KFAS Contribution: K.D. 42,748
Total Budget: K.D. 42,748
National Sickle Cell Disease Registry

(2012-1302-07)

A. Adekile
Ministry of Health, Kuwait University

Project Progress - Abstract

Sickle Cell Disease (SCD) is one of the most prevalent monogenic diseases worldwide. The prevalence of the Hb S gene in the Arabian Gulf, including Kuwait, is about 3%. The pathophysiology of the disease is related to the physico-chemical changes in the mutated Hb S such that there is a chronic hemolytic anemia and recurrent vascular occlusion. With time, most tissues and organs of the body are affected by the disease. There is a need to establish a registry for SCD in Kuwait to document the following: the number of patients followed in different hospitals, the mode of presentation, complications and management options. It is hoped that this will lead eventually to uniform, rational treatment protocols and facilitate national planning. It will foster collaboration with other doctors looking after SCD patients in other Gulf countries and contribute to international research literature on the disease. The registry will be based in the Pediatric Hematology Unit of Mubarak Al-Kabeer Hospital, but there will be participation by the five major general hospitals in Kuwait. Initially the registration will be retrospective to include patients already being followed and subsequently patients will be recruited as they are referred to the clinics. Informed consent will be obtained and confidentiality will be maintained according to international practices. A questionnaire will be filled by the patient’s doctor at recruitment to document personal and clinical data. These will be collected at regular intervals by the registry coordinator and entered into the Microsoft Access Database. The patient’s data will be updated annually. The registry will be analyzed yearly and the findings will be presented to the relevant Ministry of Health authorities and will also be published in peer-reviewed journals and presented at scientific/professional conferences.

KFAS Contribution: K.D. 56,669
Total Budget: K.D. 86,717

Sumudu Characterization of the Maxwell Eigenvalue Problem

(2012-1413-02)

J. Madouh, A. Al-Kandari and F. Belgacem
Public Authority for Applied Education and Training

Project Progress - Abstract

In this project, we investigate the distinction ensued by adding an eigenvalue Magnetically related forcing term, $\lambda m(z, t)H$, on the dynamics of a planar, transverse electromagnetic (TEMP) wave propagating in the direction $z$ in lossy media with constant permittivity $\varepsilon$, permeability $\mu$, and conductivity $\sigma > 0$.

In the presence of the magnetic eigenvalue forcing term, the TEMP is then best described by the Modified Maxwell’s equations, or Maxwell Eigenvalue Problem,

\[
\begin{align*}
(i) \quad \nabla \times E &= -\mu \frac{\partial H}{\partial t} + \lambda m(z, t)H \\
(ii) \quad \nabla \times H &= \varepsilon \frac{\partial E}{\partial t} + \sigma E.
\end{align*}
\]

When the source term, $m(z, t) = 0$, various forms of solutions for the electric and magnetic fields have been determined by various authors, using different techniques. Recently, many aspects of Maxwell TEMP Connoted problem were resolved by using the Sumudu transform technique (see for instance, Belgacem, Husein-Belgacem, Rathinavel-Belgacem). The Sumudu transform technique is not only
robust due to its various desirable attributes such as scale and units preserving properties, elaborated upon in the body of the project, but also it turns out to be user-friendly. In this instance, we use the Sumudu to variationally characterize the principal eigenvalue of Maxwell’s eigen problem, as was done for the Indefinite Ecological problem by Belgacem and Belgacem-Cosner.

The function, $G(u)$, being the Sumudu of $f(t)$, is obtained by integration against the kernel, $e^{-t}$, as follows,

$$G(u) = \mathcal{S}[f(t)] = \int_{-\infty}^{\infty} f(ut)e^{-t}dt, u \in (-\tau_1, \tau_2).$$

As an operator, the domain of the Sumudu extends over the set of functions,

$$A = \{f(t)/ \exists M, \tau_1, \tau_2 > 0, |f(t)| < Me^{\frac{M}{\tau_j}}, if \ t \in (-1)^j \times [0, \infty)\}.$$  

For instance, we have, $\mathcal{S}[e^{\alpha t}] = (\alpha + 1)u^\alpha, \mathcal{S}[t^R] = n!u^R, \mathcal{S}[\exp(at)] = 1/(1-au), for a \in (-1/a, 1/a)$.

The Sumudu Operator exhibits very direct convolution properties, namely, when $M(u)$, and $N(u)$, are the respective Sumudis for the functions, $f(t)$ and $g(t)$, with convolution, $(f * g)(t)$, then, the Sumudu of the convolution of the functions, $f(t)$, and $g(t)$, is given by, $\mathcal{S}[(f * g)(t)] = uM(u)\mathcal{N}(u)$. In particular, the Sumudu of the anti-derivative, $(f^*(t))$, of the function, $f(t)$, is given by, $uM(u)$. The Sumudu of the $n$'th derivative, $f^n(t)$, of $f(t)$, is,

$$G_n(u) = \frac{G(u)}{u^n} - \sum_{k=0}^{n-1} \frac{f^{(k)}(0)}{u^{n-k}}.$$  

For, $n = 1, 2$, we have, $G_1(u) = \mathcal{S}[f^'(t)] = \frac{G(u) - f(0)}{u}, G_2(u) = \mathcal{S}[f''(t)] = \frac{G(u) - f(0) - f'(0)}{u^2}$.

Setting, $a = 1/\sqrt{\mu\varepsilon}, b = \sigma/2\varepsilon$, some of the main results obtained via the Sumudu method are,

Theorem 1 [Husein-Belgacem]: For $m(z, t) = 0$, the transient electric field, $E(z, t)$, in the TEMP problem as described in equation (1), is given by,

$$E(z, t) = e^{-\frac{b}{a^2}} f\left(t - \frac{z}{a} - a \int_{z/a}^{\infty} f(\tau) - \frac{b}{a} \int_{z/a}^{\infty} \frac{\partial}{\partial z} e^{-\frac{b}{a} \frac{\sqrt{z^2 - (ar)^2}}{t^\mu} d\tau.}$$

Theorem 2 [Rathinavel-Belgacem]: For $m(z, t) = 0$, the transient magnetic field, $H(z, t)$, in the TEMP problem as described in equation (1), is given by,

$$H(z, t) = e^{-\frac{b}{a^2}} h\left(t - \frac{z}{a} - a \int_{z/a}^{\infty} h(\tau) - \frac{b}{a} \int_{z/a}^{\infty} \frac{\partial}{\partial z} e^{-\frac{b}{a} \frac{\sqrt{z^2 + (ar)^2}}{t^\mu} d\tau.$$  

In this project we extend theorems 1 & 2 to cases where the source term is acting positively (a positive source) and uniformly, $m(z, t) = m > 0$, and distinguish them from cases where the sourcing term, $m = f(z, t) > 0$, is positive but varying in space and/or time. We give a meaning and a nomenclature to the various cases, and variationally characterize the eigenvalue in each case. Also, there will be a distinction between various cases of boundary conditions (Dirichlet, Neumann and Mixed Robin).

KFAS Contribution: K.D. 4,300
Total Budget: K.D. 4,300
Development of Carbon Supported Hydrodemetallization Catalyst for Kuwaiti Heavy Crude Oil

(2012-1504-01)

M. Singh
Kuwait Institute for Scientific Research

Project Progress - Abstract

The main tasks undertaken were Supports Preparation (Task 2) and Characterization (Task 5), along with some other activities related to the preparation for Tasks 3, 4, 6 and 7. The laboratory works for Tasks 2 and 5 were begun and the preliminary results are summarized. The selection of support played an important role in enhancing the stability of catalysts, as well as properties such as mechanical, textural, and moderate acid sites, which vary not only with the preparation conditions but also with the support composition. Based on the characterization results, a correlation between the support composition, textural properties, and acid strength are illustrated and are partially interpreted.

KFAS Contribution:  K.D. 73,243
Total Budget:  K.D. 147,943

Advanced Crystalline Silicon Photovoltaics Research Program

(2012-1508-01)

Y. Abdulraheem
Kuwait University and IMEC, Belgium

Project Progress - Abstract

Several research activities were undertaken at Imec by KU residents. They included the installation of the Silvaco © simulation software at Kuwait University and the training of research assistants on the software and on experimental characterization that was conducted and will be used in studying samples that were prepared at Imec and shipped to KU for study.

Research activities conducted up to the first half of 2014 has resulted in the publication of 5 journal and conference papers in internationally recognized periodicals and conferences in the field of photovoltaics. So far, two visits were conducted between Imec and KU. During the visit, an update on the status and progress of the work was presented by Imec and KU to the research administration and KFAS and technical presentations and discussions were held between the KU and Imec team.

The research teams will continue research activities according to set plans mainly working on the development of the ibc and n-pert-cell platforms and the amorphous silicon-crystalline silicon interface - both simulation and characterization. Additionally, more equipment is expected to arrive at KU - QSSPC system and the microprobe station where installation and training will take place by the end of September. A new set of activities on the module level were also introduced as part of the Imec-KU collaboration where the effects of encapsulant on the ibc and pert cell performance will be studied by means of opto-electronic simulations using Silvaco © as the main simulation tool.

KFAS Contribution:  598,000 K.D.
Total Budget:  598,000 K.D.
Publications:


Innovative Metal Vapor Laser Spectroscopy with Energy Applications

(2012-1513-01)

M. Makdisi
Kuwait University

Project Progress - Abstract

We shall search the fundamental behavior of hot and dense metal vapor mixtures in new experimental environments, using femtosecond and nanosecond lasers, and various spectroscopic tools and techniques. New complex experimental approaches pertinent to the use of ultrafast (femtosecond) lasers in hot and dense Ba, Sr, and Ca metal vapor mixtures will be especially emphasized. Experiments will be carried out in heat-pipe ovens with and without bias voltage using ultrafast, nanosecond and cw lasers. These will enable inventive use of the optimal coherent control in proposed experiments with dense metal vapor mixtures with fullerenes (Ba-C60, Sr-C60). Multiphoton ionization experiments of the above special alkaline earth mixtures with focused femtosecond laser will be applied (later in the project) in order to observe high harmonic generation (HHG). One of the goals is to propose new spectroscopic techniques for plasma diagnostics in metal vapor mixtures using high harmonic generation. Noble gases (He, Ne, Ar, Kr, and Xe) and fullerenes (C60) will be introduced into heat-pipe ovens in several different ways. The structure of the homogeneous and inhomogeneous parts of the heat pipe ovens will be analyzed using appropriate mixing of metal vapors and gases. Based on our results, we shall develop novel devices (special hot-heat-pipe ovens) for optimal ionization process in energy converters. The final goal will be the optimization of the energy conversion process in order to develop the complete theoretical model and a comprehensive converting device for efficient energy transformation.

KFAS Contribution: K.D. 278,546
Total Budget: K.D. 278,546
A Mobile Unit for Detection of Breast Cancer

(2012-5302-01)

K. Al-Saleh
Cancer Aware Nation (CAN)

Project Progress - Abstract

The National Campaign for Awareness of Cancer (CAN) aims at raising the public awareness of members of the community towards cancer and encouraging the public to adopt a healthy lifestyle that prevents them from developing the disease. The Campaign also adopts a number of promising developmental projects that will help in reducing the incidence of cancer in Kuwait.

Breast cancer is considered as the most widespread type of cancer, both in Kuwait and elsewhere. If detected early, it is the most completely curable type of cancer, hence the importance of its early detection. On one hand, it raises the percentage of successful treatments; on the other hand, it lowers the economic burden on the State and on the public and private establishments, since cancer treatment requires a long time and takes a great deal of effort and money if not detected early.

Therefore the Organizing Committee of the National Awareness Campaign against Cancer (CAN) worked our project CAN MOVE which aims at setting up, preparing and running mobile units for early detection of breast cancer. These mobile units will be distributed to the Governorates of Kuwait to provide this service to the largest sector of the Kuwaiti community. This follows similar projects, which were implemented in a number of advanced countries.

KFAS Contribution: K.D. 82,800
Total Budget: K.D. 82,800

Human DNA Profiling Using STR and SNP Genomic Markers: A Concordance Analysis Project in the Kuwaiti Population

(2012-6302-01)

J. Adullah, M. Fathallah, H. Jarjanazi, M. Alenizi and S. Sangoor
Arabian Gulf University, Kingdom of Bahrain

Project Progress - Abstract

The aim of this project is to carry out a genetic analysis of the Short Tandem Repeats (STR) markers on the Kuwaiti population that is commonly used worldwide for human DNA profiling along with a number of defined SNP markers in the human genome, to form concordance and present its usefulness in pharmacogenomics, population genetics, paternity tests and forensic analysis. The research methodology will be divided into two phases, first phase is to investigate the Hardy-Weinberg equilibrium, observed heterozygosity, expected heterozygosity, matching probability, power of discrimination, polymorphic information content, power of exclusion and typical paternity index of the STR markers in the Kuwaiti population that are commonly used in human DNA profiling. The second phase investigates the allele distribution of 500 to 1000 defined SNP genomic markers in the Kuwaiti population with specific conditions.

The following tasks were completed:

• Collection of 400 samples DNA mouth swab from the targeted Kuwaiti population.
• DNA typing of all the samples for 17 Short tandem repeat sequences using three different internationally used DNA typing forensic kits.
• Analysis of the data generated from the experimental work.

The second and final experimental phase of the project is ongoing to confirm some of the polymorphism/DNA variation specific to the Kuwaiti population that has been strongly suggested through the analysis of the first set of experiments.

KFAS Contribution:  K.D. 16,380
Total Budget:  K.D. 16,380

Hydrodynamics of Nearshore Processes and Its Connectivity to Larval Dispersal and Settlement

(2012-6401-01)

M. AlNajjar
Stanford University and University of Georgia, U.S.A.

Project Progress - Abstract

The project has provided valuable insights into the circulation dynamics of Isla Natividad and we anticipate 2 first-author publications, and 3-4 co-authored publications in leading scientific journals (Journal of Geophysical Research, Marine Ecology Progress Series, Geophysical Research Letters) from this work alone. Additional field studies were conducted in Monterey Bay (not reported here) should also result in 1-2 first-authored publications also in leading scientific journals.

KFAS Contribution: $38,500
Total Budget: $38,500

Restoration and Management for Damaged Ecosystems in the State of Kuwait

(2012-6401-02)

M. Abdullah
Texas A&M University, U.S.A.

Project Progress - Abstract

The central objective of this proposal is to assess and design a restoration plan for a portion of northern Kuwait. Specific objectives of this project that were completed in 2014 include assessment of the protected areas using remote sensing. Landsat images from different years were used to assess the change in vegetation and land classification. We found that while the war itself was not the main source of damage, instead, the subsequent management of the area, due to the war, altered the vegetation. The factor that was affecting the overall desert ecosystem in Kuwait was human population growth, which in turn led to grazing and camping activities that began again after the region was cleared from land mines in 1998. At this time, the vegetation decreased in the unprotected area from 65 km² in 1998 to 3 km² in 2002. This rapid decrease in cover occurred over only 4 years. This result suggests that the removal of these pressures, for example, by fencing off the location, would result in vegetative recovery. Subsequent work on soil erosion will be used, in combination with these remote sensing results, to develop a restoration plan.

KFAS Contribution: $35,550
Total Budget: $35,550
Mixing Induced by Winter Shamals in the Northwestern Arabian Gulf

(2012-6401-03)

F. Al-Senafi
Texas A&M University, U.S.A.

Project Progress - Abstract

The key results from analysis of surface meteorological observations collected in the Northern Arabian Gulf (NAG; Kuwait, Bahrain and NE Saudi Arabia) were documented, which spans a 40-year period (1973-2012). The first part of this study analyzed climate variability in the NAG, in relation to teleconnection patterns (North Atlantic Oscillation, El Nino Southern Oscillation, and Indian Ocean Dipole). Results of the analysis indicate that during the study period, the climate in the region experienced a general trend of increase in temperature (0.8°C), decrease in barometric pressure (1 mb), reduction in humidity (6%), and decrease in visibility (9%). Significant correlations were found between the three teleconnection patterns and the meteorological conditions suggesting that seasonal variability in air temperature, barometric pressure, and precipitation are closely related to the teleconnection patterns. The second part of this study examined the 40 years variability of Shamal events (strong NW winds that commonly generate significant dust storms). The data suggests that on average Shamal events occur at a rate of 10 events per year with 85% of the events occurring during the summer and winter. These events resulted in abrupt changes in meteorological conditions: an increase in wind speed of 2.7 m/s, a decrease in visibility of -1.7 km, and reduction in humidity of -4.3%. The events also varied seasonally for temperature (an increase in temperature during summer of 0.8°C, and a decrease of -1.5°C during winter), and barometric pressure (a decrease in barometric pressure during summer of -0.6 mb and an increase of 7.8 mb during winter).

KFAS Contribution: 20,241 K.D
Total Budget: 20,241 K.D

Potential Native Plant Phytoremediators for Restoration of Petroleum Hydrocarbon Polluted Soils of Kuwait

(2012-6501-01)

S. Al-Ateeqi
University of Glasgow (UK), Public Authority for Agriculture and Fish Resources

Project Progress - Abstract:

During the First Gulf War (1990-91), major hydrocarbon pollution of desert soils occurred in Kuwait because of the damage caused by burning of some 700 oil-wells. We report results from a survey of oil-damaged ecosystems in Kuwait, aimed at establishing the phytoremediator potential of native plant species, which establishes the range and abundance of plant communities characterized by Haloxylon salicornicum, or Cyperus conglomeratus (considered from previous studies to be tolerant of hydrocarbon-polluted soil conditions), plus other plant communities, across gradients of oil pollution stress, and other anthropogenic disturbances (e.g. impacted by high explosives in 1990-91, heavy grazing pressure, or other anthropogenic recreational pressures). That was for the first part of the project, while the second part will be undertaking a fieldwork program that will integrate (selecting sampling locations etc.) the work that has been done to date by KISR (Kuwait Institute for Scientific Research) and other international consultants commissioned by the Public Authority for Assessment of Compensation (PAAC) and Kuwait National Focal Point (KNFP), in assessing the extent of damage.
caused by oil lakes resulting from oil-well fires in 1991, as well as the possible remediation alternative. The sampling sites will be located across a combination of natural environmental gradients (e.g. soil type, and/or desert ecosystem type, both of which vary across Kuwait: Al-Ateeqi & Al-Hurban, 2006), and gradients of oil-pollution stress plus other human disturbance, in order to cover a sensible range of the likely pressures affecting survival of potential phytoremediator species in Kuwait.

Within each selected site, precise geo-coordinates (latitude, longitude and altitude), will be established using GPS, and a minimum of 5 randomly-position quadrats will be sampled around the sampling point. In each quadrat species presence, frequency, estimated cover (5-point DAFOR scale or similar) and mean vegetation height will be recorded, together with an estimate of soil pH (undertaken in situ, or on return to the lab). Soil and plant samples will be collected for subsequent lab analysis of a range of relevant chemical parameters. Datasets on (i) abundance of each plant species present (cover; %F); (ii) mean vegetation height (m); (iii) species diversity (S m·2 and also possibly Shannon-Weiner Index: H); (iv) soil pH; (v) altitude; (vi) latitude/longitude; (vii) semi-quantitative Oil Damage Score (ODS); and (viii) soil and within-plant concentrations (the latter only for the dominant plant species present in the quadrat) of chloride, sulphate, nitrate, and Total Petroleum Hydrocarbons (TPH). The data will be analyzed using TWINSPAN classification and CCA ordination (multivariate procedures which permit analysis of the relative influence of environmental factors predicting plant community composition) to gain insight into plant community response to current environmental conditions in the desert habitats of Kuwait influenced by hydrocarbon pollution.

For the third part of the study (second year part), there is a need to know how much this plant can tolerate from this contamination; so a controlled environment study for the plant species will be established in Green Houses in Alardyiea area with PAAFR help, using a contaminated soil from Alsabria (Bahra) area soil.

KFAS Contribution: 7,000 K.D.
Total Budget: 7,000 K.D.

The Standardization of Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV)

(2013-1109-04)

F. Hadi
Kuwait Society for the Advancement of Arab Children

Project Progress - Abstract:

The Wechsler Intelligence Scale for Children - Fifth Edition (WISC-V) is an individually administered, comprehensive clinical instrument for assessing the intelligence of children aged 6:00 - 16:11yrs. This revision provides subtest and composite scores that represent intellectual functioning in specific cognitive domains (e.g. verbal comprehension, working memory), as well as a composite score that represents general intellectual ability (e.g. Full Scale IQ). A number of other subtests, process, and index scores intended for additional clinical uses are included. The Wechsler Intelligence Scale for Children - Third Edition was standardized in Kuwait by the Department of Psychological Services at the Ministry of Education in 2009. This version is still used in Kuwait, despite of its scores and norms problems. During our task to standardize WISC-IV, a new version of the scale (WISC-V) had emerged. The new version consists of 21 subscales (13 verbal subscales, and 8 performance subscales). Ten of these subscales are from old version, and 11 are new. The WISC-V provides psychologists with diagnosis and clinical features. Therefore, researchers of this project decided to switch from version four to version five for all the features of the new one. At this point, researchers are reviewing the English version of WISC-V to determine the suitability of each item of subscales to Kuwaiti culture. The first pilot testing of 400 children aged from 6:00- 16:11yrs from the six educational regions will take place in September 2015, in order to determine psychometric properties, and orders of items for each subscales. Twelve psychologists will be administering scales in the first pilot testing. Second pilot testing of the revised scales will be in March 2016. The scales will be administered on a sample of 600
children to determine the validity, reliability, item analyses, baselines for each age group, and scoring procedures. Standardization procedures will take place in October 2016 on a sample of 2200 children from six educational regions, age ranged from 6 -16:11 years. This step will estimate norms and usage procedures of the scales for the purpose of diagnosis and clinical uses.

KFAS Contribution: K.D. 94,586
Total Budget: K.D. 117,386

Development of Antimicrobial Nanopackaging Films for Poultry Industry

(2013-1206-01)

J. Ahmed
Kuwait Institute for Scientific Research

Project Progress - Abstract:

Due to the recent food-borne microbial outbreaks and public concern about food safety, the area of food packaging has become more challenging. To develop nanotechnology based on antimicrobial films that are intended for food packaging applications is one of the emerging research activities in the fields of both applied microbiology and packaging. The combination of antimicrobials and nanotechnologies such as nanocomposites can synergistically lead to bio-plastic formulations which have balanced properties and functionalities for their implementation in packaging applications. Furthermore, the transformation of conventional packaging to biodegradable environment-friendly packaging is welcomed by consumers. The aim of this project is to develop nanotechnology-based antimicrobial packaging with the desirable thermo-mechanical and barrier properties along with strong antimicrobial activity against Escherichia coli 0157:H7, Listeria monocytogenes, Salmonella typhimurium and Campylobacter jejuni. This study involves the development of antimicrobial nano-packaging using a combination of natural antimicrobial agents (e.g. clove, garlic and cinnamon oil), and/or metal-nanoparticles (e.g. zinc oxide, silver-copper alloy-nano powder) which are embedded into low density polyethylene (LDPE)/ polylactide (PLA) through melt extrusion and solvent casting methods. The morphology of the films will be visualized using transmission electron microscopy, X-ray diffraction, atomic force microscopy and by scanning electron microscopy and the thermal properties will be investigated using differential scanning calorimetry and the mechanical properties will be measured using the dynamic mechanical analyzer and Instron universal testing machine. The antibacterial activity of films will be evaluated against each microorganism using the inhibition zone test. The outcome of the project will directly benefit the consumers by providing an innovative packaging technology, which can maintain food safety at the highest levels and improve the image of the local poultry industry.

KFAS Contribution: K.D. 77,300
Total Budget: K.D. 139,660
Composition of Steroids and Other Lipid Fractions and Proteins: Their Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes) (2013-1207-1B)

J. Al-Hassan
Kuwait University in collaboration with University of Toronto, Canada

Project Progress - Abstract:

The project involves research in a number of scientific and medicinal specializations, involving local and international experts. Our recent preliminary investigations at MD Anderson Cancer Center (MDACC) in Houston, TX, involving different lipid fractions, showed that some lipid soluble fractions from catfish skin preparations (CSP) have anti-inflammatory as well as anti-proliferative activities against prostate, pancreatic, lung and liver cancer cell lines.

Mass spectrometry will be used to scan all lipids and proteins (fractions or pure components) that have been fractionated and separated at Kuwait University (KU) for the structural characterization and various bioassays in-house to investigate their biological activities with respect to anti-cancer, anti-inflammatory, and anti-thrombotic, activities utilizing highly specialized laboratory facilities. In vitro and in vivo experiments will be carried out to illustrate activities for these fractions and establish mechanisms of action. The Luminex technology will be employed to investigate signaling pathways in plasma affected by selected purified fractions of biological interest after administration to rodents in vivo.

The final goals of the overall project are:

• Alleviation of chronic pain and inflammation;
• Inflammation and neuropathic pain that result from aggressive cancer treatment regimens;
• Introduction of novel treatments for some types of cancer; and
• Studies of-the effects of lipid and protein components on thrombosis and diabetes.

KFAS Contribution: K.D. 226,761
Total Budget: K.D. 226,761

Magnesium Treatment of Inflammation in Disorders of Glucose Homeostasis (2013-1302-01)

O. Alsmadi
Dasman Diabetes Institute in collaboration George Washington University, USA

Project Progress - Abstract

In recent years, increasing awareness of hypomagnesemia has resulted in clinical trials that associate this mineral deficiency with disorders of glucose homeostasis (e.g. diabetes, metabolic syndrome, obesity), along with standard drug therapies for cancer and cardiovascular diseases. However, clinical diagnostic testing for tissue deficiency of magnesium still presents a challenge. Research has shown that sublingual epithelial cell Mg levels correlate better with deep body tissue Mg in heart tissue obtained during bypass surgery and in skeletal muscle biopsies than serum Mg levels. The current world literature does not contain reports of epithelial cell electrolyte changes with many of the
parameters of this proposed study, since nearly all clinical trials rely upon the less relevant serum hypomagnesemia assay. The ability of treatment with magnesium to diminish C-reactive protein (CRP), Tumor Necrosis Factor-α (TNFα), malondialdehyde (MDA) and other parameters of inflammation and oxidative stress has been reported in clinical studies. Investigations of animal and cellular responses to magnesium deficiency have found evidence for complex pro-inflammatory pathways that may lead to greater clinical understanding of mediators of the pathobiology of neuronal, cardiovascular, intestinal, renal, and hematological complications. This proposed study of patients with disorders of glucose homeostasis will assess the efficacy of oral magnesium supplementation on: restoring both cellular and serum levels of magnesium, diminished circulating CRP, TNFα and parameters of oxidative/nitrosative stress and other glucose intolerance parameters. Close collaboration with investigators of the Dasman Diabetes Institute will provide evidence in support of the beneficial role of magnesium supplementation in diabetic patients in Kuwait. By focusing on the cellular deficiency of magnesium, the data from this collaborative research may provide additional evidence for treating the chronic inflammatory processes and other parameters associated with glucose dyshomeostasis. Our results may support a wider application of the cellular magnesium assay not only in diabetes and metabolic syndrome, but also in patients with cancer, cardiovascular and other diseases where magnesium and glucose homeostasis are impaired.

KFAS Contribution: K.D. 76,856
Total Budget: K.D. 76,856

A Comparative Clinical Experiment between Speech Anxiety and Speech Restructuring Treatment Approaches on Kuwaiti Adults Who Stutter (2013-1302-07)

M. Al-Ameer
Fawzia Sultan Rehabilitation Institute

Project Progress - Abstract

The aim of this preliminary investigation was to (a) test the effect of Speech Restructuring (SR on) reducing dysfluencies in Kuwaiti PWS; (b) test the effect of Speech Anxiety Treatment (SAT ) on reducing speech-anxiety in Kuwaiti PWS; and (c) test the transferability of both treatment approaches to the Kuwaiti population. These treatments were originally designed and applied in English and in the western cultures. Therefore, it was important to test them in a different culture and language (Arabic). The finding of this study will be also used to conduct a larger study to compare the effect of both therapies when presented in a different order.

The study included 10 participants (6 males, 4 females) aged between 18 and 39 years (M=22.6, SD= 6.6). Participants were divided into two groups (SR-group and SAT-group). Two assessment assignments took place before and after treatment, where the Stuttering Severity Instrument-4 (SSI-4) and the Unhelpful Thoughts and Beliefs about Stuttering (UTBAS) were used to assess stuttering and speech anxiety respectively. Each group received two weekly treatment sessions for six weeks (12 sessions total). The Camperdown Program was used for SR, and the cognitive-behavior therapy for stuttering was used for SAT. Results showed a significant difference, for both groups, in overall mean change from pre- to post-treatment assessments in both SSI-4 and UTBAS. The overall mean in SSI-4 was 29.40 (SD= 8.644) in pre-treatment and 18.90 (SD= 10.104) in post-treatment data collection. The overall mean in UTBAS was 471.50 (SD= 140.233) in pre-treatment and 326.80 (SD= 104.970) in post-treatment assessment time point. The Wilcoxon test found a significant difference between the two time points for both SSI-4 (p= 0.005) and UTBAS (p= 0.005). For the SR-group separately, the overall mean of SSI-4 was reduced from 33.20 (SD= 7.328) to 22 (SD= 11.916) post-treatment, and the UTBAS mean was reduced from 423.40 (SD= 150.351) to 366 (SD= 136.208) post-treatment. The Wilcoxon test shows a significant difference between the two time points for both SSI-4 (p= 0.043) and UTBAS (p= 0.005).
For the SAT-group separately, the overall mean of SSI-4 was reduced from 25.60 (SD= 8.849) to 15.8 (SD= 7.981) post-treatment, and the UTBAS mean was reduced from 519.60 (SD= 125.926) to 287 (SD= 48.967) post-treatment. The Wilcoxon test indicates a significant difference between the two time points for both SSI-4 (p= 0.043) and UTBAS (p= 0.043).

The current pilot study was conducted to assess the effect of SR and SAT on Kuwaiti PWS, as it was the first study of this kind in the region. It seems that the outcome of both treatments is generally promising in Kuwait. Future study will focus on performing both treatments on the same group, but with an opposite order of presentation. Such design will allow exploring which order of treatment combination is more beneficial for Kuwaiti PWS, SR then SAT or the opposite.

KFAS Contribution: K.D. 1,575
Total Budget: K.D. 1,575

A Mixed Methods Approach to Understanding the Perspectives of Obesity in Kuwait

(2013-1302-08)

E. Hamdan
Fawzia Sultan Rehabilitation Institute

Project Progress - Abstract:

Background: Obesity is highly prevalent in Kuwait, therefore Kuwaitis are at tremendous risks of developing diabetes, various cancers, cardiovascular diseases and chronic degenerative disorders. Although there has been a torrent of research on obesity in Kuwait and the Middle East in general, the majority of this research focuses on the epidemiological trends associated with obesity, rather than the perceptions of obesity, causation, consequences and effective interventions.

Objectives: We are conducting a mixed methods study to understand individuals’ beliefs about ideal body size and their views about the underlying social, psychological, environmental and lifestyle risk factors of obesity. Respondents’ perceptions on the social, psychological and health consequences of obesity, as well as opinions about the facilitators and barriers of weight management and effective interventions are being explored.

Methods and data analysis: Data collection involves the utilization of a chain-referral mechanism (snowball sampling) to recruit participants. Participants go through in-depth, 60 minute, semi-structured interview and are presented with the Stunkard’s figure rating scale to assess body size preferences. All interviews are transcribed (typed up verbatim) and analyzed using the method of Grounded Theory. A series of ANOVAs and t-tests will be used to compare differences in mean Stunkard’s figure rating scores between underweight and overweight men and women.

Project benefits: This research will allows us to ascertain the general perceptions of obesity in Kuwait, while also exploring the beliefs on the risk factors and effects of obesity. Additionally, it allows us to explore the effectiveness of current and future intervention practices for obesity in Kuwait. We believe that the results from the study will be a first step to understanding obesity in Kuwait, ultimately contributing to Kuwait’s goal to mitigate obesity and its associated health risk factors. This research will also help with the development of an obesity treatment clinic, specifically designed for overweight and obese individuals, that is founded on the pillars of participant-driven research.

KFAS Contribution: K.D. 5,000
Total Budget: K.D. 5,000
Graphene-Based Nanoribbons Polymers for Photovoltaic and Optoelectronic Applications

(2013-1506-01)

B. Alameddine
Gulf University for Science and Technology

Project Progress - Abstract:

We propose the synthesis of novel polymers based on Polycondensed Aromatic Hydrocarbons (PAHs) cores. The polymers, which can be sought as a longitudinal cross-section of graphene, will be made solution processable by attaching polyethylene glycol and aliphatic side chains to the aromatic structure.

The high electron density of these polymers will allow for their employment as potential nanomaterials for solar cell and transistor devices. Derivatives of these polymers will be then developed by attaching special functional groups which will improve the non-covalent bonding interactions. This research is expected to be of high impact in the applied field of plastic electronics and will account for a better fundamental understanding of the electron transport and self-assembly in graphene-based polymers.

KFAS Contribution:  K.D. 46,000
Total Budget:  K.D 103,400

Corporate Governance Dilemma at Islamic Financial Institutions: The Effect of Conflict of Interest between PSIA Holders and Shareholders - Kuwait Embedded Case Studies

(2013-6103-01)

S. Alhammadi
University of Reading, U.K.

Project Progress - Abstract

During the academic year 2013/14, a research methods module was completed together with two additional masters-level modules, Advanced Finance Theory with Empirical Applications, and Design, Implementation and Risk Aspects of Islamic Financial Products. Required data for empirical work was collected and preliminary results were documented on the spread in the risk adjusted returns using coefficient of variation between investment account holders and shareholders in Islamic banks. Further analysis is ongoing on the dataset. This research is expected to be of interest to policy makers and academics alike, as it aims to shed light on the impact of corporate governance mechanisms on returns to stakeholders in Islamic banks.

KFAS Contribution:  20,000 K.D.
Total Contribution:  20,000 K.D.
Investigation of Instructor’s Attitudes toward Using the E-Learning in Kuwait University

(2013-6109-01)

A. Ashkanani
Dublin City University, U.K.

Project Progress - Abstract:

Several templates of the research questionnaire were formulated, based on the theoretical framework of this study and after several reviews/discussions with the supervisors. Some of the basic information on Kuwait University faculty was collected, such as, number of instructors distributed by college, available instructor names and e-mail addresses. A pilot study was conducted on a sample of 30 instructors, with the intention to measure the reliability level of the questionnaire items. The pilot study has indicated an acceptable level of reliability as well as the validity and extent of understandability to the questions by the target group. Using the SPSS Package by DCU University to establish the information base for the questionnaire, the research questionnaire was given to the supervisors for review and approval by a panel of experts and academics who work in DCU departments. The questionnaire on Qualtrics was completed and it will be posted on the website, once the it is approved. It will be distributed to all instructors in all colleges of Kuwait University in September 2014. The researcher attended The Second International Conference on: ICT for Serving Disabilities and Learning Difficulties, 19-21March, 2014, in The State of Kuwait. It was a great opportunity to review updates in the field of e-learning. The researcher was selected as one of the evaluation members for the Electronic Commerce Business Competition, conducted at Kuwait University College of Business Administration.

KFAS Contribution: 6,908 K.D.
Total Budget: 6,908 K.D.

Physical Medicine & Rehabilitation Awareness among Medical Students, Resident Physicians and Attending Physicians

(2013-6302-01)

H. Ali and K. Ethans
University of Manitoba, Canada

Project Progress - Abstract:

The project aims to measure physical medicine and rehabilitation awareness and knowledge among medical students, resident physicians and attending physicians in Canada and to investigate how PM&R resident physicians and attending physicians came across the specialty. The views of the concerned groups will be taken into account, while attempting to understand how to increase the awareness as well as to address the lack of it. Based on the fact that, the Kuwaiti and Canadian health systems are very similar in training and patient access and referring system, the outcomes and benefit of this project will benefit both countries to a great extent, such as reducing waiting patient list, delivering better specialized services to the disabled patient population.

This study is highly dependent on the response rate. Therefore, a strong incentive to all participants is essential. Awareness and knowledge among medical students, residents and physicians is low. This deficit can be corrected by designing an educational module. A questionnaire will be e-mailed to undergraduate and post graduate studies departments to three target universities and the same will be emailed to three College of Physicians and Surgeons. Their role is to forward the email to their students, resident physicians and attending physicians.

KFAS Contribution: K.D. 10,000
Total Budget: K.D. 10,000
Effects of a 12-week Cardiac Rehabilitation Program for ST-Segment Elevation Myocardial Infarction Patients in Kuwait: A Quasi-Experimental Trial

(2013-6302-02)

F. Al-Ansari
Swansea University, U.K.

Project Progress - Abstract:

This study will examine effects of a 12-week comprehensive cardiovascular rehabilitation (CR) program for MI patients in Kuwait, which involves exercise and educational sessions (Phase III). The aim of the study is to determine whether a supervised comprehensive CR program can improve physical functional capacity, psychosocial status and healthy lifestyle adherence. Environmental and cultural factors usually affect adherence to healthy lifestyle habits, and regions of the Middle East are easily affected by such factors (e.g. obesity, diabetes), due to unhealthy lifestyle habits and exacerbated by a severe hot climate that militates against regular physical exercise and outdoor pursuits. A tailored program in a safe medical setting could prevent and manage cardiac events, to help reduce the risks, which will be held at the Dasman Diabetes Institute.

This study will be the first to investigate the effects of this new healthcare provision, comprehensive cardiac rehabilitation in Kuwait. The study’s design will be of a quasi-experimental nature, comparing study’s participants with patients that receive the usual after-care, following acute MI, ranging between young adults and elderly, for both males and females.

The study will collect data before and after the 12-week CR program. The objectives set out will estimate measuring effects of change via the outcome measure VO2max, for physical functional capacity, using the cardiopulmonary exercise testing (CPX) as a measuring tool. A secondary outcome measure will be to compare psychosocial status before and after the 12-week CR program using the Health Promoting Lifestyle Profile (HPLP). Adherence to the intervention will be evaluated via interviews with patients who attend less than 8-weeks of the total 12-weeks (drop-out participants) to investigate reasons for non-continuance.

KFAS Contribution: K.D. 12,300
Total Budget: K.D. 12,300
Identifying the Functional Significance of IGF2BP1 Expression in Breast Cancer

(2013-6302-03)

S. Fakhraldeen
University of Wisconsin- School of Medicine and Public Health, U.S.A.

Project Progress - Abstract

CRD-BP/IMP-1 is an RNA binding protein described as showing “oncofetal” expression, thus widely expressed in embryonic tissue, and induced in response to tumorigenesis in many tissue types. In this study, we re-evaluate this description, showing that not only does transcription initiate at a distinct internal promoter in the CRD-BP gene in adult tissues and tumors but the predominant form of the protein is distinct from that expressed in embryos. Overall, CRD-BP expression has been under-reported due to the variety of mRNA species expressed, and the fact that the short-form of the protein is missing key, antibody-reactive epitopes. We show that a CRD-BP mutant mouse strain retains expression of the shorter transcript (ΔN-CRD-BP) originating in intron 2. Also, a long (7kB), let-7-regulated 3’UTR is absent from most tumor cells, eliminating this miRNA-based control mechanism. We find that CRD-BP protein is expressed by both normal and tumor breast epithelial cells, and that it is crucial to the clonogenic survival of mouse and human breast tumor cell lines. Furthermore, both the full-length CRD-BP protein, and the N-terminal truncated version typical of tumor cells, can individually rescue clonogenic activity. In summary, the CRD-BP gene locus shows heterochronic regulation, relying on distinct regulation of transcription initiation in embryos and adults, and CRD-BP is essential to breast tumor cell survival.

KFAS Contribution: $69,884
Total Budget: $69,884
The Dictionary of the Holy Qur’ân

A. Al-Ghunaim

Project Progress – Abstract

The dictionary of the Holy Qur’ân emanated from a noble directive. His Highness, the late Sheikh Jaber Al-Ahmad Al-Jaber Al-Sabah, the former Amir of Kuwait, had vowed to present to the Muslim nation in particular, and the world at large, a dictionary of the Holy Qur’ân that would make it easier to comprehend, elucidate its contents and explain its objectives in a contemporary style that meets the requirements of the average intellectual and does not fall short of the needs of the specialist in the field. In other words, it would be an ‘encyclopedia’ that deals with the Holy Qur’ân: its words and what may represent a technical term or a notion that deserves to be analysed and clarified to qualify as an entry in a dictionary. His Highness – may Allah have full mercy on his soul – assigned the implementation of this significant project to the Kuwait Foundation for the Advancement of Sciences.

The Dictionary is the first to be published in Arabic, translated into English and French, and combines the legislative, historical, geographical, archeological, botanical, zoological and medicinal aspects in words, illustrative pictures and maps. It comprises two main divisions: (1) a series of studies that present the Qur’ân, its history, language, the ways of inferring rules from it, and all the basic issues related to the Qur’ân, and (2) the terms of the Qur’ân itself, i.e. the entries that express its substance and reveal its objectives. The reader can easily understand the term and its explanation, and identify the related terms.

The Dictionary included several lexicons each devoted to a specific subject in order to underscore the significance of the Qur’ân as the eternal Muslim Book, and the source of the various jurisprudential sciences and the course of Muslim life, whether doctrinal, worshipping, legislative or social, between Muslims or international relations with non-Muslims.

As an introduction to these Lexicons, several volumes were issued, that deal with the history, language and rules of the Holy Qur’ân, namely:

1. Introduction: to the Holy Qur’ân, relating to its history and subject matter, written by a number of scholars, published in Arabic, English and French.
3. The language of the Holy Qur’ân, by the late Professor Ahmad Mukhtar Umar, in Arabic.

Several lexicons have also appeared:

1. The Lexicon of Plants and Botanic Terms, in Arabic, English and French.
2. The Lexicon of Medicine, in Arabic and English.
3. The Lexicon of Zoology, in Arabic and English.
4. The Lexicon of the Terms of Civilization, in Arabic.
5. The Lexicon of Names: Part I – Proper Names, in Arabic and English.
6. The Lexicon of Names: Part II – Pseudonyms, in Arabic; an English version is in the press.
7. The Lexicon of Faiths.

The panel is currently engaged in continuing this large project which was well received by those interested in Islamic studies and by intellectuals in general.

- The Lexicon of Ethics.
- The Lexicon of Geography, Astronomy and Geology.
- The translation into English of other lexicons.

This project is related to the Book of Almighty Allah. Its treatment requires the utmost precision and attention. Therefore, the implementation of one volume/lexicon per year, in addition to following up translation work is what could be accomplished in this respect. With this great project, the vow taken by the Amir and the State of Kuwait to the Muslim world would be fulfilled.
NEW PROJECTS

A National Study of Behaviors and Attitudes towards the Sun and Skin Cancer in Kuwait

(2012-1113-01)

E. Al-Hamdan
Fawzia Sultan Rehabilitation Institute

Abstract

The World Health Organization (WHO) estimates between 2 million and 3 million non-melanoma skin cancers and 132,000 melanomas are diagnosed globally each year. Unlike other cancers, a growing body of research has demonstrated that melanoma incidence is increasing over time. American and Australian researchers have published the majority of literature on skin cancer; there is a paucity of data from the Middle East on skin cancer awareness as well as attitudes and behaviors towards the sun.

The objective of our study is to explore the attitudes and behaviors of the population of Kuwait toward the sun and skin cancer through our validated survey. The majority of skin cancers are directly related to sun exposure over time. This study represents, to our knowledge, the first population-based assessment of knowledge and behaviors towards the sun and skin cancer within the Middle East.

A hard-copy survey will be distributed to a random grouping of Kuwait’s population at the Fawzia Sultan Rehabilitation Institute, Kuwait University, American University, Kuwait and Marina Mall to collect data from the Kuwaiti population. In-depth statistical analyses will be performed as described in our proposal with the goal of preparing a manuscript for publication as well as for conference presentation.

KFAS Contribution: K.D. 6,425.728
Total Budget: K.D. 7,427.000
Concomitant Anti-EGFR Antibody (Cetuximab) Plus Hyper-Fractionated Radiotherapy versus Chemotherapy Plus Hyper-Fractionated Radiotherapy in Advanced Non-Metastatic Head and Neck Cancer

(2012-1302-06)

K. Al Saleh
Ministry of Health

Abstract

This is a randomized study comparing the use of cetuximab versus platinum-based chemotherapy with concurrent hyperfractionated radiation therapy (HRT) in locally advanced non-metastatic head and neck carcinoma.

Patients will be randomly assigned to HRT consisting of 120 cGy twice daily, to a total of 69.6 - 75.6 Gys in 58-63 fractions over 6 weeks, plus either platinum-based chemotherapy (Arm A) or weekly cetuximab (Arm B). The overall radiation dose will be the same for the two groups. Locoregional control rate as well as progression free survival (PFS) are set as primary end points, while overall survival (OS) is set as secondary end point as well as acute and late toxicity.

KFAS Contribution: K.D. 35,750
Total Budget: K.D. 49,750

Development of Arabic Therapeutic and Communication Application for Individuals with Dysphasia and Delayed Language Development

(2012-1510-01)

N. Al-Ghurair, H. Qasem, G. Al-Naqi, A. Al-Qattan, A. Al-Qalaf, E. Rashid, L. Al-Kulaib
Kuwait Institute for Scientific Research

Abstract

In 2007, Kuwait Institute for Scientific Research (KISR) won the World Summit Award in the e-Health category for the computer application Arabic Video Phonetics, which was developed in cooperation with phoniatrics at the Kuwait Physical Medicine and Rehabilitation Hospital (KPMRH). KISR has been gaining a well-known reputation in providing technical support for people with special needs. KPMRH had approached KISR to develop a computer-based suite of applications in Arabic language for the treatment and enhancement of two kinds of speech disorders, namely, Dysphasia and delayed language development. According to KPMRH 2010 statistics, there were 721 delayed language development cases and 175 Dysphasia cases registered in KPMRH records with limited number of phoniatrics. A need arises for an Arabic suite of applications to train the cases and test their performance, which is the topic of this proposal.

In this proposal, several computer applications are suggested to be developed separately to be used both at phoniatrics/speech clinic and at home, which will enable them to test their performance and
Designation, Measurement and Localization of Knowledge Productivity in Public Institutions, Kuwait State
(2013-1103-03)

K. Al-Hashash
Kuwait University

Abstract

Global efforts are aimed at transformation towards a competitive knowledge economy in order to strengthen the principle of material and moral returns. A variety of challenges stand out, most notably the absence of a comprehensive mechanism to measure quality and quantity of the efficiency of knowledge production resources, such as human capital, capital structural and capital relations in public institutions of the State.

This project aims at addressing the challenges behind this problem by identifying Productive Knowledge sources in public institutions and distinguish them if they belong to Productive Knowledge which represents the ability to produce knowledge or not and Knowledge Productivity which represents the process of knowledge production, to measure and develop it by identifying institutional standards.

The project seeks to educate public institutions on the importance of Knowledge Productivity and its impact on developing professional and technical capabilities in addition to its main role in enhancing the financial and moral resources.

Total Budget: K.D. 22,300

KFAS Contribution: K.D. 22,300

Study of E-Learning Readiness in Secondary Public Schools in Kuwait
(2013-1109-05)

F. Al-Dhafeeri
Kuwait University

Abstract

E-learning with Information and Communication Technologies (ICTs) is a new approach, and may face numerous challenges. In this project, we propose to study the readiness of instructors and students in secondary public schools in the State of Kuwait. Two E-Learning Readiness Instruments will be developed to survey instructors and students focusing on following critical e-learning aspects: cultural readiness, pedagogical readiness, content readiness, technical readiness, sociological readiness, management readiness, psychological readiness, resource readiness, environmental readiness, financial readiness, and technology readiness.

Total Budget: K.D. 7,175

KFAS Contribution: K.D. 7,175
The Emergence of Flexibility: Towards a Comprehensive Theory for Transferring Experience in Context-Dependent Learning

(2013-1109-06)

O. Hamid and M. Al-Akaidi
Arab Open University

Abstract

In the early days of artificial intelligence (AI), the term “behavioral flexibility» was frequently used to denote the ability of an inexperienced agent to acquire experience through learning in a more or less stationary environment. Today, as artificial systems are becoming increasingly inspired by their biological (natural) counterparts and research is considering also changing environments, «behavioral flexibility» connotes the ability of an already experienced agent to exploit experience, so as to navigate a non-stationary environment.

This project aims at deploying principles of natural intelligence in the design of intelligent E-learning and tutoring systems. Specifically, we investigate how contextual information helps transfer experience within environments, where uncertainty is the only certainty. In such environments, initially irrelevant environmental cues may well, over time, prove vitally important for flexible performance. For example, an intelligent E-learning system would be more effective, if it bases the interactive learning of its users on their individual differences. Such differences could be due to cultural, environmental, or genetic characteristics. Embedding user's individuality enhances the performance of the system, for it lends the system more flexibility.

To this end, we conduct an interdisciplinary research that combines both cognitive and engineering approaches. Specifically, an in-house developed associative learning paradigm requires human subjects to first learn and then memorize sensorimotor associations in the face of unbeknown multiple context reversals. Experience is transferred, implicitly, via the temporal sequence of the occurring events. Building on the analysis of experimental results, we then deploy artificial neural networks together with the theory of reinforcement learning to devise and test computational models that serve the design of flexible artificial systems on the basis of natural intelligent behavior.

KFAS Contribution: K.D. 9,500
Total Budget: K.D. 9,500

Allies’ Use of Photographic Propaganda to Influence Arabs during World War II

(2013-1112-01)

J. Hayes
Gulf University for Science and Technology

Abstract

This project proposes to research and analyze the content of an Arabic newspaper that was published by the Allies throughout the Middle East as an important medium in the Allies’ propaganda campaign to rally support of Arabs to oppose the intervention of Nazis in the Middle East region. A Kuwaiti reader saved a large collection of this newspaper, which will be used for the content analysis. This study will demonstrate how photographs and related captions have been used to influence ideas and decisions during wartime, including how Kuwaitis may have formed their opinions about both Allies and Nazis.

KFAS Contribution: K.D. 6,900
Total Budget: K.D. 6,900
Composition of Steroids and other Lipid Fractions and Proteins and their Anti-Inflammatory, Anti-Cancer Activities in Preparations from the Skin of the Arabian Gulf Catfish (Arius Bilineatus, Valenciennes) (2013-1207-1A)

J. Al-Hassan
Kuwait University in collaboration with MD Anderson Cancer Center, U.S.A.

Abstract

This project is multi-faceted in nature. It involves research in a number of scientific and medicinal specializations. The only way to achieve its goals is to involve local and international experts in these fields. Our recent preliminary investigations at MD Anderson Cancer Center (MDACC) in Houston, TX, involving different lipid soluble fractions from catfish skin preparations (CSP), showed that some fractions have positive anti-inflammatory as well as anti-proliferative activities against prostate, pancreatic, lung and liver cancer cell lines.

Non-steroidal anti-inflammatory drugs (NSAIDs) have been found to markedly reduce cancer incidence and delay progression in patients with breast, prostate, pancreatic, lung and colorectal cancers, suggesting critical role of inflammation in cancer. Recent advancement on stem cells lead to enhanced understanding on the critical role of inflammation on endothelial mesenchymal transitions and cancer stems cells. Thus, targeting inflammatory pathways could ultimately be most effective strategy for both primary and secondary prevention in inflammation-associated cancers. Emerging evidences support the notion that bioactive lipids, particularly arachidonic acid cascade and phospholipids are key mediators that regulate inflammatory process and cancer development. Modulation of the metabolism of the lipid mediators in normal and tumor cells could ultimately be most effective strategy for both primary and secondary prevention in inflammation-associated cancers. Emerging evidences support the notion that bioactive lipids, particularly arachidonic acid cascade and phospholipids are key mediators that regulate inflammatory process and cancer development. Modulation of the metabolism of the lipid mediators in normal and tumor cells could suppress inflammation i.e. reduction of COX-2/PGE2, NFkB and LTB4 and enhance the anti-inflammatory mediators including lipoxins (resolvins and protections). This could form a novel approach both in prevention and management of cancer, metastasis and stem cells survival.

The final goals of the overall project are: alleviation of chronic pain and inflammation, as well as inflammation and neuropathic pain that result from aggressive cancer treatment regimens and introduction of novel treatments for some types of cancer and studies of the effects of lipid and protein components on thrombosis and diabetes.

KFAS Contribution: K.D. 96,407
Total Budget: K.D. 544,654

Characterization of the Role of the Catfish Skin Preparations as Anti-Inflammatory and Neuroregenerative Agents in Crushed Sciatic Nerve Rat Model (2013-1207-1C)

J. Al-Hassan
Kuwait University in collaboration with MD Anderson Cancer Center, U.S.A.
Abstract

This project is multifaceted in nature. It involves research in a number of scientific and medicinal specializations. The only way to achieve its goals is to involve local and international experts in these fields. Our recent preliminary investigations at MD Anderson Cancer Center (MDACC) in Houston, TX, involving different lipid fractions, showed that some lipid soluble fractions from catfish skin preparations (CSP) have anti-inflammatory as well as anti-proliferative activities against prostate, pancreatic, lung and liver cancer cell lines. Preparations from the skin of the catfish (CSP) exhibit potent anti-inflammatory and healing properties, as shown by our previous clinical trials for healing of non-healing diabetic foot ulcers, chronic back pain and other neurological disorders.

Pre-clinical studies of peripheral nerve injury have identified a crucial role for neural tissue inflammation in the onset of neuropathic pain. Activation of immune and immune-like glial cells at the site of nerve injury, spinal cord, and dorsal root ganglia give rise to the production of pro-inflammatory cytokines (e.g. tumor necrosis factor (TNF)-alpha, interleukin (IL)-1beta, IL-6, IL-15, IL-17), which may induce the discharge of neural ion channels and nociceptors, alter the activity of glial cells supporting neural function or induce the degeneration of neurons and Schwann cells. Sciatic nerve crush injury has been widely accepted as the best model to study the mechanism of peripheral nerve regeneration. It allows investigators to perform a standard direct trauma in rat and also results in a lesion similar to those seen in patients with peripheral nerve injury. Keeping in mind the details of nerve secondary injury pathophysiology, we propose the following hypothesis: CSP possess neuroprotective and neuro- regenerative properties to alter, regulate, control and/or render the injured peripheral nerve microenvironment milieu towards more permissive rather than inhibitory effect which in turn may speed up the way to neuronal survival and axonal regeneration by modulating the anti-inflammatory factors. The novel aspect of this proposed study is that it will focus on peripheral nerve fibers and characterize functional and sensory recovery in peripheral nerve regeneration following nerve crush injury and treatment with CSP. The final goals of the overall project are: 1) alleviation of chronic pain and inflammation, as well as inflammation and neuropathic pain that result from aggressive cancer treatment regimens; 2) introduction of novel treatments for some types of cancer; and 3) studies of the effects of lipid and protein components on thrombosis and diabetes.

KFAS Contribution: K.D. 306,147
Total Budget: K.D. 544,654

Molecular Diagnosis for the Rapid Detection of Bovine Tuberculosis in the State of Kuwait

(2013-1207-02)

S. Al-Mouqatea and M. Razzaque
Kuwait Institute for Scientific Research

Abstract

Bovine tuberculosis (bTB) is a disease caused by Mycobacterium bovis having a major negative economic impact on the livestock industry. Cattle are the principal hosts for M.bovis and responsible for maintaining the disease. Humans and domestic and wild animals including sheep, goats, camels, horses, dogs and foxes are also susceptible to M.bovis infection. bTB has been reported in Kuwait. In 2007, several employees of Public Authority for Agricultural Affairs and Fish Resources (PAAFR) and eight laborers of livestock farms were infected. In 2009, more dairy farms were found positive for bTB and the affected cattle were condemned by PAAFR. Because of the adverse social and economic impact that the disease imposes on livestock and the people of Kuwait, development of surveillance, testing and control programs are needed to detect new cases and eradicate the disease. The objectives will be to quantify the magnitude of the bTB problem in Kuwait; assess the nature of the epidemiological features, incidence and transmission of bTB. Technical cooperation will be requested from the Ministry of Public Health (MOH) and (PAAFR) and livestock producers of Kuwait for meeting
the above objectives. Six operating tasks will be undertaken for achieving the objectives. Rapid and highly sensitive molecular diagnostic tools such as Real-time PCR and ELISA (Enzyme Linked Immuno Sorbent Assay) will be evaluated and compared with traditional, intraderm reaction-based and slaughterhouse inspection-based diagnostic schemes. The anticipated output will be the generation of baseline data on the status of bTB in the livestock population of Kuwait and recommendations of strategic control and surveillance program for control and eradication of bTB. This is the first proposed project at Kuwait Institute for Scientific Research (KISR) for a systematic investigation of bTB in livestock production subsector of Kuwait. Based on the results, further studies will be pursued.

KFAS Contribution: K.D. 73,750
Total Budget: K.D. 141,840

Cytokine Production Patterns in Osteoporosis

(2013-1302-02)

F. Azizieh
Gulf University for Science and Technology

Abstract

Osteoporosis is a significant public health issue. Considering its extent, predicted growth rates, and growing economic impact on health care, osteoporosis is set to rise alarmingly worldwide. A variety of compounds, including hormones and nutrients, are known to modulate bone remodeling. In addition to these well-characterized substances, the immune system plays a role in this process through the involvement of pro-inflammatory cytokines. Cytokines play important roles in the regulation of normal bone remodeling, as well as in bone resorption and formation during pathologic bone remodeling.

Recent studies have suggested that bone loss in women at post-menopausal period is mediated, at least in part, by increased production of certain cytokines. It is reported that a similar situation characterizes inflammatory arthritis. Rheumatoid arthritis is an example of rheumatic diseases in which inflammation is associated with skeletal pathology.

This project is designed to compare cytokine profiles in postmenopausal osteoporotic women, patients with rheumatoid arthritis and normal healthy individuals. We propose to compare the production patterns of selected osteoclastogenesis stimulator cytokines TNF-α, IL-6, IL-12, IL-17 and osteoclastogenesis inhibitor cytokines IL-4, IL-10, IL-13, IL-18, IFN-α and the inflammatory cytokines IL-20 and IL-23 produced by peripheral blood mononuclear cells (PBMC). PBMC from these subjects will be stimulated with the mitogen phytohemagglutinin and the levels of cytokines will be estimated in culture supernatants by ELISA. Serum levels of the chemokine mediators RANK-L and OPG in the serum of the subjects will also be estimated by ELISA. The results are expected to shed light on possible links between cytokine profiles and bone health.

Research along the lines described in this proposal will contribute to better understanding of the etiopathology underlying osteoporosis, and may subsequently contribute to the development of strategies for reversing systemic bone loss associated with the disease, by targeting both the bone and the inflammatory process.

KFAS Contribution: K.D. 24,800
Total Budget: K.D. 24,800
Face Recognition Using Thermal Imagery Characteristics 
(2013-1510-01)

N. Zaeri
Arab Open University

Abstract
Recent advancement of the technologies in the field of biometrics and pattern recognition provides the opportunities for researchers and scientists to explore in depth the thermal human face image signals and to convert information into a meaningful knowledge through computational-based models, for the task of identification and recognition. Recently, researchers have investigated the use of thermal imagery for face recognition with good results. The advantage gained from working with the Infrared (IR) imagery type of sources is that the eye is not sensitive in this range, and illumination can be used in a more flexible way. The anatomical information which is imaged by infrared technology involves subsurface features believed to be unique to each person. Also, the IR face recognition, being not vulnerable to facial skin and expressions, can eliminate the drawbacks of face recognition in visible light. In this project, we investigate this promising field of biometrics and study the thermal imagery for human face recognition as an innovative area for machine vision. We discuss the advantages and the challenges associated to this field of study. We aim at proposing a new and simple solution for thermal face image recognition using the local statistical characteristics of a thermal image. We believe that by considering the statistical features at the component level, beside the “whole” image, the system performance will be enhanced. These characteristics and features will be combined together using a certain fusion method.

KFAS Contribution: K.D. 15,750
Total Budget: K.D. 15,750

Symbolism and Inspiration in Modern Kuwaiti Literature: The Absurd Theater of Sulaiman D. Al-Hezami As a Case Study 
(P114-11AA-01)

S. Arkadan
Gulf University for Science and Technology

Abstract
This study is a scientific critical study of the absurd theater of the creative Kuwaiti writer Sulaiman Al-Hezami. It aims to achieve a number of scientific, literal and aesthetic objectives preceded by the definition of the literature domain by its cultural - literal art inside and outside Kuwait. It is proposed to achieve this through the provision of the writer and his methods of innovation and enquiring on how to treat the realities and challenges of his current anti-future surrounding environment and society. In addition, it is proposed to focus on the distinctive and innovative language of the writer and how it is used in the presentation of his vision of reality and challenges and the use the solutions in various fields (cultural and social). The language that characterizes his writing, especially theater of the absurd makes the writer an important Arab patron.

KFAS Contribution: K.D. 5,000
Total Budget: K.D. 5,000
Cinema in Kuwait: A Critical Study of Development of Film Industry in Kuwait
(P114-11AM-02)
J. Malekpour
Gulf University for Science & Technology

Abstract
According to most histories of the cinema, this form of entertainment was created in and around 1890s and the first true narrative film was made in 1903. The Great Train Robbery, directed by Edwin Porter at the Edison Film Company established an industry that has been one of the most important industries, economically and culturally. Today, Bollywood makes more than 1200 films a year while Hollywood makes around 700. These cinemas are not only a form of entertainment in India and the United States but is a cultural foundation, which also reflects the sociological structure of those nations and its influence on other cultures. Kuwait was not exempted from this phenomena and evidence states that in fact a film, Son of Sindbad was shot in Kuwait in 1939 by an Australian photographer Alan Villiers and a few years later “Kuwait Cinema Company” was established in 1954 to establish movie theatres and import and screen films for the Kuwaiti and expats living in Kuwait. Therefore, we can argue that Kuwait was one of the first countries in the region, which welcomed this new form of entertainment. No surprise that in 1972, Kuwaiti national, Khalid Al-Siddiqi, produced BAS ya Bahar (The Cruel Sea) promising the birth of a national cinema in Kuwait. Unfortunately, this was not the case and despite many attempts, Kuwaiti cinema in 80s and 90s start diving down till today.

This research will attempt to argue that the rise and the fall of the Kuwaiti cinema and document and structure it so that the new generation will be able to be inspired and motivated to regenerate the cinema that Kuwait was once a pioneer in the region. As this research is about cinema (a visual art form), I will make a DVD to accomplish this research visually.

KFAS Contribution: K.D. 7,200
Total Budget: K.D. 7,200

Violence and Women in Kuwaiti Society: The Prevalence of Violence against Kuwaiti Women and its Relationship to their Mental and Physical Health
(P114-11OS-01)
H. Al-Kandari
Kuwait University

Abstract
The present study aims to identify the prevalence of violence against women in Kuwaiti society and its impact on the physical and mental health. The study will select nearly 4,000 people from various Kuwaiti cultural backgrounds. The sample will randomly be selected to include adult males and females, aged 18 years and older, married and unmarried, and from various educational levels. Measures will be adapted to identify the prevalence of violence against women in Kuwaiti society, the impact of violence on physical and mental health, the factors that help to protect women from violence, the sources used by women to protect them from violence, and attitudes toward violence against women. We will benefit from the results of the study in the development of recommendations for the protection of Kuwaiti women from violence and the prevention of it and determine the importance of establishing a center for battered women and enacting laws to guard against violence.

KFAS Contribution: K.D. 4,600
Total Budget: K.D. 4,600
Assessment of Iodine Status among Elementary School Children and Pregnant Women in Kuwait

(P114-13MC-01)

Q. Al Dowairy
Ministry Of Health

Abstract

Iodine Deficiency Disorders (IDD) continue to be an important public health problem in many countries and the main cause of irreversible mental retardation. Iodine is one of the vital micronutrients required for optimal health throughout the life cycle. Assessing iodine status in populations is recommended by International Council for Control of Iodine Deficiency Disorders (ICCIDD). It is crucial to set appropriate intervention policies. However, data on iodine status in Kuwait are insufficient.

Hence, the aim of this study is 1) to determine iodine status among primary school children and pregnant women and 2) to determine the iodine content of salt used for food preparation at the household level. The study will be carried out through a non-interventional and cross-sectional method. It will be school-based for school children and clinic-based for pregnant women. A total of 2600 subjects will be recruited in the study. The subjects will include 2100 healthy school children aged between 6 to 12 years from both genders from the list of 12 cluster (schools) representing the primary schools of the 6 governorates of Kuwait and 510 healthy, pregnant female aged 21 years and over from the records of maternal care unit of 5 clusters (primary health care centers) representing the maternal clinics of all Kuwait governorates. Casual urine samples will be collected from all subjects and will be sent to an external reference laboratory in Dubai as recommended by ICCIDD to estimate Urinary Iodine Excretion (UIE) levels according to the criteria set by WHO/ ICCIDD 2007 Guidelines. The study will also enable collection of 2100 samples of 20 grams household salt by school children. The iodine content in these samples will be determined in food laboratory of MOH. Analysis of urine samples from the school children and pregnant women will show the iodine status in Kuwait which can be compared to the international standards and analysis of the household salt, which will confirm that Kuwait is implementing the regulation that iodization of salt at the household level is obligatory.

KFAS Contribution: K.D. 48,750
Total Budget: K.D. 48,750

Review Design of Concrete Structures: Evaluating Learning Effectiveness

(P114-15EV-01)

M. Jaeger
Australian College of Kuwait

Abstract

Competent design of concrete structures is one of the most important factors for the sustainable development of infrastructure. Consequently, “concrete structures” is considered a core unit in construction and civil engineering education, and students learn concrete design skills through traditional or problem-based learning approaches.

The “review of the application of design of concrete structures” is not an integrated learning outcome in all curricula. However, it is one of the learning outcomes in the diploma unit “RIICWDS33A - Prepare detailed design of civil concrete structures” as published by Training.gov.au, the National Register on Vocational Education and Training (VET) in Australia (Training.gov.au. 2014).
The purpose of this research project is the analysis of the effectiveness of learning "reviewing concrete design", when comparing two different learning approaches. The first learning approach is based on a traditional instructional approach where vocational engineering students learn the basics of concrete design through lectures and tutorials. The second learning approach is based on an active learning approach where vocational engineering students learn the basics of concrete design through hands-on implementation of simple concrete structures.

Methodologically, the difference of learning effectiveness can be analyzed by carrying out semi-quasi pre-test/post-test experiments with an experimental group of students and a control group of students. Practical and statistical significance will provide insights regarding the learning effectiveness of both approaches and allow conclusions for the curriculum design of concrete design-related training courses and civil engineering education in general.

**On the Classification of 4-Dimensional Division Algebras over Finite Fields GF(q)**

*(P114-16SM-01)*

**M. Ata**
Public Authority for Applied Education and Training

**Abstract**

The project aims to classify 4-dimensional division algebras over finite fields \(F_q\), \(Q\) odd prime, and admitting elementary abelian group of automorphisms \(E=2^2\). This classification will mainly be based on Chevalley-Warning theorem and on Lang-Weil bound for the reducibility of homogeneous polynomials over algebraic closures of finite fields. It is expected that this project will lead to the classification of 8-dimensional division algebras over finite fields \(F_q\), admitting elementary abelian groups \(E\) of order 8 as an automorphism subgroup, and the existence of such division algebras. Certain computer programs at certain stages of the project will be used to conduct certain computations. Many Kuwaiti researchers in this domain and in particular graduate and Ph.D students at the Kuwait research centers will benefit from the results of this project.

**KFAS Contribution:** K.D. 8,250  
**Total Budget:** K.D. 8,250

**Modelling and Design of Nano-Structures: Efficient Integral Equation Methods for Two-Dimensional Nanoplasmonics**

*(P114-16SM-02)*

**H. Kurkcu**
Gulf University for Science and Technology

**Abstract**

Nanoplasmonics forms a major part of the field of nanophotonics, which explores how electromagnetic fields can be confined over dimensions on the order of or smaller than the wavelength. Initiated in 1902 by R.W. Wood with the discovery of grating anomalies, this phenomenon has attracted significant
attention over the last century. Current applications relate, for instance, to bio-sensing wherein the binding of analyte molecules to a properly treated metallic arrangement can provide a very sensitive means to detect their presence through a shift in the resonant (plasmonic) frequency. The potential for further impact is even greater as the confinement of light in sub-wavelength regions can clearly provide significant gains in a wide variety of areas (e.g. telecommunications, microscopy). We believe that state-of-the-art computational thinking can be used to dramatically improve the design process for nanostructured optical materials. The Principal Investigator (PI) proposes to develop new fast and accurate simulators that can be used for real-time design. The use of such can only proceed when fabrication processes have advanced to the level of allowing for very fine control of metallic patterns. This, in turn, justifies the use of accurate schemes that, as the PI expects, will replace current practices which still rely largely on old-fashioned and inaccurate techniques (such as the ever-popular «FDTD»). Although alternatives to these have been pursued (finite elements, integral equation methods), each one of these is limited in accuracy and/or efficiency, rendering them of limited use in virtual design. On the other hand, the schemes we propose are based on high-order (spectral) treatment of the (integral-equation formulation) mathematical models and they can thus deliver highly accurate solutions in significantly lower computational times. We feel that careful structuring of the necessary computations is critical to achieving this aim.

KFAS Contribution:  K.D. 5,000
Total Budget:  K.D. 5,000

Assessing the Impact of Western-Style Higher Education in Kuwait on Intercultural Effectiveness and Business Communication Patterns

(P114-19TT-01)

F. Al-Sumait
Gulf University for Science and Technology

Abstract

As part of their national development plans, the Gulf Cooperation Council countries have focused heavily in recent years on enhancing higher education in the region. A common strategy has been to increase the number of Western-affiliated universities, such as those found in Kuwait. However, due to their relatively recent entrance into the region, little is currently known about the various impacts these universities have on both educational outcomes and cultural practices. The present project, therefore, assesses the key influences of «Western-style» education on the intercultural attitudes and cross-cultural communication patterns exhibited by Kuwaiti undergraduate and graduate students. Specifically, the study attempts to identify the style and development of students’ intercultural effectiveness, as well as their cross-cultural communication patterns, which are increasingly relevant in today’s business and educational environments. The study is divided into three phases, each with interrelated goals and data-collection instruments designed to provide a triangulated measurement of the study’s central concepts. Phase 1 analyzes written communication patterns to identify important features of local business communication. Of particular interest are differences in the patterns of «context» employed by varied participants. Phase 2 assesses the “intercultural effectiveness” of Kuwaiti business students by means of an internationally validated instrument called the Intercultural Effectiveness Scale (IES). This survey will be administered at both the initial and final stages of university education to provide evidence for a given university’s effectiveness in creating global-ready business graduates. Phase 3 provides insight into the question of «why» specific patterns emerge from the previous two phases through the use of in-depth, semi-structured interviews. These interviews enable participants to reflect on their own cultural behaviors and intercultural aptitudes, as well as their perception of these traits in others. The combined data cover both deductive and inductive approaches, quantitative and qualitative methodologies, and branch differing disciplines and national interests.

KFAS Contribution:  K.D. 12,620
Total Budget:  K.D. 15,620
MAK - Modernist Architecture in Kuwait: A Systematic Inventory for the Preservation of Kuwait Modern Heritage (1955-1985)

(P114-55EA-01)

R. Fabbri
Dar Al Athar Al Islamiyyah

Abstract

For about twenty years, from the 60s to the early 80s, Kuwait catalyzed the attention of major international designers working with local firms and local authorities, and leaving on the ground very important examples of late modern architecture. As Kuwait gained independence and autonomy, the necessity of a new landscape to represent the fresh founded state grew high.

This extraordinary presence of valuable designers (Dar al Handasah, Hassan Fathy, G. Sultan, S. Makiya, S.O.M., T.A.C., A. Roth, P.L. Nervi and many others) operating almost in the same period on a single city was certainly a gift for Kuwait but at the same time, like all the transformations that happened fast, it boosted the critic of superimposing a different culture (and taste) over the local traditions. The result is that, in general, nowadays, there is a lack of knowledge and big misconceptions about these architectures.

The local population is showing disaffection, a low sense of belonging to these spaces and very few measures were taken in the past years to promote the conservation and restoration of this important heritage. Erasing this part of the national history, and this local and international architectural heritage, is a big loss for the country and a missed opportunity to investigate the recent Kuwait history. Conservation attitude can come only after a process of knowledge.

Therefore, this research project is the first systematic survey and in-depth thematic investigation of Kuwait modernist heritage and concrete architecture. Following the path of previous studies done for the pre-oil houses, the research aim is to collect all the possible information, including drawings and original picture/videos of the major buildings. A custom-made digital database will collect and organize all this information for a number of 150 buildings already shortlisted (between 1960s-1980s).

The output of the research will be the content for a double-language publication/catalogue and an exhibition to be displayed at the American Cultural Centre by Dar al Athar al Ismaiyyah.

KFAS Contribution: K.D. 75,167
Total Budget: K.D. 132,667

Kuwaiti Female Labor Force Participation: Agency and Development Sustainability in Kuwait

(P114-61IC-01)

S. Garrison
American University of Kuwait

Abstract

To contribute to the State of Kuwait’s new plan for “reform and development,” of which the development of human capital is an important element, this research will identify the drivers behind female labor force participation in Kuwait which (according to World Bank statistics) is low as compared to other high-income countries, world averages, and many non-Arab Islamic societies. To do so, research will
explore the nature of the female labor market in the context of the dominant traits of Kuwait—an oil-rich, Islamic society with a high migrant labor population—and consider what social, economic or political forces shape the female labor market and drive the demand and supply of female labor. In addition, research will consider the role of agency in improving female labor force participation and overall participation in Kuwait’s sustainable development. To foundationally inform this study, research will seek a basic understanding of the Kuwaiti woman’s experiences, definitions, and perceptions of her capability and agency in society and the workforce. The ethnographic methods of in-depth interview, observation, and secondary data will be used to study Kuwaiti women in Kuwait.

In addition to enhancing the development strategy of the State of Kuwait, this research attempts to add to the wide gap in scientific literature regarding the female labor market and female labor force participation in oil-rich Islamic societies with high-migrant populations, and particularly the gap in research on the female labor market in Kuwait.

**KFAS Contribution:**  K.D. 7,628  
**Total Budget:**  K.D. 7,628

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**Structure and Function of High Density Lipoprotein (HDL)**  
(P114-62MB-01)  
F. Alkandari, M. Caslake and C. Packard  
University of Glasgow, U.K.

**Abstract**

The aim of this PhD thesis is to determine whether measurements of High Density Lipoprotein (HDL) functions, subclass levels, particle size, or particle number are of clinical importance in evaluating an individual patient, which will also depend on further clinical and epidemiological studies, including the evaluation of these HDL markers, in ongoing longitudinal studies that also include measurements of underlying subclinical atherosclerosis.

**KFAS Contribution:**  £ 14,102  
**Total Budget:**  £ 14,102

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**The Effect of Anthropogenic Disturbance on the Ecology and Physiology of Dhubs (Uromastyx aegyptius) in Kuwait**  
(P114-62SL-01)  
M. Al Sayegh  
Arizona State University, U.S.A.

**Abstract**

In order to fully understand the impact that anthropomorphic changes have on a species, it is necessary to first gain knowledge about the mechanisms that enable a species to tolerate environmental challenges. The agamid lizard Uromastyx aegyptius, otherwise known as the dhub, have been directly and indirectly affected by human disturbance. Anthropogenic disturbances of the ecosystems, in which dhubs live, challenges the plants upon which dhubs feed and therefore the long-term persistence of dhubs. This study will examine the adaptations that enable dhubs to manage thermal, energy, and water
constraints associated with their desert environment, as well as the extent to which current measures to protect habitat in Kuwait is benefitting dhub ecophysiology. The goal of the study is to provide vital information to improve protection and conservation plans in order to increase the chances of dhub persistence in Kuwait. Our hypothesis is that anthropogenic disturbances are negatively affecting the ability of dhubs to maintain energy and water balances, but that preservation of habitat with the resulting return to a more healthy ecosystem promotes the likelihood of the species’ persistence in Kuwait.

Our study will test the following questions:

1. Does habitat protection positively affect both the vegetation community and dhub population ecology?
2. What is the influence of habitat protection on dhub ecophysiology?
3. What is the interrelationship among temperature, metabolic rate, and evaporative water loss in dhubs?
4. What physiological adaptations enable dhubs to exist in their extremely water-limited environment?

KFAS Contribution:  US$ 20,793
Total Budget:  US$ 20,793

The Use of Alu Elements in Forensic Medicine:
A Study on an Arab Population

(P114-63MC-01)

S. S. Abumarzouq
Arabian Gulf University, Kingdom of Bahrain

Abstract

Alu elements represent a family of short interspersed DNA elements (SINEs) found in primate genomes. These are members of a group of transposable elements that integrate into the genome by the process of retro-transposition. Recent integrations of Alu elements within the human genome have generated presence/absence of variants useful as DNA markers in human population studies, as well as forensic analysis. Besides the ease of use, this type of marker is unique because the absence of the Alu represents the ancestral form. However, Alu repeats exhibit less variation than multiplex Short Tandem Repeat (STR) profiles would, therefore, most likely be used to gain more information on an unknown sample rather than as an independent source of identification in forensic world. Because of these characteristics, polymorphic Alu elements are useful in studies of human genetic diversity and forensic analysis.

The aim of this study is to provide a database of Alu insertion polymorphism in Kuwaiti population to ascertain the inferred geographic ancestry of unknown human DNA samples. Also, it aims to search for an Arab-specific new Alu element in Kuwaiti population as a new tool in forensics. In addition, the application of Alu elements based methods will be studied as a new tool to be used in Kuwait forensic investigations, such as, identifying an unknown individual gender and as well as in medical and scientific applications. DNA will be extracted from 500 adult blood samples and the nature of the candidate Alu loci will be evaluated by its presence or absence in human samples. These samples will be subjected for genetic analysis using known Alu insertion polymorphisms and mobile element-based sex typing assay. Standard PCR reactions for agarose gel-based detection will be carried out for the amplification and population study. Also, the samples will be subjected for the identification of new Alu insertion that might be specific for Kuwait/Arab population using the recent mobile element scanning (ME-Scan) technique.

This project will offer new tools that can be used in Kuwait forensic medicine investigations. Alu elements based methods are significantly useful in narrowing the pool of investigation in addition to
the identification of unknown sample gender. Moreover, this study will provide databases for Kuwait population that can be used latterly in different projects of application including pharmacogenomics, disease project and population genetics as well as forensic medicine.

KFAS Contribution:  K.D. 7,300
Total Budget:  K.D. 7,300

App-Delivered Therapy for Arabic Readers with Hemianopic Alexia

(P114-63MC-02)

S. Al-Ragam
University College London, U.K.

Abstract

Hemianopic Alexia is a specific reading disorder that is related to a visual impairment mainly caused by stroke or head injury. This damages a person's vision relating to one half of the visual world (hemianopia). For readers of English text (left-to-right readers), the hemianopia is usually on the right side, for readers of Arabic (right-to-left readers), the hemianopia is on the opposite, left side. In order to read, you have to move your eyes along a line of text three to four times per second. To do this efficiently, you make use of the visual information to the right (English) or left (Arabic) of where you are looking. Patients with hemianopic alexia are deprived of much of this information and make many extra eye movements. This slows them down significantly, often preventing patients from being able to read efficiently for work or pleasure. I am interested in exploring the rehabilitation of hemianopic alexia in Arabic readers after stroke, a condition that currently has no assessment or treatment resources. The aim is to develop novel Arabic reading tests and rehabilitation materials. In English, a treatment package delivered via the website http://www.readright.ucl.ac.uk/ has already been developed. My project will (1) translate this package into Arabic, (2) develop new Arabic reading test materials and (3) collect data from Arabic stroke patients in a Phase 2 clinical trial. This will provide an effective, novel, and scientifically proven reading treatment package for Arabic readers with hemianopic alexia helping them read again.

KFAS Contribution:  £ 20,000
Total Budget:  £ 20,000
Techno-Economical Evaluation of the Production of Bio Drugs: Study of Two Processes for the Manufacturing of Recombinant Human Biodrug Interferon-Alpha

(P114-63MM-01)

D. Al-Otaibi
Arabian Gulf University, Kingdom of Bahrain

Abstract

Biodrugs are set to dominate the pharmaceutical market. Fifty-seven percent (57%) of the drugs currently in development are biodrugs. Currently, the market cost of Biodrugs is very high which restrict their large availability and make their use an economic burden to the health care system. Therefore, mastering of the techno-economic aspects of the production of biodrugs is crucial for the development of new biopharma industry in the gulf countries. In addition, controlling the techno-economic aspect of their manufacturing will contribute to lowering the prices of drugs. This work consists of analyzing the techno-economic aspect of the manufacturing of recombinant human interferon alpha, an important multi-indication biodrug considered to be life-saving in hepatitis B and indicated in 14 types of cancer. The work shall be carried out on two manufacturing processes that were developed by my PhD supervisor. The two processes hold international patents. The first allows the production of recombinant human alpha interferon from Escherichia coli bacterium and the second from the yeast Pichia pastoris. The evaluation of the techno-economic aspect of the manufacturing of interferon alpha using each process will be carried out throughout the development of a pilot study in a 20 liter fermenter. Each of the upstream (biomass production) and the down stream process (purification) steps will be monitored for capital cost and running breakdowns. The fixed capital investment will be approximated using the Lang factorial method with factors in the range of 4-7 that are more suitable for the biopharmaceutical sector. Operation costs related to the manufacturing processes will be calculated. Finally, the economic performance of each process will be compared taking into consideration the yield and specific activity for the final product from the two processes.

KFAS Contribution: KD 9,500
Total Budget: KD 9,500
Multiplying the Optical Fiber Channel Capacity through Spatial Multiplexing

(P114-65EE-01)

S. Alanzi
Florida Institute of Technology, U.S.A.

Abstract

A novel and revolutionary spatial division multiplexing (SDM) and orbital angular momentum of photon (OAM) based technique for optical fibers has been developed. These patented techniques provide a method to launch, transport and detect two or more optical channels that operate at exactly the same wavelength inside a single optical fiber. These techniques add two new dimensions and two new degrees of photon freedom to existing fiber multiplexing techniques and complements time division multiplexing (TDM) as well as wavelength division multiplexing (WDM). As a result, the bandwidth of existing and new optical fiber systems can be increased by multiple folds. As a result, multi-TB/s hybrid architecture are feasible. This endeavor is intended to summarize the operating principles of spatial multiplexing technique and to lay down the road map leading to optimum utilization of this innovation.

KFAS Contribution:  K.D. 14,558
Total Budget:  K.D. 14,558

Publications:

• Analysis of spatial domain multiplexing/space division multiplexing (SDM) based hybrid architectures operating in tandem with wavelength division multiplexing, Syed Murshid; Greg Lovell; Bilas Chowdhury; Arnob Hridoy; Gurinder S Parhar;Abhijit Chakravarty; Saud Alanzi. Proc. SPIE 9202, Photonics Applications for Aviation, Aerospace, Commercial, and Harsh Environments V, 920214 (5 September 2014).

• Analysis of an all optical de-multiplexer architecture utilizing bevel design for spatially multiplexed optical fiber communication systems, Syed H. Murshid; Michael F. Finch; Gregory L. Lovell


• An order of magnitude improvement in optical fiber bandwidth using spatial domain multiplexing/ space division multiplexing (SDM) in conjunction with orbital angular momentum (OAM), Syed Murshid; Saud Alanzi; Arnob Hridoy; Greg Lovell; Gurinder Parhar; Abhijit Chakravarty; Bilas Chowdhury. Proc. SPIE 9202, Photonics Applications for Aviation, Aerospace, Commercial, and Harsh Environments V, 92020U (5 September 2014).
ENVIRONMENT

Completed Projects  14
Ongoing Projects    20
New Projects        7
During the fiscal year, renewed efforts were directed towards addressing Kuwait’s fish resource management, food security and desertification issues. Research in fisheries isolated and identified a probiotic bacterium, which proved to have favorable impact on the growth and immunity of the Nile tilapia. Feasibility studies on establishing a national Cleaner Production Center and Gene Bank commenced this year. Intensive stocking experiments, extensive sea cruises/trawling in Kuwaiti and international waters and comprehensive statistical analyses shed new light on the status of national and regional fisheries, including ‘maid’, shrimp stock and, for the first time, the pearl oyster community composition. Scientists explored the Zobaidy population in Kuwaiti and Irani waters using advanced molecular techniques to genetically characterize the samples.

A study that deployed molecular techniques to detect and identify virus strains affecting tomato plants in Kuwait, generated full-length viral genome clones and important information on a new strain, specific to the region. Several studies on C. lancifolius pointed out to some of the vital traits of the plant, including its adaptive mechanism, thermo-tolerance and antioxidant defenses in harsh desert environment. Researchers also developed and implemented suitable protocols for the propagation of the Amla tree. Another plant, Gliricidia showed early signs of adaptability, with promising scope for landscaping. Trace metals detected in some desert plants were labeled as bio-indicators of air pollution, while another project focused on probing Alfalfa plant’s potential for phytoremediation.

Joint research initiatives with NASA was launched to study soil moisture in desert environment using SMAP application and climate models. The successful mapping of climate data of the Arabian Peninsula marked another milestone in collaborative research undertakings. A major venture was initiated by KISR, in collaboration with Sultan Qaboos University, Columbia University and the University of Basra to assess the current physical oceanographic parameters in the north-western Kuwaiti territorial waters. Significant observations, utilizing state-of-the-art equipment, provided valuable atmospheric data for further analyses and interpretations.

Scientists at KISR reported on successfully developing remote-sensing/GIS-based models which can be used as predicting tools for detecting the presence of algal blooms in Kuwait bay and coastal waters. Concerted efforts by scientists to trace the sedimentation patterns and presence of organic and inorganic pollutants in Kuwait Bay resulted in significant findings on, not only the origin and history of contaminants, but also its distribution in Kuwait’s marine environment. In view of better understanding and conserving the biodiversity of Kuwait, local scientists joined hands with MIT researchers to capture relevant data related to regional climate, soil and vegetation and to set up crucial datasets on local species, ecosystems and ecological processes. Scientists reported on successfully isolating, culturing and maintaining benthic species and analyzing the changing physical, chemical and biological parameters at local sampling sites. Molecular probes into Legionnaire’s disease-causing microorganisms set the crucial baseline data for future environmental surveillance program and epidemiological investigations.
COMPLETED PROJECTS

A Remote Sensing-Based Early Warning System for Algal Blooms in Kuwait Bay and Coastal Waters

(2007-1207-04)

S. Uddin, M. Behbehani, W. Al-Rashed, D. Al-Shamroukh, A. Al-Khabbaz,

A. Al-Yaegoub and M. Al-Bahloul

Kuwait Institute for Scientific Research

Abstract

Recurrent occurrences of algal blooms are reported from Kuwait bay and the coastal waters. The project addresses the problem of identifying algal blooms using remote sensing and developing a GIS-based system that can be used as an early warning system. This study builds on experience gained from Monitoring and Event Response for Harmful Algal Blooms (MERHAB) project of National Oceanic and Atmospheric Administration (NOAA). Monitoring algal blooms in Kuwait bay was achieved by extracting the chl-a concentration spatially and temporally using Moderate Resolution Imaging Spectroradiometer (MODIS) and Medium Resolution Imaging Spectrometer (MERIS) data and by applying various existing operational algorithms for CASE I waters (e.g., OC3M-547, GSM, GIOP) and other bio-optical methods that were designed for CASE II waters. The extracted Chl-a concentration using these algorithms were compared to measure in-situ Chl-a data. There were no significant HABs event in Kuwait bay and the coastal waters during the execution of this study. The MODIS/MERIS data spanning over 12 years was compared with known HABs instances in order to develop a suitable model for prediction of HABs. The web-based GIS was developed, providing synoptic capabilities for displaying spatial and temporal distribution of the algal blooms and also paving the way for investigating the factors controlling the distribution of these blooms. The team utilized the
generated data sets to extract spatial relationships that could assist in the development of conceptual and quantitative models that identify the significant factors, which control the spatial and temporal distribution of algal blooms in Kuwait bay and quantify the extent to which the bloom distribution is controlled spatially and temporally by each of these factors. The significance of these identified factors and others (factors) reported by researchers working on similar problems elsewhere were tested using statistical methods. Quantitative models were then constructed using 80% of data points, that were tested and validated against field data. Finally, it was used as a predictive tool by retrospectively predicting blooms. Twenty percent of data points were used for validation. The hybrid multivariate regression and the hybrid artificial neural network models showed an overall accuracy of 91and 99.9% respectively, providing confidence that the remote sensing based models can be used as early warning system for algal blooms in Kuwait bay and coastal waters.

KFAS Contribution: K.D. 65,150
Total Budget: K.D. 110,750

Improvement of Growth Performance and Disease Resistance of the Nile tilapia Oreochromis niloticus through Autochthonous Probiotic Bacteria
(2009-1207-10)
M. T. Ridha, I. S. Azad
Kuwait Institute for Scientific Research

Abstract
This 24-mo project was aimed at isolating a probiotic bacterium from the gut of Nile tilapia, evaluating growth, immunity, and disease resistance in tilapia fed with different probiotics.

An autochthonous bacterium identified as Bacillus subtilis by DNA sequencing was isolated from the gut of healthy Nile tilapia. The isolate (TPI) showed good inhibition for Vibrio alginolyticus and mild inhibition of V. parahaemolyticus and Streptococcus agalactiae, but no inhibition for Proteus vulgaris.

Two trials evaluated the effect of feeding three probiotics on growth, feed conversion (FCR), and yield in juvenile (28.3 g) and adult (93.4 g) tilapia compared to a control probiotic-free diet (CON). In the first trial, (TPI), commercial Lactobacillus acidophilus probiotic (COM1) and a combination of both (MIX) were tested. In the second trial, the same treatments were tested in adults (101.8 g) only with the replacement of COM1 with another commercial probiotic (COM2) consisting of four bacteria. Results showed that in juveniles, the MIX treatment had the highest (P < 0.05) mean weight, yield, and best FCR, followed by the TPI and the COM1 treatments. Growth in adults was not affected by probiotics and was depressed by COM1. In the second trial, the COM2 treatment had the highest (P <0.05) weight, yield, and best FCR, followed by the MIX and the TPI treatments. These results indicate the positive effect of the probiotics on growth and the synergetic effect of mixing more than two bacteria.

TPI had the highest gut colonization and retention after 15 d of withdrawing the probiotics followed by the MIX treatment. COM1 and COM2 had no proliferation.

In juveniles, the MIX and the TPI probiotics enhanced the rate of return (RR) and the benefit-to-cost ratio (BCR). In adults, only the COM2 enhanced the BCR. In the event of disease outbreak, probiotics significantly increased RR and BCR.

Generally, probiotics improved the immunity. TPI caused the highest improvement. Tilapia fed with the TPI and MIX bacteria, then challenged by injecting the LD_{50} dose (10^{4.68} cfu fish^{-1}) of P. vulgaris, had a higher relative percentage of survival than the COM treatments.

KFAS Contribution: K.D. 24,950
Total Budget: K.D. 69,950
High Resolution Historical Records of Trace Metals and Organic Pollutants from Sediments and Coral Reefs in Kuwait

(2009-4401-01)


Kuwait Institute for Scientific Research

Abstract

The goal of this project is to establish the sedimentation patterns and pollutant histories of inorganic and organic pollutants, particularly the persistent organic pollutants (POPs) regulated under the Stockholm Convention, in the sediments of the northwestern Arabian Gulf.

Surficial sediment samples were obtained from 25 locations within Kuwait Bay and outside the Bay, in the Gulf proper, to access recent pollution in Kuwait. This was complimented by collecting sediment cores from five locations to reconstruct the historical records of trace metals and organic pollutants in Kuwait. The concentrations of POPs in surficial sediments were generally higher within Kuwait Bay than outside the Bay.

The historical record of polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs) generally showed subsurface peaks corresponding to certain pulses in the inputs of the particular contaminant often linked to war-related activities. The absolute concentrations of various compounds were different at different sediment coring sites. These differences in concentrations at the various coring sites were often linked to their proximities to point sources. Stations 26, 27 and 28 were in close proximity to the shore and land-based sources are thought to play a significant pathway for contaminants delivery. Station 26 is very close to the navigational channel which can be a significant source of contaminants, particularly of PAHs from petroleum spillages. The concentrations of organochlorine pesticides (OCPs) in sediment cores were generally low at all stations. The only compound that was detected in sediments were primarily isomers of hexachlorocyclohexanes (HCHs) with sporadic occurrences of some compounds in some sediment slices at some stations. Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) were measured only at Station 29. The sedimentary record shows that PCDD/F concentrations started to increase above pre-industrial background levels at a depth of 30 cm. This was followed by an exponential increase in concentrations attaining a maximum of 7.5 pg g⁻¹ about 14 cm and fluctuated between 4 and 7 pg g⁻¹ in recent sediments.

KFAS Contribution: K.D. 58,000
Total Budget: K.D. 118,000

Development of a Decision Support Tool for the Conservation of Terrestrial Biodiversity of Kuwait

(2010-4401-02)

W. Y. Roy
Kuwait Institute for Scientific Research

Abstract

The diverse range of environmental problems faced by the State of Kuwait is due to the desertification...
of rangelands and lack of proper conservation measures leading to the degradation of existing biodiversity.

The Decision Support Tool for the Conservation of Terrestrial Biodiversity of Kuwait project was undertaken to design a decision support tool using state-of-the-art-technologies like geographic information system, (GIS) remote sensing, customized natural resource models developed at Massachusetts Institute of Technology and gap analysis to visualize current and future aspects of biodiversity in Kuwait. The study was aimed at identifying factors that cause land degradation, thus influencing the biodiversity, and establishing criteria mainly for selection of high asset areas of Kuwait with significant biodiversity.

Reconnaissance field surveys of the protected areas of Kuwait were undertaken during the study, identifying species, ecosystems, and ecological processes, and the collected data (vegetation types, key fauna species, microhabitats, etc.) were validated and uploaded to GIS geospatial datasets to enhance the decision support system.

**KFAS Contribution:** K.D. 122,020  
**Total Budget:** K.D. 170,890

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**Mapping and Monitoring of Soil Moisture over Kuwait Desert Environment**  
(2010-4401-03)

**Hala K. Al-Jassar, K. S. Rao**  
Kuwait University

**Abstract**

Field work was conducted 24 times between April 2011 and September 2013 in the KISR (Kuwait Institute of Scientific Research) protected site located at Sulaibiya with the intent of measuring soil moisture at 16 specific locations over a 50 sq. km area. Soil moisture was measured using the thermo-gravimetric method and TDR (Time Domain Reflectometer) method. The TDR probe was calibrated in both the field and laboratory. Soil profile measurement was also conducted up to a depth of 1.2 m and sub-surface soil moisture was estimated at two locations. The field measurements indicate that the volumetric soil moisture (VSM) varies from 0.11 m3 m-3 in the wet season to less than 0.01 m3 m-3 in the dry season with a standard deviation ranging from 0.02 m3 m-3 in the wet season to less than 0.0009 m3 m-3 in the dry season. Remote sensing soil moisture data of (NASA product) was acquired from the Advanced Microwave Scanning Radiometer (AMSR-E) instrument and the monthly averaged soil moisture over the Kuwait study area was found to vary from 0.06 m3 m-3 in August to 0.083 m3 m-3 in January. Land Surface Temperature (LST) data was acquired from MODIS (Moderate-Resolution Imaging Spectroradiometer) instrument. Four locations in the Arabian Peninsula were selected and detailed study of VSM and LST trends was conducted. Soil moisture over the KISR site in Kuwait was retrieved by processing active microwave sensor data from ENVISAT satellite. SMOS (Soil Moisture and Ocean Salinity) satellite was analyzed and the antenna configuration was simulated. An environmental Atlas of Arabian Peninsula was prepared which contains monthly averaged and color shaded VSM and LST maps. CMOSA (Climate Maps from Operational Satellites over Arabia) website was developed with the purpose of communicating Arabian Peninsula climate data to the end user.

**KFAS Contribution:** K.D. 120,000  
**Total Budget:** K.D. 120,000
Zobaidy Population Genetics: Application of Molecular Methods to Investigate Stock Depletion

(2011-1207-02)

S. AlMomin, V. Kumar, M. Al-Hussaini, S. Al-Amad, T. Dashti
Kuwait Institute for Scientific Research

Abstract

The Silver pomfret population of Kuwait has undergone drastic depletion due to several factors. Such phenomenon requires population investigation in order to support the fish stock management and for formulation of policies for sustainable management of natural resources. Molecular studies were applied to investigate and characterize the Zobaidy populations in Kuwait and Iran. Various molecular tools for the analysis of inter-simple sequence repeat (ISSR), Random Amplified Polymorphic DNA (RAPD) and microsatellites were employed. Fish samples were collected from several locations from Kuwait and Iran waters. Genetic polymorphism in the genome of Zobaidy collected from Iran and Kuwait have been recorded and presented in the form of dendrograms with statistical analysis. Next generation sequencing approach was used in the current study to discover novel microsatellites for the study of population structure. Over 8,000 microsatellite loci were identified and 48 potential microsatellites were selected for further analysis. The primers for all these loci had been designed. The results of the ISSR analysis using POPGENE software revealed that Zobaidy samples from Kuwait and Iran showed 98.81% similarity, and the genetic distance between them was 0.0119. There was considerably high variation within the population of Zobaidy from both Kuwait and Iran. In addition to that, the Kuwaiti and Iranian populations did not show two genetically distinct populations in the Arabian Gulf.

KFAS Contribution: K.D. 88,000
Total Budget: K.D. 140,040

Development of Micropropagation Technology for the Amla Tree in Kuwait

(2011-1207-06)

L. Al-Sabah, C. Sudhersan, S. Jibi, A. Al-Ajeel and S. Al-Melhem
Kuwait Institute for Scientific Research

Abstract

The Amla tree (Emblica officinalis) is a multi-purpose tree species grown for its highly valuable and nutritious fruit. Amla was introduced to the KISR campus along with many other medicinal plants through a general research activity. One Amla tree was found to be adapted to Kuwait’s climatic conditions and showed a very good greenery value in Kuwait; however, vegetative cutting trials failed at KISR. Hence, the current project was initiated in December 2011 with the financial support from Kuwait Foundation for the Advancement of Sciences (KFAS). The aim of this research project was to develop a reliable micropropagation protocol for the Amla tree adapted to climatic conditions of Kuwait to use in the greenery program. The main objectives of the project were: to develop complete in vitro protocol for clonal propagation of the Amla tree and to produce few acclimatized plants for the field evaluation in Kuwait. The main objectives were accomplished through three major research tasks, mobilization, development and execution of micropropagation protocol development, and acclimatization. The mobilization task was done. In task 2, a micropropagation protocol was developed and executed for the Amla tree through experimental studies, and a three-stage culture media formulation was standardized. A protocol for plantlet regeneration through somatic embryogenesis and organogenesis was standardized using cotyledon, stem nodal segment, and shoot tip explants. About
1000 plants were produced for the rooting and acclimatization experiments. In task 3, experiments on adventitious root induction using different concentrations of Murashige and Skoog (MS) media with different concentrations and combinations of Indole-3 butyric acid (IBA) and α-Naphthalene acetic acid (NAA) were carried out. About 100 rooted plantlets were acclimatized and 10 plants were planted in the field for further evaluation. An acclimatization protocol was standardized for 100% survival of in vitro grown Amla plants in the greenhouse.

KFAS Contribution: K.D. 23,660
Total Budget: K.D. 47,500

Conocarpus Lancifolius under Semi-arid Conditions in the State of Kuwait: Ecophysiological, Biochemical and Cytological – Phase II
(2011-1207-08)
R. Al-Hassan, M. Afzal, P. Suleman, A. Redha
Kuwait University

Abstract

Since its introduction into the State of Kuwait, the species Conocarpus lancifolius appears to have adapted or tolerate the semi-arid conditions. Its long-term survival however, under semi-arid conditions of Kuwait is still questionable. The research project aimed to understand the adaptation mechanisms in Conocarpus lancifolius under stressful semi-arid environment of Kuwait.

Ecophysiological studies in phase II were aimed at some of the mechanisms of tolerance, resistance or adaption by the plant to the semi-arid conditions. The plant produces abundant biomass in summer that is pruned and discarded. This plant material could be used as compost to improve the condition of the local sandy soil and/or in the biological control of soil-borne pathogens such as fungi and nematodes. The accumulation of plant secondary metabolites and their potential as fungicides, nematicides, and/or allelopathic compounds was also investigated. Leaf extract contained several secondary plant metabolites which showed antifungal, nematicidal and allelopathic effects in dicots and monocots. The leaf extracts inhibited germination, radicle and plumule lengths, root and shoot growth of monocotolyden and dicototydonous plants.

Studies also focused on C. lancifolius tolerance mechanisms to high temperatures with respect to the production and accumulation of heat shock proteins (HSPs), UV-B irradiation, phytochemical constituents or secondary metabolites in leaf extracts, antifungal activity of extracts and allelopathic capacity of leaf extract and root exudates. Temperatures between 30 and 40°C induced the production of 70 KDa HSP, and 40-50 oC HSPs; 70 and 90 KDa. UV-B irradiation treatments correlated linearly flavonoid production 15 days after treatment.

The biochemical studies focused on the adjustment of antioxidant defenses in Conocarpus lancifolius, subjected to four abiotic oxidative stresses including temperature shock, salinity, water deficit and polyethylene glycol-800. C. lancifolius exposure to elevated temperature at 40°C significantly increased the antioxidant defenses while the plant resistance to oxidative stress decreased by other abiotic stressors. This was confirmed by measuring the antioxidant capacity of C. lancifolius by employing four different assays with two distinctive mechanisms. These assays confirmed that C. lancifolius developed thermotolerance on exposure to increased temperature by generating antioxidant defenses against free radicals. This may be an important factor that contributes to adaptation of C. lancifolius to harsh desert environment. In addition C. lancifolius showed high accumulation of potassium and boron ions to keep its osmotic balance that could help it survive under severe abiotic stress. Free amino acids accumulated in the plant response to stress were also evaluated. The analysis of chromosomes was carried out by 3D-fluorescent in situ hybridization (FISH) using labeled probes. The protocol was modified during the investigation. Further work has been carried out on the molecular characteristics
of C. lancifolius using improved methods for DNA isolation and purification for gene sequencing.

The implementation of these studies resulted in five publications in peer-reviewed journals.

**KFAS Contribution:**  K.D. 51,100  
**Total Budget:** K.D. 51,100

**Publication:**


- **EFFECTS OF UV-B ON PHOTOSYNTHETIC PARAMETERS, LIPID PEROXIDATION, FLAVONOIDS AND GROWTH TRAITS OF CONOCARPUS LANCIFOLIUS (ENGL.),** Patrice Suleman, Amina Redha, Mohamad Afzal and Redha Al-Hasan, American Journal of Agricultural and Biological Sciences, 2014 Volume 9, Issue 1, Pages 55-63.


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**Molecular Characterization and Identification of Whitefly-Transmitted TYLCV Diseases in Tomato Plants in Kuwait**

**(2011-1207-10)**

**E. M. Al-Ali, H. Al-Hashash, A. Ben Hejji, N. Al-Shyji, H. Al-Aqeel**  
Kuwait Institute for Scientific Research

**Abstract**

Viral diseases cause remarkable economic losses in many crops in Kuwait. Proper disease diagnosis is essential for successful virus management. A good method of diagnosis is the use of polymerase chain reaction (PCR). The first objective of this project was to adapt and optimize a rapid and sensitive method for the detection of TYLCV and other whitefly-transmitted viruses in the tissues of tomato plants and in their vectors. Since diagnosis of viruses can be compromised by the sequence diversity that occurs within every virus species, the second aim was to characterize TYLCV isolates from different tomato-growing regions in Kuwait and compare these with those reported from other locations. Both of these aims were accomplished. For the first objective, PCR and RCA (rolling circle amplification) were adapted and successfully used in the detection of begomoviruses in tomato in Kuwait. These assays were used to screen samples from tomato plants in different production regions of Kuwait. TYLCV was the only begomovirus detected. The highest frequencies were found in the second half of the growing seasons. PCR and RCA products from TYLCV-infected plants were screened for sequence diversity using an array of restriction enzymes. Sixteen clones of full length genomic sequences were obtained. The full length viral genome clones generated from this study are available for use in other studies. These TYLCV sequences were determined to belong to three different TYLCV strains: TYLCV-Bou, TYLCV-IL (A) and a new strain, designated TYLCV-Kuw. The strains were not limited to production regions. The diversity of TYLCV strains calls the question the effectiveness of commercially available
TYLCV-resistant tomato cultivars if these were to be deployed since it is now known how well these resistance will hold up to these strains. These data will be helpful to growers who will now be armed with accurate knowledge.

KFAS Contribution: K.D. 31,560
Total Budget: K.D. 92,364

Speciation and Distribution of Selected Heavy Metals in Kuwait Marine Sediment

(2011-1401-03)

H. Alshemmari, L. Ali, L. Talebi, A. Ali, A. Taqi, R. Al-Kandari, A. Al-Yaegoub
Kuwait Institute for Scientific Research

Abstract

Core sediment samples were collected from 21 stations from Kuwait marine environment for the speciation of heavy metals such as cobalt (Co), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb) and zinc (Zn) using the Bureau Community of Reference (BCR) sequential extraction procedure. Grain sizes, total organic carbon (TOC) and carbonate were also determined. The average abundance of the total concentrations of heavy metals increased as follows: Pb < Co < Cu < Zn < Cr < Ni. Grain-size analysis showed that study area contained mostly silty fraction at most locations with mean value of 81.2% silt, 12.6% of sand and clay, 6.23%. The analysis of TOC showed a mean value of 1.53%; whereas, the carbonate showed a mean value of 30.0% calcium carbonate (CaCO3). The geoaccumulation index (Igeo) suggested that sediment was not contaminated by Co, Cr, Cu, Ni, Pb, and Zn. Results of this study showed that the total concentrations of Cu, Pb, and Zn in the sediments were below the national sediment quality guidelines; whereas, the maximum total concentrations of Cr and Ni were above some of the national sediment quality guidelines. In the sediments, the dominant fractions as hosts for Co, Cr, Cu, Ni, and Zn were the residual fraction, followed by the reducible, and then the oxidizable fractions. The exchangeable fraction was the least important for most metals. However, reducible fraction was reported the most important fraction for Pb. In sediments, the mobility order of exchangeable fraction of the heavy metals studied decreased in the order Pb > Ni > Zn > Co > Cu > Cr; the reducible fractions decreased in the order Pb > Cu > Zn > Co > Ni > Cr; the oxidizable fractions decreased in the order Pb > Cr > Cu > Ni > Co > Zn, and the residual fractions in sediments decreased in the order Co > Cr > Ni > Zn > Cu > Pb. Multiple linear regression analysis that was applied on sediment datasets for exchangeable, reducible, and oxidizable fraction predicted that TOC was the main factor influencing predictions of most heavy metal concentrations with a positive effect.

KFAS Contribution: K.D. 43,290
Total Budget: K.D. 66,090
Spatial, Temporal and Economic Loss Assessment of Sewage Pollution of Kuwait’s Coastal Areas using Fecal Sterols as Biomarkers

(2011-1401-05)

T. Saeed, F. Al-Shemmari, A. Al-Mutairi, H. Abdullah, M. Al-Asfour, N. Abdulmalek
Kuwait Institute for Scientific Research

Abstract

The discharge of sewage into the marine environment is an important source of large input of anthropogenic compounds. Kuwait has a long history of discharging sewage into the coastal areas that has resulted in the deteriorating quality of seawater and polluted sediments. The main objective of the present study was to conduct spatial and temporal assessment of sewage pollution of Kuwait coastal areas. The assessment was carried out by measuring fecal sterols (especially coprostanol) which are recognized as robust indicator of sewage pollution, in the marine sediments collected throughout the Kuwait’s marine areas. Spatial assessment was conducted by collecting 113 surface sediment samples from off-shore and intertidal zone. For temporal assessment, 20 core samples (from off-shore and intertidal zone) were collected. The core was split into 5 layers. The freeze dried samples were extracted and sterol fraction separated. Derivatized sterols were analyzed by GC/MS in selected ion monitoring mode and using internal standard method. The results of surface sediment showed that areas in the vicinity of the sewage outfalls were heavily contaminated. The western part of Kuwait Bay especially the area between Jahra and Salaam beach were worst in terms of contamination level. Two off-shore sites in Kuwait Bay were also classified as contaminated. Coprostanol levels in Kuwait Bay ranged from 0 to 17904 ng/g. Coastal area south of Ras al Ard was less severely contaminated. However, three sites in the intertidal zone were contaminated with fecal materials. Off-shore areas were relatively lightly contaminated. The results of temporal assessment produced historical profiles of fecal contamination of the sampling sites. The core samples collected from the contaminated area in Kuwait Bay indicated chronic input of sewage throughout the depth of the core sample. Locations near Jahra, Amghra and Ghazali outfalls were found to be chronically contaminated. Both off-shore locations in Kuwait Bay also had a long history of contamination. In south, Abu Hasaniya sample was contaminated in deeper layers. Economic loss due to Mishref pumping station failure and subsequent release of large amount of raw sewage to the coastal areas was assessed. The hotels and restaurants in the impacted areas did not report significant losses except two establishments in the close proximity of the discharge outlets (10-25% loss). Fishing industry also did not show negative effects. Entertainment sector experienced an estimated loss of 26% due to decreased number of visitors. In public health sector, there were no indications of significant increase of sewage-related ailments apart from increased number of diarrhea cases in Kuwait during 2009-2010.

KFAS Contribution: K.D. 20,250
Total Budget: K.D. 43,456
A Preliminary Assessment of the Air-conditioned Environment in Selected Buildings in Kuwait for the Presence of Legionnaires’ Disease Causative Agent, Legionella

(2011-1402-01)

Q. Al-Matawah, S. Al-Zenki, A. Al-Azmi, T. Al-Waalan, F. Al-Salameen, A. Ben Hejjii, A. Farhan
Kuwait Institute for Scientific Research

Abstract

The main aim of the project was to test for the presence of Legionnaires’ disease-causing microorganisms in air-conditioning (AC) buildings in Kuwait using molecular technologies. Therefore, during the period from October 2012 to October 2013, 547 samples were collected from 38 cooling towers for the analysis of Legionella pneumophila. These samples included those from water (n = 178), air (n = 231), and swabs (n = 138). Out of the 547 samples, 226 (41%) samples were representative positive for L. pneumophila, with L. pneumophila viable counts in the positive water samples ranging from 1 to 88 CFU/ml. Of the Legionella culture positive samples, 204 isolates were examined by latex agglutination. These isolates were predominately identified as L. pneumophila serogroup (sg) 2-14. 74 representatives isolates were further serogrouped using the Dresden panel of monoclonal antibodies. Results showed that 51% of the isolates belonged to serogroup 7 followed by 1 (18%) and 3 (18%). Serogroups 4 (4%) and 10 (7%) were isolated at a lower frequency and two isolates could not assigned to a serogroup. These results indicate the wide prevalence of L. pneumophila serogroup 7 as the predominant species at the selected sampling sites.

Furthermore, the 74 L. pneumophila (sg1 = 13; sg 3 = 13; sg4 = 3; sg7 =38; sg10 = 5; sgX =2) isolates were genotyped using the seven gene protocol sequence-based typing (SBT) scheme developed by the European Working Group for Legionella Infections (EWGLI). The results showed that Legionella isolates were discriminated into nine distinct sequence typing (ST) profiles, six of which were new to the SBT database of EWGLI. Additionally, all of the ST1 serogroup 1 isolates were of the OLDA/Oxford subgroup. This baseline data will form the basis for the development of a Legionella environmental surveillance program and used for future epidemiological investigations.

KFAS Contribution: K.D. 25,440
Total Budget: K.D. 73,992
Calibration and Validation of NASA (SMAP) Satellite for the Retrieval of Soil Moisture and Its Application to Weather and Environmental Modeling in Kuwait

(2012-1413-01)

Hala K. Al-Jassar
Kuwait University

Abstract

Satellite imagery, particularly in the microwave domain, provides key information on land surface and subsurface parameters. The prospective SMAP mission sponsored by NASA and scheduled for launch in 2014 will have two microwave sensors, one active and one passive, commonly known as radar and radiometer, respectively. Observations from these sensors will greatly improve our understanding of the dynamic of surface condition and the interaction between land and atmosphere. Soil moisture will be the core deliverable of the mission. However, observed backscatter and brightness temperature will also be sensitive to soil texture and change in surface condition. In Kuwait these observations are critical for several applications, like dust storm prediction and monitoring, air quality and human health. In addition, soil moisture is particularly important for hydrology, climate and weather forecasting, carbon cycle, environmental and agriculture. Another very crucial application of Soil Moisture Active Passive (SMAP) is the study of water scarcity in a changing climate conditions. Current climate models uncertainties result in disagreement on assessment of water availability in the region. SMAP data will enable climate models to be brought into agreement on future trends in water resource availability.

SMAP has unique configuration fully dedicated for the retrieval of soil moisture from both active and passive microwave sensors. SMAP will be launched by NASA in November 2014 to provide global measurement of surface soil moisture. The SMAP instrument includes a Radiometer operating at L band (1.41 GHz) and Synthetic Aperture Radar (SAR) operating at L-band (1.20 GHz). The radiometer will measure the surface emission while SAR will measure the backscatter from the Earth surface.

NASA favorably selected the soil moisture observation site established in Kuwait among few other networks in the world, as core calibration/validation site for the mission. The main objective of this project is to build upon this initial successfully effort and expand it to study the physics of microwave signatures in a unique desert environment. The objectives of our work in the pre-launch phase will involve calibration testing, and improving of models and algorithms for soil moisture retrieval. Then we will verify and improve the performance of algorithms and validate the accuracy of soil moisture retrieval in the post-launch part. Scatterometer/radiometer will be used for studying the microwave signatures of desert terrain. Finally we will participate in the validation campaign in coordination with other core groups working on the SMAP mission. This project is a spinoff of our earlier research in collaboration with MIT sponsored by KFAS.

KFAS Contribution: K.D. 298,100
Total Budget: K.D. 534,170
The Requirements of the Environmental Centre for Students – South Surra

(2012-5501-01)

A. Al-Baejan
UNESCO

Abstract

The previous financial support which we received from Kuwait Foundation for Advancement of Science in phase one covered the most important needs to start the implementation of the Environmental Centre for Students in 2012. In Phase one, we provided electricity, lighting, plumbing, full furnishing and internet for the place. Also, we activated computer lab, environmental lab, showroom and classes, and supplied them with computers, projectors, data shows, lab tools and safety system. Finally, we provided the theatre, praying room and kitchen with full furnishing.

KFAS Contribution: K.D. 25,000
Total Budget: K.D. 25,000
A Comprehensive Management Strategy for Long-Term Sustainability of Kuwait’s Shrimp Stocks.

(2006-1207-15)

Kuwait Institute for Scientific Research

Project Progress – Abstract

During the past 12 months, May 2013 through May 2014, seven of the project’s 11 tasks were active. From May until February, project personnel successfully sampled 15 to 17 stations in international waters and 16 to 18 stations in Kuwait territorial waters. Cruises scheduled for August, September, and October were not conducted because of technicalities. Catch rates of Penaeus semisulcatus kilogram per hour (kg/h) at 3.3 knots were 4.9, 4.1, and 14.5 for May, June, and July, respectively, and 12.6, 6.8, 9.3 and 8.4 for November, December, January, and February, respectively, while in Kuwait waters, were 3.7, 11.6, and 35.1 kg/h at 3.3 knots for May, June, and July, respectively, and 34.5, 14.8, 9.1, and 6.9 for November, December, January, and February, respectively. P. semisulcatus dominated the catch for all months accounting for > 92%. Size variation of P. semisulcatus between the two areas was similar, i.e., mostly adults with a notable component of ‘new’ recruits. Catch rates by five different representative commercial vessels, including the RV Bahith 2, showed significant differences, but this was due to the rigging by different vessels. In general, comparative catch rates ranged from about 10 to 15 kg/net/30 min. Tagged shrimp released in international waters and Kuwait waters in July 2012 numbered at 1961 and 2263, respectively. Respective returns were 3 and 6.5%. Of 85 shrimps recaptured in international
waters, nearly half (46) had been tagged and released in Kuwait waters; of 108 shrimps recaptured in Kuwait waters, only 10% had been tagged and released in international waters. This is a direct evidence of stock mixing and supports the existence of a single stock in the northern Gulf.

KFAS Contribution: K.D. 126,771  
Total Budget: K.D. 376,294

Characteristics, Impacts and Regulation Strategy for Recreational Fisheries in Kuwait  
(2009-1107-01)

F. Al-Hasawi  
Public Authority for Agricultural Affairs and Fish Resources

Project Progress - Abstract

Globally, recreational fishery is an important and growing component of many marine fisheries. Therefore, data about the numbers and kinds of fish taken through recreational fishing are essential for fisheries management. Although there is an active recreational fishery in Kuwait, virtually no information is available about the current states of recreational fisheries concerning captured species, catch and number of participants or even the impact on natural populations. Extensive recreational fishing creates conflicts and contradictions within the fishery domain because of disparate interests. The overall goal of fisheries management is to produce sustainable biological, social, and economic benefits from renewable aquatic resources, thus, there is a vital need for better understanding of the characteristics and impacts of recreational fisheries along Kuwaiti coastal waters. Accordingly, this project has been proposed to study the characteristics, impacts and regulation of recreational fisheries in Kuwait through a two-year survey program. The program aimed at estimating catch and effort exerted with recreational fishers, creating geographical map for recreational fishers’ activities, determining demographic and socio-economic characteristics of recreational fishers, and formulating future management strategy for recreational fisheries along coastal Kuwaiti waters. Recreational fisheries information will be compiled through creel survey (access site and roving creel survey). Personal interviews and questionnaires will be adopted for data compilation. Compiled data will be statistically analyzed and Geographical Information System (GIS) will be adopted to map distribution and abundance of recreational fishing activities. The anticipated output of the project will fill the information gap about recreational fisheries and help decision-makers in adopting rational management for marine fish resources.

KFAS Contribution: K.D. 38,550  
Total Budget: K.D. 110,120
Restoration of Pearl Oyster Resources in Kuwait Sea Bed

(2009-1207-01)

F. Al-Hassawi, U. Khalifa, M. Fouda
Public Authority of Agriculture Affairs and Fish Resources

Project Progress – Abstract

The third progress report includes description and calculation of pearl oyster densities along eight selected oyster beds. For the first time, community composition of the pearl oyster is considered. It was found that P. radiata and P. margaritifera was the most dominant species, where they contributed about 98% of the early oyster community. The former constituted about 76%, while the later represented about 22% of the total biomass of pearl oyster community. Population structure for the two species have been introduced and discussed. Size-weight relationship for the two species have been calculated and statistically compared. Morphometric relationship between dorsoventral measure and other shell dimensions have been calculated for the two species. Stocking experiment has been carried out by transferring oysters from rich bed oyster in Ben Jumada to poor oyster bed in Bneder. Unfortunately, growth cages have been completely distracted before finishing the experiment. Concomitantly, massive mortality of pearl oyster has been recorded in the two studied areas.

KFAS Contribution: K.D. 22,450
Total Budget: K.D. 63,170

Metal Acquisition by Marine Algae and their Associated Bacteria in the Kuwait Coastal Seawater

(2009-1207-03)

D. Al Waheeb
Kuwait University

Project Progress – Abstract

For the first time, the region of the Arabian Gulf Kuwaiti-Site is investigated for the presence of “Iron scavenger” organic compounds secreted by marine bacteria in association with phytoplankton. Also, the research involved the isolation and the grouping of these marine bacteria, which is considered original. The primary characterization of the isolated organic compounds has been carried out and their identification has been processed. Based on the available data, hydroximate functional group is most likely to be part of the structure of these compounds. The research results are of great importance. It will provide information that can be used in the assessment of future environmental marine problems in Kuwait, such as “fish kills”, and information that is globally needed to understand the marine iron cycle.

KFAS Contribution: K.D. 112,280
Total Budget: K.D. 112,280
Assessment of Maid Stock (Liza klunzingeri) in Kuwait Waters
(2010-1207-02)

Kuwait Institute for Scientific Research

Project Progress – Abstract

Samples of maid fish collected from three sites along Kuwait’s coast were identified as Liza klunzingeri. Confirmation by another expert is pending. Commercial landings ranged from 42 t in September to 105.6 tons in June 2013, and catch per 1000 m2 gillnet/set ranged from 76 kg in July to 139 kg in September. Commercial catches of maid were relatively uniform in size ranging from 15 to 22 cm total length (TL). Modal sizes from May through September 2013 varied only 1 cm, i.e., 17 or 18 cm TL. This relatively uniform size-frequency distribution is believed to be a result of the selectivity of the gillnets used to capture maid. The recent acquisition of seine nets and mid-water trawl nets will allow sampling of juveniles and adult maid in the intertidal area and open water.

KFAS Contribution: K.D. 48,183
Total Budget: K.D. 125,535

Eco-Hydro-Geomorphological Modeling of Kuwait Desert Environment
(2010-4401-04)

E. Eltahir
Massachusetts Institute of Technology

Project Progress – Abstract

In arid and semi-arid ecosystems, vegetation is often thought of as the integrated response of the hydrologic interactions with the terrestrial and atmospheric systems, rather than an interactive component within these systems. The focus of the Eco-Hydro-Geomorphological Modeling component of the Kuwait Climate, Water and Vegetation proposal is to understand the influence of rooting profiles on the water and energy balance. It is proposed that through an understanding of the manner in which vegetation root systems interact with the hydrology, we can begin to examine how vegetation in this region responds to both natural and anthropogenic disturbances. In an environment where resources are variable and limited, understanding the mechanisms that attains these resources is critical in understanding vegetation survivorship and distribution. The model framework for this study is the Triangulated Irregular Network (TIN) based Real-Time Integrated Basin Simulator (tRIBS), coupled to the Vegetation Generation for Interactive Evolution (VEGGIE). tRIBS is a physically-based distributed hydrologic model. The following additions have been made to tRIBS+VEGGIE over the course of the project in order to better represent the hydrology-ecology interactions in arid regions: (i) subsurface redistribution – improved scheme to allow lateral layer to layer flow; (ii) dynamic vegetation of multiple PFTs – updated to allow multiple PFTs to reside in one computational element, thus allowing for the competition of resources; and (iii) dynamic rooting scheme – to allow for vegetation to adapt to natural variability. The development of these models have not only added more realism to the treatment of vegetation roots but also addressed the discrepancy in the level of sophistication with which above and below ground vegetation is represented in hydrologic models. The ability of this new scheme to capture the hourly energy flux dynamics, the distribution of soil moisture through the soil column as well as the above-ground dynamics of the vegetation illustrates the strength of the improved tRIBS+VEGGIE model. This evaluation provides confidence that the model is able to capture the multi-directional interactions between climate, soil and vegetation at this site.

KFAS Contribution: K.D. 81,540
Total Budget: K.D. 81,540
Coupled Biosphere - Atmosphere Modeling over Kuwait

(2010-4401-05)

E. Eltahir
Massachusetts Institute of Technology

Project Progress – Abstract

Two thirty-year regional climate simulations were performed, coupled to a dynamic vegetation model over Kuwait. One simulation, the control, prescribed vegetation and plant coverage types that could not compete or change over the thirty years. Another simulation allowed for plant competition and hence dynamic vegetation. It is found that over the surrounding region of Kuwait, a slight greening occurs and shrub lands and grasslands can persist in some years, those which are wet or preceded by wet years. Although changes in biomes occur, they are quite slight in terms of the amount of greening caused by these changes (i.e. changes in the actual leaf area index). This result is due to the extreme climate conditions that occur over Kuwait; by June, Kuwait and the surrounding area is too hot and dry to support plant life, thus the shrubs and grasses subsequently die off, regardless to biome classification or plant functional type.

As a result, small decreases in temperature over the area occur from December to April, when the region is greenest. The slight decrease in DJF temperature is a result of a slight increase in the latent heat flux during the same months due to increased evapotranspiration. Later in the year, during the spring, the net radiation over Kuwait increases slightly as the upward longwave radiation decreases. In contrast, no significant changes in rainfall totals or patterns are observed. Therefore, it is concluded, that overall, vegetation dynamics do not play a significant role in the climate of Kuwait.

KFAS Contribution: K.D. 98,529
Total Budget: K.D. 98,529

Pre-Commercial Scale Production of Dunaliella Salina: Induction and Extraction of β-Carotene

(2011-1207-03)

T. Abu-Rezq, Musaad Al-Roumi, N. Ahmed, M. Al-Shamali and A. Naseeb
Kuwait Institute for Scientific Research

Project Progress – Abstract

From 1 September 2013 to 28 February 2014, different activities as part of Task 1 were carried out. Mobilization includes construction of Dunaliella salina pre-commercial scale production facilities in Al-Khiran. Task 2 includes testing D. salina maximum growth under outdoor pre-commercial scale production (Stage 1). A part of Task 3 which includes assessment of the stress factors required for maximum β-carotene induction (stage 2); and Task 4 which includes evaluation of a practical and suitable method for pre commercial scale β-carotene flocculation and extraction. Due to the delay and continued unsatisfactory performance of the Asmaa Al-Dira Company (contractor), there was a total delay of 15 months in project activities.

The research work under Tasks 2 and 3 continued at Marine Research Campus of KISR in Salmiya using 2m3 outdoor tanks. In addition, research experiments were initiated in Khiran although the new facilities were not completely handed over. The results of Task 2 using 2m3 outdoor fiberglass production tanks in KISR laboratories in Salmiya showed that the highest mean cell count on day 17 was 0.78x10630.03 cells ml-1, when temperature range was between 20 and 24°C and a light intensity mean was of 83.6735.90 x103 lux. The results obtained from Khiran using 24 m3 raceways showed that
the highest mean cell count on day 17 was 0.19x10^6 ± 0.08 cells ml^-1, temperature range was of 14 to 16°C and a light intensity mean was of 37.33 ± 9.16 xl 03 lux. Furthermore, the growth values calculated for both trend lines showed that the b values for both using 2m^3 outdoor tanks in KISR laboratories in Salmiya and at Khiran using 24m^3 raceways were 0.0828 and 0.019, respectively. Although these results indicated that using 2m^3 outdoor tanks gave better results in algal growth rate, it is still too early to decide. Several runs will be conducted later on for better conclusion. Some problems were encountered during the first set of experiments in Khiran (Task 3). Results of Task 4 showed that using 1 to 5% freshwater for D. salina cells separation is the cheapest and more practical method.

KFAS Contribution:  K.D. 56,705  
Total Budget:  K.D. 85,688

Biodiversity and Taxonomy of Kuwait’s Marine Benthic Dinoflagellates (Microalgae)  
(2011-1207-05)

Kuwait Institute for Scientific Research

Project Progress – Abstract

The biodiversity of microalgae has not been comprehensively studied in the most tropical and subtropical areas, including Kuwait’s waters. Conducting a comprehensive ecological survey program on benthic dinoflagellates relies on the identification of the dinoflagellate species. The present second annual progress report covers six tasks, namely mobilization, sampling program and procedure, sample processing; microscopic examination, and culture work; molecular analysis and data analysis; and reporting. It represents the period from March 2013 to March 2014. Seawater samples were collected from the bottom depth of four stations, including the inshore coral habitats (Qitat Funaitees), offshore coral islands (Kubbar), Doha beach and north of Kuwait Bay at Bubiyan Island (Station A) during spring (March to May 2013) and summer (June to August 2013). The samples were analyzed for concentrations of chlorophyll-α, turbidity, dissolved oxygen, ammonia, micronutrients and macronutrients. Ten stations (Shuwaikh, Dasman, Turtle Island, Marina Crescent, Salmiyah, Fahalleel, Julai’a, Khiran pond, Khiran lagoon and Khiran open sea beaches) were sampled for seawater, sediment and macroalgae during spring (March to May 2013) and summer (June to August 2013) for the qualitative analysis of benthic dinoflagellates. For the quantitative and the qualitative studies of the benthic dinoflagellates, dead corals, sediment and macroalgae were processed from the inshore reefs of Qitat Funaiitees and from offshore islands Kubbar, besides sediment and macroalgae from Doha beach and sediment from Station A. Scanning Electron Microscope pictures were taken for Prorocentrum sp. and Coolia monotis from Khiran. DNA sequence was run for Prorocentrum rhathymum from Khiran Open sea (July 2013). Four species of benthic dinoflagellates Coolia monotis Prorocentrum emarginatum, Prorocentrum bimaculatum and Prorocentrum fukuyoi were isolated, cultured and maintained. Statistical analysis of the microalgae and marine physical and chemical parameters collected during 2013 revealed significant differences between data from sampling sites, mostly related to southern (Qitat Funaiitees and Kubbar) or northern locations (A, Doha) of the sampling area.

KFAS Contribution:  K.D. 51,085  
Total Budget:  K.D. 164,785
Properties of Mineral Dust in Kuwait’s Atmosphere
(2011-1401-01)
I. Sabbah
Public Authority for Applied Education and Training

Project Progress – Abstract
The Arabian Peninsula is one of the dustiest places in the world. The main sources of dust are the alluvial plains of Iraq, the plateau of eastern Jordan, the Jazirah (Jezireh) of eastern Syria, and the interior plains of Dhofar and adjacent interior eastern Yemen. Kuwait is of great interest due to highest recorded dust density in the Arabian Peninsula. We installed a polarized Micropulse Lidar (P-MPL) at the college of Health Sciences in November 2013. This is the first Lidar in the region. We continuously observe aerosols and clouds up to 25 kilometers. A good correlation is obtained between the Aerosol Optical Depth (AOD) retrieved with MODerate resolution Imaging Spectroradiometer (MODIS) sensor aboard NASA’s Aqua satellite with the simultaneous ground based AErosol RObotic NETwork AERONET-AOD measurements. Additionally, we obtained a good correlation between the satellite AOD and the concentrations of the air pollutant PM10 (particular matter with an aerodynamic diameters less than 10 microns) observed by Kuwait Environment Public Authority. Finally a good correlation is obtained between airborne pollens and the number of patients diagnosed with asthma. The increase in wind speed helps to spread the pollens in air and consequently increase the number of patients.

KFAS Contribution:  K.D. 76,900
Total Budget: K.D. 122,180

The Biology of Marine Bivalves and their Environment in Kuwait, Phase I: Population, Structure, Reproduction and Mitochondrial DNA
(2012-1207-02)
S. Al-Mohanna
Kuwait University

Project Progress – Abstract
Current study on commercial and economically important bivalves revealed 5 species of clams, two species of pearl oysters and one species of scallop. Encountered species have been identified based on their conchological features. The five clam species are Amiantis umbonella, Protape cor, Marcia opima, M. flammea and Circenita callipyga belonging to four different genera and all are members of the family Veneridae. These clams are widely distributed along the northern littoral zone of Kuwait’s marine environment. However, only two species of pearl oysters, Pinctada margaritifera and Pinctada radiata belonging to the family Pteriidae, and one scallop species Chlamys livida of the Pectinidae family were found sublittorally along the northern Kuwaiti coast.

KFAS Contribution:  K.D. 63,750
Total Budget: K.D. 74,750
Performance Evaluation of Gliricidia Sepium for its Potential Use in Kuwait’s Landscape
(2012-1207-03)

H. Al-Zalzaleh, G. Deruz, D. Awadh
Kuwait Institute for Scientific Research

Project Progress – Abstract

For the beautification of Kuwait, several ornamental plants were introduced to the country for use in landscape projects. Evaluation of these exotic plants under the climate conditions prevailing locally is necessary before these plants can be recommended for large-scale planting. Accordingly, Gliricidia sepium was selected to be studied for its use in urban and suburban landscapes. Gliricidia has several good qualities, such as, adaptability to dry conditions, growth in alkaline soil, fast growth rate, attractive flowers and growth with minimal use of water. The main objectives of this project are as follows: to introduce G. sepium into Kuwait; to determine the adaptability of Giliricidia provenances under Kuwait’s climatic conditions; to develop a hedge-grow planting system for G. sepium mixed with Conocarpus and to develop an irrigation schedule for C. sepium. The current reporting period contains the results of completed Tasks 1 and 2, i.e., mobilization and greenhouse preparation and growing of seedlings, and the progress made in Subtask 3a (evaluation of Gliricidia as a pure crop under urban climate) and Subtask 3b (evaluation of Gliricidia as an interplant with Conocarpus sp). It also includes the results of analytical study of the plant establishment characteristics in the completed Task 2. The present study revealed that a high percentage of germination and survival rate was noticed in all the provenances. It also shows that plants propagated through seeds recorded better performance related to the germination and survival percentage than those through cuttings. The vegetative propagation of Gliricidia stem cuttings with 100 cm length and 3 to 4.5 cm stem thickness was successful in generating high plant establishment and number of leaves per cuttings. Irrespective of the provenances, all the plants showed excellent growth characteristics when outplanted in the field under the prevailing climatic conditions of Kuwait.

KFAS Contribution: K.D. 13,380
Total Budget: K.D. 39,000

Spatial and Temporal Variations in the Atmospheric Concentrations of the Newly Listed Chemicals in the “Stockholm Convention on Persistent Organic Pollutants”
(2012-1401-02)

B. Gevao, M. Porcelli, and M. Al-Baloul
Kuwait Institute for Scientific Research

Project Progress – Abstract

The primary goal of the current study is to generate spatial and temporal atmospheric concentration data on the ten ‘newly’ added chemicals in Kuwait, with the aim of understanding their environmental behavior and to support Kuwait’s effort in meeting its treaty obligations. High volume sampling and
the passive sampling campaigns were completed, in addition to two intensive sampling campaigns to determine the diurnal variations in the levels of persistent organic pollutants in air. The analytical methods for the analysis of polyfluorinated compounds have been developed following the delivery of the liquid chromatography tandem mass spectrometer. Sample analysis is ongoing. Results are presented and discussed in the progress report on polybrominated diphenyl ethers and polychlorinated biphenyls in passive air samples. The passive sampling data showed that $\sum$PBDEs were fairly uniform across Kuwait City with concentrations ranging from 7 to 33pg/m$^3$ except at Sulaibiya where the concentrations ranged between 34 and 105 pg/m$^3$. The spatial distribution of $\sum$PCBs were similar to those of $\sum$PBDEs with concentrations in the urban areas (range, 4 to 78 pg/m$^3$) higher than those at the remote sites (range, 2.2 to 17 pg m$^3$). As was the case with PBDEs, the highest PCB concentrations were measured at the site in Sulaibiya where the levels were found to range from 170 to 390 pg m$^{-3}$. The concentrations of $\sum$PBDEs and $\sum$PCBs at the Sulaibiya station was shown to be strongly correlated with temperature with the highest concentrations measured during the June to September sampling period.

KFAS Contribution:  K.D. 62,240
Total Budget:  K.D. 116,780

Hydrocarbon Pollution of Kuwait’s Coastal Zone: Differentiation of Petrogenic, Anthropogenic and Biogenic Hydrocarbons

(2012-1401-03)

T. Saaed, F. Al-Shammari, N. Ahmad, A. Al-Mutairi, and H. Abdullah
Kuwait Institute for Scientific Research

Project Progress - Abstract

This report describes the progress achieved in the first 9 months of this project. In this period, mobilization was completed during which the chemicals, apparatus, standards and other required materials were acquired. Sampling task has also been completed. A total of 70 samples were collected from the intertidal zone as well as offshore locations. Sediment samples were freeze-dried and sieved. Total organic contents (TOC) were determined and have been reported here. Sample analysis protocols were established and trial runs were made. Extraction and fractionation were optimized by using a model mixture. The separation of aliphatic and aromatic fractions was achieved. The results of fractionation, gas chromatography/flame ionization detection (GC-FID) and gas chromatography/mass spectrometric (GC/MS) analysis of Kuwait crude oil and one of the samples (MAB-B) are presented to illustrate the applicability and suitability of different analytical techniques. After some refinement of the analytical conditions, the qualitative and quantitative analysis of the samples is expected to proceed in the next few months.

KFAS Contribution:  K.D. 38,000
Total Budget:  K.D. 71,686
Multi-dimensional Assessment of Trace Metals and Criteria Pollutants Using Air and Water Quality Indices in the Kuwait Environment

(2012-1401-04)

A. Bu-Olayan
Kuwait University

Project Progress - Abstract

The present investigation of multidimensional quality assessment in (a) outdoor and (b) indoor ambient air, (c) selected desert and cultivable plants and, (d) in the marine ecosystem, is the advanced findings of our earlier investigation in Kuwait (KFAS-sponsored Project 2006-1401-02).

In the first phase, environmental variables from six Kuwait Governorate areas (GI - GVI) revealed the influence of temperature, wind velocity, humidity and altitude to particulate dispersion, besides the effect of anthropogenic sources. Studies have shown higher dispersion of PM10 than PM2.5 and PM1.0 in the outdoor environment, indicating the influence of the dust storms and industrial pollution. Criteria pollutants such as CO, NO2 and SO2 were found high in GVI and GI areas, indicating the influence of oil and industrial pollution. Air quality index (AQI) indicated high NO2 concentrations, indicating the increase of automobile emission. Trace metals concentrations in the selected desert and cultivable plants were observed high in Portulaca oleraca, Citrullus collocynthus, Phaseolus vulgaris and Lycopersicum annuum leaves, stem and root respectively and thus, labeled as possible bio-indicators of air pollution. Air tolerance pollution indices (APTI) validated the sensitivity of such desert and cultivable plants to air pollution. Translocation factor (TF) in all the plants samples were >1 signifying the hyper-accumulation process.

The second phase of the investigation was conducted during the year 2014 and determined the influence of different variables in selected indoor premises. Our study showed that the indoor/outdoor ratio (I/O) in Criteria pollutants - PM10, SO2, NO2, CO and CO were high during winter than in the summer, except O3. These pollutants were high in warehouses, tools, car park basements in GVI and GII areas of Kuwait validating the effect of low/absence of heating, ventilation, air conditioning system (HVAC), automobile and industrial emissions. The indoor air quality index (IAQI) was found correlated with discomfort index (DI) for a given premises and this was found above the exceeding limits in GVI areas. The study on radon gas showed an increasing trend in car park basements, and premises that were aged, had crevices/leaks in the walls and without HVAC system in carpentry-warehouse. An integrated study of the indoor system alone revealed the pollutants in the magnitude of CO>CO2>SO2>NO2>Radon>PM10 pollutants.

During the third phase of this study in the year 2015, we will determine the role of criteria pollutants, trace metals toxicity and bioaccumulation process (BF) in the marine organisms and also deduce the effects of air and water interface pollution.

In summation, the final report will incorporate the different indices of concern to air, water, plants and humans in relation to seasonal and environmental variables to quantify exposure assessment of the criteria pollutants in the six Kuwait Governorates, besides the determination of possible dietary toxicity and risk assessment of selected pollutants to residents of Kuwait.

KFAS Contribution: K.D. 24,260
Total Budget: K.D. 50,460
Photocatalytic Oxidative Removal of Phenolic Compounds from Wastewater Using Ozone and Hydrogen Peroxide Produced by New Electrodes

(2012-1405-01)

H. Al-Kandari
Public Authority for Applied Education and Training

Project Progress - Abstract

In this stage of the research project, characterization of reduced graphene oxide is performed. Carbon materials were loaded on commercial TiO2 using different methods: Graphene oxide (GO) was synthesized from commercial graphite using Hummers’ method. Then, GO was initially impregnated over TiO2 (GOTi) and reduced later using a stream of hydrogen gas in a controlled reactor at 450°C (H2RGOTi) or reduced initially by hydrazine hydrate solution (HH) in a 1000-W microwave oven (HHRGO) then loaded later on TiO2 (HHRGOTi). Also, hydrothermal reduction was applied to obtain reduced GO (RGO) and RGO/TiO2 composite (RGOTi). All as-prepared composites were characterized by bulk and surface techniques. These techniques include X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Infrared spectroscopy (IR), Raman spectroscopy (Raman) and Ultraviolet - Visible spectroscopy (UV Vis). Surface areas of all as-prepared composite were also measured. In addition, electrodes of H2O2 and O3 generation were prepared and partially characterized due to some obstacles, which will be mentioned later. The photocatalytic activity of the aforementioned composites was tested for phenol, p-chlorophenol, p-nitrophenol degradation in absence of H2O2 and also was compared with the commercial TiO2.

KFAS Contribution: K.D. 68,960
Total Budget: K.D. 79,060

Effects of Kuwait Crude Oil on the Behavior of Sobaity Sea Bream (Sparidentex Hasta)

(2012-1407-01)

Q. Karam, M. Beg, K. Al-Abdel-Elah, S. Hussain, S. Al-Dufaileej and E. Al-Hassan
Kuwait Institute for Scientific Research

Project Progress - Abstract

The project progress report discusses the examination of the effects of water-accommodated fraction (WAF) of Kuwait crude oil (KCO) on the swimming performance of sobaity fish fingerlings (Sparidentex hasta). Chemicals characterization of WAF of KCO solutions revealed that total petroleum hydrocarbon (TPH) concentrations were 0.411, 0.787 and 1.280 mg/l for the three oil loadings and 0.125, 0.25, and 0.5 g KCO/l seawater, respectively. The TPH concentration was not proportionally increased with increase in oil loadings. Behavioral pattern of fish fingerlings was standardized in control seawater using different duration intervals, which indicated consistent swimming performance values with time. Exposure to fish anesthesia used as positive control revealed that, upon increasing the anesthesia concentration, both swimming speed and swimming height were decreased. Subsequently, the effects on fish of WAF prepared at varying oil loading were examined. In WAF exposed fish average swimming speed decreased compared to that of fish exposed to control, while no significant change was noticed in their average swimming height. Exposure concentration triggered toxicity indices from 0.8 and 0.47 to 0.25 and 0.5g KCO loading /l seawater respectively, while no toxicity index was recorded for the lowest 0.125g KCO/l seawater loading. Other behavioral parameters remained slightly unchanged.
after WAF exposure. The ability of fish to recover from the toxic effects was examined at 24 and 48 h after cessation of 5-d long exposure at varying WAF concentrations. At all the three exposure concentrations, swimming performance of fish exhibited a recovery and their behavior was improved. The study is in progress and experiments are being conducted to link behavior with histopathological damages in internal tissues and muscle fibers of fish.

KFAS Contribution: K.D. 57,920
Total Budget: K.D. 100,370

Probability and Statistical Analysis of Total Suspended Atmospheric Particulate Matter in Kuwait

(2012-4401-01)

S. Neelamani, M. Al-Sudairawi, A. Al-Dousari, A. Al-Homood, M. Ahmed, N. Al-Dousari, M. Abdullah
Kuwait Institute for Scientific Research

Project Progress - Abstract

Statistical and probability analyses were carried out on the available total suspended particulate (TSP) data in five different locations in Kuwait, viz. Mnageesh, Jahra, Reqqa, Shuwaikh and Kuwait City. It was found that the mean value of TSP varies from 197 to 330µg/m³, median, from 123 to 167µg/m³ and mode, from 7 to 163µg/m³. It was found that Jahra area experiences TSP > 2000 µg/m³ for 9 d/yr whereas for other locations it is from 1 to 3 d/yr. For Jahra, 13.8% in a year, the TSP > 500 µg/m³. Out of the five locations studied, Kuwait City experiences the least TSP value and Jahra experiences the highest TSP value. Correlation between summer daily average TSP and the corresponding visibility is linear and satisfactory. Correlation between the 5 min average visibility and corresponding TSP measured at the Kuwait Institute for Scientific Research (KISR) follows power fit. Correlation between the seasonal average rainfall and the annual average TSP for the following year is better when compared to the seasonal average of two years or three years rainfall and the following year’s annual average TSP. In general, if the seasonal rainfall is higher, the following year’s annual average TSP is lesser. Dust also causes serious socio-economic effects. Delay of one day oil export causes a revenue loss of about US$ 350 million. Delay in air traffic per day causes a loss of US$ 2,462,400/-. The annual dust fallout into the Kuwait Bay from August 2009 to July 2010 and August 2010 to July 2011 is 225186.051 t and 283172.109 t respectively.

KFAS Contribution: K.D. 11,170
Total Budget: K.D. 58,380
Multi-dimensional Assessment of Trace Metals and Criteria Pollutants Using Air and Water Quality Indices in the Kuwait Environments - Extended Task II

(2013-1401-02)

A. Bu-Olayan
Kuwait University

Project Progress - Abstract

Following a detailed literature and preliminary site surveys of our earlier Project (KFAS 2012-1401-04), we found that specific findings in polluted sites of Kuwait is essential to determine the role of air and water pollution in a multi-dimensional approach; hence, the Extended Task Phase-II study.

Site specific study of outdoor air quality assessment was conducted to determine: (1) the effect of ‘criteria pollutants’ and trace metals near cement mixing quarries, waste disposal in open areas-landfills, constructional activities in newly built locations distributed in the Kuwait Governorate areas; (2) selected trace metals of importance in particulates (PM_{10}, PM_{2.5}) in the above-mentioned sites from ambient air, (3) bio-monitoring studies on the trace metals in selected cultivable edible plants of Kuwait that will determine the concept of pollution indices, translocation factor and, deduce the toxicity levels of each pollutant especially from the indigenous cultivable plants of Kuwait to residents of Kuwait.

This investigation will undertake site-specific study of selected trace metals and ‘criteria pollutants’ in selected indoor establishment of public utility to deduce the occupational exposure of indoor pollution and correlate the influence of external and internal variables and indoor air quality. This study validates water pollution assessment by training and supporting a Master Student (Eman A. Al-Feraih) enrolled for the Environmental Science Course (EVS: 500). A case study was addressed on the assessment of mercury pollution in seawater, sediment and commercial marine fishes to deduce the dietary intake of residents in Kuwait. This study will create public awareness to curb pollution through multi-dimensional approach.

KFAS Contribution: K.D. 14,842
Total Budget: K.D. 14,842
Genetic Engineering of Alfalfa for Remediation of Soil Contaminated with Heavy Metals and Residual Crude Oil

(2013-4401-01)

Kuwait Institute for Scientific Research

Project Progress - Abstract

Phytoremediation is a cost-effective and environmental-friendly approach among the available technologies to remediate soil that is contaminated with various pollutants. Remediation of oil-contaminated soil is a major challenge for Kuwait. Bioremediation can be used effectively to eliminate significant level of crude oil from contaminated soil. However, traces of crude oil and associated heavy metals should be eliminated from contaminated soil using alternative technologies, such as, phytoremediation. The aim of this project is to screen selected plant species for the remediation of oil-contaminated soil and engineering alfalfa plants for enhanced metal uptake ability. Task 1, Mobilization was completed. Essential supplies and equipment needed for the project were procured. The proposed work under Task 2 to 5 has begun. In Task 2, the metal tolerance, uptake ability and tolerance to petroleum hydrocarbons was assessed for Atriplex halimus, alfalfa, barley and Indian mustard species. Due to the unavailability or seeds, Atriplex halimus plants were propagated through tissue culture methods. The protocol for micropropagation of Atriplex halimus was established successfully. In Task 3, the samples are being prepared for heavy metal analysis from various plant tissues. In Task 4, primers were designed and were used to clone ATP sulfurylase gene from Arabidopsis cDNA. The recombinant plasmids having a full length gene are being sequenced for the confirmation of the isolated gene. In Task 5, the tissue culture optimization work is under progress. Future work will be focused on mobilizing the full length gene into a plant transformation vector, transformation of alfalfa with the engineered vector, generation of transgenic events and the analysis of the transgenic alfalfa plants for their phytoremediation efficiency.

KFAS Contribution: K.D. 44,300
Total Budget: K.D. 130,740
NEW PROJECTS

The Collapse of Kuwait’s Fishery Stocks: Analysis, Data Needs and Remedial Management Actions
(2011-1401-06)

M. Al-Husaini
Kuwait Institute for Scientific Research

Abstract

This project is designed to address a major natural resources management and food security issue for Kuwait - the reasons for the dramatic recent decline in fresh fish landings into Kuwait and how these landings might be restored to previous levels. Fish landings in Kuwait have declined by over 60% since the late 1980s and now contribute about 14% of Kuwait’s fresh fish demand. This is stark contrast to the situation in the 1980s, when Kuwait was not only self-sufficient in fish but also produced surplus of shrimp that supported an important export industry. This change has resulted in fish imports into Kuwait rising significantly to the point where they now account for approximately 86% of Kuwait’s fish supply.

This 3-year project will therefore have three objectives: (a) To identify and prioritize the causes for the decline in the landings of fresh fish into Kuwait since 1985; (b) based on the identification of the causes for the decline in fish landings, to prepare a management road map of what actions need to be undertaken to increase the sustainable production of Kuwait’s fish resources; and (c) to identify the critical data needs to allow monitoring of the fish stocks of Kuwait and to allow the measurement of effectiveness of management actions in rehabilitating fish stocks. These three objectives will be addressed by undertaking the project in six tasks, including the holding of three annual workshops, which will provide the forum for the sharing of data, exchange of ideas and involvement of all stakeholders including, where necessary, neighboring countries.
Successful completion of the project and uptake of the recommendations would result in the causes of the decline being understood, appropriate management being put in place to address the reasons for the decline, fish landings to Kuwait being restored to the levels of the 1980s and the lessening of Kuwait’s dependence on imported fish. This would in turn result in an increase in contribution to domestic fish demand.

**KFAS Contribution:** K.D. 310,000  
**Total Budget:** K.D. 310,000

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**The Effects of Developments in Mesopotamian Marshland on Boubyan and Warba Islands**  
*(2012-1401-01)*

Kuwait Institute for Scientific Research

**Abstract**

Shatt Al-Arab, the final stretch of Tigris and Euphrates river from Iraq supplies the major fresh water and sediment into the North Western part of the Arabian Gulf. The construction of dams in the tributaries and distributaries of Tigris and Euphrates and the drainage of the Mesopotamian marshlands through Shatt Al-Arab from 1990 to 2003 has changed the geomorphology, sediment transport and hydrodynamic regime around Boubyan and Warba Islands. Kuwait is planning to develop these Islands through few mega projects in the near future. Understanding the physical change of the morphology, sediment transport and hydrodynamic changes are essential for planning, execution and management of these projects. Hence it is proposed to study in detail on these physical oceanographic changes around these Islands. It is also essential to assess the temporal variation of fresh water flow into the Kuwaiti territorial waters. The reduced fresh water flow from Shatt Al-Arab is expected to induce seawater intrusion into Kuwait and also affect the hydrodynamic and sediment transport regimes. The tools used for the study will be remote sensing techniques, field measurements of physical oceanographic parameters (such as current, tide, seawater temperature, salinity), lab analysis and numerical models.

It is proposed to compare the present day physical oceanographic status to the pre-Mesopotamian marshland desiccation period for assessing the physical impact in the North western part of Kuwaiti territorial waters. The work will be carried out by KISR, in which Sultan Qaboos University, Oman, Columbia University, USA and University of Basra, Iraq will work in the project as consultants.

**KFAS Contribution:** K.D. 80,064.650  
**Total Budget:** K.D. 169,334.650
Promoting Eco-Literacy Dimension in Government School Curriculum in Kuwait

(2013-1101-01)

O. Karar
Arab Open University

Abstract
The proposed project aims at studying the role of State in promoting eco-literacy among school students through their curriculum of study. This is the first ever project in Kuwait that would critically examine the impact of education at the formative level in promoting eco-literacy that contribute to behavioral changes towards environmentally sustainable behavior. The project aims to initiate a dialogue between the state and education providers in examining the impact of introducing eco-literacy curriculum and programs towards creating sustainable changes in promoting pro-environment-friendly behavior.

KFAS Contribution: K.D. 10,075
Total Budget: K.D. 10,075

Feasibility Study for Establishing a National Gene Bank for Living Organisms in Kuwait

(2013-1207-04)

S. Al-Bustan
Kuwait University

Abstract
The rate of global biodiversity deterioration is increasing at an unprecedented rate. Kuwait biodiversity has been also severely impacted due to the loss of habitat, as a result of development activities, the Gulf war and other anthropogenic causes. Consequently, there is an urgent need for the establishment of a national gene bank for future restoration and rehabilitation of the degraded biodiversity in the terrestrial and marine ecosystems, to conserve the fauna and flora of Kuwait for future generation and to fulfill Kuwait’s obligations to regional and international biodiversity conventions and agreements.

A gene bank is a facility where a collection of seed, vegetative tissues of plants, and genetic materials as well as gametes of animals are preserved and maintained for future use. The main objective of the project is to establish the Kuwait National Gene Bank to facilitate the acquisition and preservation of such material.

The feasibility study will include a team of researchers from both Kuwait University and KISR who have expertise in DNA technology, animal biology or plant biology. The team will also include experts on biodiversity and ecology. The research team will conduct a survey of existing gene banks facilities in Kuwait as well as international and regional gene banks. They will also be responsible for compiling information and statistics on native and indigenous species, then prioritize organisms that are in immediate need of conservation. The study will focus mainly on examining the advantages and disadvantages of what type of genetic resources is best used for cryopreserve. The study will culminate with suggestion of a suitable site and structure for a National Gene Bank and outline the facilities and budget needed for its development and maintenance.

KFAS Contribution: K.D. 40,000
Total Budget: K.D. 40,000
Using Value Methodology for Development of Scrap Tires to Fight Desertification in Kuwait and Ration Water

(2013-1501-01)

F. S. Al-Anzi
Kuwait University

Abstract

Kuwait is facing many environmental challenges. Some of which are natural while others are man-made. Responding to these challenges in localized, innovative, effective and economic ways are the encounters that researchers rising to. One of the vital and significant examples of the natural challenges is desertification. Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and human activities. Desertification is a significant global ecological and environmental problem. Fighting desertification requires huge investment and technological solutions that most of the times are becoming hard to maintain and hence, they become not economical and manageable in the long run. This study will focus on the following directions:

• Getting rid of ever growing huge tire dumpsters in Kuwait in a safe and environmental-friendly manner.
• Finding out an economical alternative to well-known technology of Waterboxx kits.
• Harvesting rain water and managing the most valuable water resources.
• Capacity-building in planting shrubs and trees in Kuwait deserts using state-of-the-art techniques.

KFAS Contribution: K.D. 99,400
Total Budget: K.D. 99,400
A Feasibility Study Plan for Establishing and Operating a National Cleaner Production Center

(2013-4406-01)

Esraa Al Eisa
Kuwait University

Abstract

This feasibility study is created based on the Term of Reference (ToR) approved by KFAS and in accordance to UNIDO/UNEP Manual for creating cleaner production centers and Project Management Institute Standards for project initiation and execution. The plan includes enterprise environmental factor associated with the State of Kuwait. There are internal and external factors that surround or influence the cleaner production center’s success. The objective is to determine the scope of work, time frame and the qualifications required for the project. It also establishes main expected deliverable and the suggested technical, administrative infrastructures required to establish the center and to reach its full potential as a national focal point for the implementation of Cleaner Production. The main deliverable is a feasibility study and a basic programmatic plan for the national center to support the industrial sector and protect the environment through the development and adoption of cleaner production practices that would minimize waste generation and increase efficiency in the utilization of natural resources and related services including energy efficiency, industrial symbiosis and waste recycling, life cycle assessments, ecolabelling and environmental accounting.

The study assumes no financial returns in the first three years. The program shall start off as a project hosted by host institution, then transferred after that into another organization or becomes a stand-alone nationally owned entity.

As explained by the ToR, the study will only cover the industrial sector; primarily large and medium sized enterprises, as it is considered as a major national concern. Services associated with agriculture, hotels, ports, hospitals, etc. could be included after the establishment of the center.

KFAS Contribution:  K.D. 40,000
Total Budget:  K.D. 40,000
Chemical and Biological Assessment of Endocrine Disrupting Chemicals in Waste- and Coastal Waters in Kuwait

(P214-42WE-01)

N. Al-Jandal, T. Saeed
Kuwait Institute for Scientific Research

Abstract

Endocrine disrupting chemicals (EDCs) are emerging pollutants that have attracted widespread attention from all over the world due to their potency and potential to disrupt physiological functions in the living organisms in aquatic environment. Among the many classes of compounds showing endocrine disruption are natural estrogens and industrial chemicals. Exposure to these chemicals can cause problems including cancer, birth defects and feminization of males thus affecting marine productivity. Very little information are available of the levels and effects in Kuwait’s marine environment. One of the main sources of EDCs in marine areas is sewage discharge and treated wastewater. Water treatment plants partially remove most of these compounds. Since Kuwait has been discharging sewage and treated wastewater to the coastal areas, there is a need to investigate the levels and the effect of EDCs in Kuwait. In this proposed study, the occurrence of EDCs in Kuwait’s inflow and outflow streams of wastewater treatment plants will be investigated by chemical and biological methods. Levels discharged in water and concentrations in the sediments close to the discharge point will also be determined. The effects of EDCs will be assessed by exposing local fish species next to the discharged water followed by measuring induced vitellogenin by enzyme-linked immunosorbent assay (ELISA) and sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS/PAGE) coupled with western blot analysis. Histopathological studies of fish gonads and molecular studies will complement the vitellogenin findings. Chemical analysis will be carried out by gas chromatography-mass spectrometry (GC/MS) in selected ion monitoring mode after water and sediment extracts have been cleaned by solid phase extraction. Measurement of individual high priority estrogens, progesterone and bisphenol A will be carried out by selective concentration using immunoaffinity chromatography followed by ELISA.

KFAS Contribution: K.D. 58,325
Total Budget: K.D. 152,104
WATER & ENERGY

Completed Projects 6
Ongoing Projects 14
New Projects 4
RESEARCH TARGETS
NATIONAL & REGIONAL PRIORITY

ISSUES - WATER, OIL, RENEWABLE ENERGY & POWER

Some of the prime areas of research target of KFAS-funded projects included the assessment of groundwater resources in the country and its effective management and conservation, as they constitute a strategic natural resource in the region. Researchers directed concerted efforts at collecting data and new information on diverse factors affecting groundwater quality and its chemical and microbiological constituents in order to conceptualize a national groundwater monitoring network system. Investigations were ongoing to study the impacts of oil production and urbanization on groundwater quality/levels and local agricultural crops.

Bench-scale testing of treated wastewater shed positive light on domestic and industrial wastewater management as well as the re-use of the effluent, particularly for irrigational purposes. Scientists also sought to address emerging problems related to wastewater secondary treatment systems and its related effluent quality. Attempts were initiated during the year to monitor the flow and quality of two main aquifers in the south of Kuwait and freshwater resources in the northern part of Kuwait. On the other hand, collaborative efforts by KISR and NASA hydrologists commenced to set the groundwork for subsurface exploration of the desert. Efforts were underway to conduct an extensive bench-scale testing program that will examine the Plate Heat Exchanger-based Multiple Effect Desalination process. A baseline survey continued during the year in assessing the emerging contaminants in influents and effluents produced by the wastewater treatment plants in Kuwait. Mobilization tasks progressed at the seawater treatment plant with an attempt to enhance the quality of the feed for membrane and thermal desalination units, as well as for power generation equipment.

Survey of household consumption and conservation of electricity and water progressed. Under the KFAS-sponsored program, undertaken by The Oxford Institute for Energy Studies, three research papers were published pertaining to Gulf Energy Futures, with in-depth discussion and investigation of the fundamental energy themes underlying the GCC states, particularly Kuwait and the successful transition into emerging 21st century economies. In view of His Highness the Amir’s support for renewable energy projects, the intensive focus of novel ventures rested on addressing the growing demand for energy in the country by developing and testing wind turbines to generate electric energy and residential solar PV systems as energy-efficient and environment-friendly alternatives. New projects aimed at promoting sustainability programs at the local university campuses and achieving green, energy-efficient communications networks in the country.

Mega signature projects, undertaken jointly by MIT and researchers in Kuwait, were expected to set significant trends in engineering designs and technologies with innovative solutions and methodologies, directed towards long-term sustainability in the State of Kuwait and the region at large.
COMPLETED PROJECTS

Assessment of the Effect Anthropogenic Activities in Northern Kuwait on Natural Groundwater Recharge
(2009-1405-01)

A. Akber, T. Rashid, A. Mukhopadhyay, H. Al-Qallaf, A. Al-Haddad, V. Kotwicki and S. Uddin
Kuwait Institute for Scientific Research

Abstract

Major human activities that commonly involve quarrying, cross-country movement of heavy vehicles and construction of roads, barriers, and military installations can lead to significant hydrogeological alterations, and ultimately result in substantial impacts on the groundwater system.

The primary objective of this study, which was partially funded by Kuwait Foundation for the Advancement of Sciences (KFAS) and extended over 30 months starting from 1 June 2011, was to assess the potential effects of the new constructions and changes in the overall geomorphology since 1990 on the surface and subsurface runoff volume, flow directions, points of accumulation, and groundwater recharge, and to determine the long-term effects of these changes on the groundwater quality and the evolution of the freshwater lenses in Kuwait.

The study was carried out through five interrelated tasks that involved Mobilization and Data Collection, Field Investigations and Sample Collection, Laboratory Analysis, Numerical Simulation as well as Data Assessment and Interpretation. The findings of this study are expected to have immense implications on the management of the groundwater reserves of northern Kuwait, which hosts the only substantial fresh groundwater body in the country. The study identified the activities that have major impacts on the natural recharge volume, its locations, groundwater flow and quality, and safe yields. It also recommended steps to minimize the adverse effects of human activities in northern Kuwait on the groundwater resources in an effort to safeguard the freshwater accumulations of northern Kuwait that have strategic importance in this water-starved country. Additionally, the findings of the study are
expected to help in devising ways to improve natural recharge to the aquifers, thus, improving both the usable groundwater volume available and its safe yield.

KFAS Contribution:  K.D. 108,052
Total Budget:  K.D. 197,120

**Design of a National Groundwater Monitoring Network in Kuwait**

*(2009-1505-03)*

**A. Akber, T. Rashid, Al-Al-Haddad, H. Al-Qallaf and V. Kotwicki**

Kuwait Institute for Scientific Research

**Abstract**

The primary objective of this study, partially funded by Kuwait Foundation for the Advancement of Sciences (KFAS), was to comprehensively investigate the groundwater levels and quality in the main aquifers of Kuwait through the field design of a permanent national monitoring network. The specific objectives of the study were to determine the current groundwater levels and identify the current chemical and microbiological constituents to establish baselines for different groundwater levels and constituents (with an emphasis on those chemical and microbiological constituents that can be used as groundwater quality indicators) and to establish and develop a database of the information and data obtained during the execution of the study. During the study period, relevant data and information regarding the regional baseline levels and distribution of the main constituents in the groundwater of the two major aquifers in Kuwait were collected, the wells to be investigated and sampled were selected, and the groundwater samples were collected and analyzed for chemical and microbiological constituents. The data and information obtained during the course of the study were reviewed, refined, and stored in a computerized format, and were then utilized to conceptualize a national groundwater monitoring network in Kuwait.

The conceptual groundwater monitoring network that was developed during the course of the study suggests that a total number of 410 to 465 monitoring wells with depths ranging between 10 and 500 m below ground surface would be required for the comprehensive monitoring of groundwater resource of the country. By integrating some of the already existing monitoring wells in this network, the total number of new monitoring wells for the national network could be reduced between 255 and 300. The actual locations, depths and monitoring zones of the wells may be modified to some extent during implementation as per the existing ground reality. The study recommends that the proposed monitoring network be implemented on the ground by the Ministry of Electricity and Water (MEW) that manages the groundwater resources since such a network will provide early warning communication on the threats to groundwater resources either from overexploitation or from human activities and will allow for timely intervention to maintain groundwater health. The network can also be used as a model to follow in the Arabian Gulf countries, which are characterized by similar prevalent climatic and environmental conditions.

KFAS Contribution:  K.D. 45,000
Total Budget:  K.D. 162,570

**Bench Scale Studies to Improve the Quality of Conventional Septic Tank Effluent**

*(2012-1505-02)*

**A. Shahalam, A. Abusam, M. Ahmed and A. Mydlarczyk**

Kuwait Institute for Scientific Research

**Abstract**

The final report contains the details of designs, operation and testing of performance of bench-scale
models of three systems proposed for treating effluent of conventional septic tanks. It also includes testing results, results analysis, best performing process, cost estimates of the best performing process, conclusions and recommendations.

On the merits of their performances and previous experiences, the following three systems were selected for the study: sedimentation tank, aerobic bioreactor, final clarifier, grass-bed sand filter and chlorination unit (system 1); sand-gravel partially anaerobic bioreactor, grass-bed sand filter and chlorination unit (system 2); and sedimentation tank, peat bio-filter and chlorination unit (system 3). The bench-scale models were operated and tested using effluents of a conventional septic tank. From obtained results, system 1 appeared to be the best performing process alternative. It satisfied the Kuwait Environmental Public Authority (KEPA) standards for reuse of treated wastewater in irrigation. Further, it was found to be robust to changes in hydraulic and organic loadings.

Prospects for Renewable Energy in GCC States – Opportunities and the Need for Reform

L. El-Katiri and M. Husain
Oxford Institute for Energy Studies

Abstract

This study explores the economic potential for, and possible caveats of, renewable energy in the GCC countries. Looking at the case of Kuwait, the authors highlight the growing potential for economic cost savings, primarily for solar photovoltaic power in the GCC states over oil-fired power generation, in the current global high-price environment for oil. The economics of solar power versus gas-fired power generation in the GCC are less obvious, though rising LNG imports by some GCC countries (chiefly Kuwait, the UAE and possibly Bahrain) are expected to improve these economics in the future. Renewable energy also entails some important caveats for the region. Highly distorted domestic energy markets that continue to price fuel at a fraction of its shadow economic cost provide few market-based incentives for utilities to switch towards renewables. The recent emphasis on the use of energy policies for renewables for the creation of ‘green’ jobs by GCC policymakers may increase, rather than reduce, unproductive economic sinks across the GCC states domestic energy industries and that would considerably dilute, if not call into question, any economic gains to be made from renewable energy in the GCC.

The US Tight Oil Revolution and Its Impact on the Gulf Cooperation Countries – Beyond the Supply Shock

B. Fattouh
Oxford Institute for Energy Studies
Abstract
While the impact of the increase in US production on prices and on oil market dynamics is yet to be fully felt, as some of the underlying forces still need time to unfold and need to be fully understood, it is important to provide a general framework to help us analyze the US shale revolution and its potential impacts on oil markets and key Middle East producers. In this paper, we propose a broad framework based on three main aspects: the US tight oil revolution as a positive oil supply shock – with the potential to transform into a global supply shock if hydraulic fracturing technology successfully diffuses to other parts of the world; the US tight oil revolution as a force disrupting the existing trade flow patterns of crude oil, petroleum products, condensates, and NGLs; the development of US shale as a powerful force behind the shift in market perceptions, not only from a position of oil scarcity to one of oil abundance, but also as a shift in terms of the USA’s aspiration to achieve energy independence and how this would impact US foreign policy and its relations with other players, including key Middle East oil exporters.

KFAS Contribution: US$ 45,000
Total Budget: US$ 45,000

Publications:
The US Tight Oil Revolution and Its Impact on the Gulf Cooperation Council Countries: Beyond the Supply Shock. Bassam Fattouh. OIES paper: WPM 54, October 2014

Price Reform in Kuwait’s Electricity and Water Sector – Assessing the Net Benefits in the Presence of Congestion
(2013-2603-03)
B. Fattouh and L. Mahadeva
Oxford Institute for Energy Studies

Abstract
Kuwait’s domestic electricity and water sector has been in disarray for several years, struggling with fast-rising demand for several decades as a result of rapid industrialization, population growth, rising living standards as well as due to the artificially low utility prices set by the government. We use a model-based methodology to compare the current pricing scheme against an alternative where consumer prices are raised to market levels and consumers are on average compensated by cash transfers that do not distort their economic decisions. Our main finding is that a realignment of prices at or closer to the market price level confers a benefit on current and future generations of Kuwaitis, in terms of fiscal savings, that outweighs the impact of raising electricity and water consumer prices to market price levels. Specifically, in the market price scenario with consumer prices at about ten times current levels, there is a total fiscal cost of about one-third of the value of fuel input used in the power sector (or about 1.5 per cent of GDP), entirely due to the cash transfer. This, however, is just less than one-fifth of the fiscal cost of the current low-price regime, and in principle represents a massive saving. The net benefit of moving to market prices is 6.3 per cent of GDP. By implication, if it is judged that a cash transfer scheme, undifferentiated by usage, can help gain acceptance for the price reform, it is shown to be affordable. We also show that the shift to market pricing will be a more efficient route to achieving spare capacity in the electricity and water system.

KFAS Contribution: US$ 45,000
Total Budget: US$ 45,000

Publications:
Assessment of the Hydrological and Hydro-chemical Interaction between the Main Aquifers in Southern Kuwait

(2009-2505-02)

K. Hadi and M. Al-Senafy
Kuwait Institute for Scientific Research

Project Progress - Abstract

The Dammam Formation and the overlying Kuwait Group are the two main aquifers that yield useable groundwater (when water salinity is <5000 mg/l) in Kuwait. Recent studies indicate that the large-scale exploitation of this brackish water resource in Kuwait generates major changes in the flow directions of groundwater in these aquifers. As a result, the hydrochemical equilibrium is expected to be disturbed, and some impact on the quality of the produced groundwater is expected. Accordingly, the Natural Water Resources Development and Protection Program of the Water Research Center at the Kuwait Institute for Scientific Research (KISR) initiated this project on 1 October 2011 for duration of 30 months with partial funding received from the Kuwait Foundation for the Advancement of Sciences (KFAS). The project aims to assess the impact of groundwater production on the potentiometry, hydrochemical equilibrium in the aquifers and on the produced water quality to ensure the continued, sustainable management of the available brackish water resources of the country.
The project was amended and the official approval from KFAS was obtained, and the project's tasks were re-scheduled, accordingly. The progress report describes the activities of Task 2 (Drilling of New Wells for Data Collection) and Task 3 (Pumping and Tracer Tests) which were partly completed. Under Task 2, re-tendering was completed and the drilling bids were received from the Central Tender Committee (CTC) and evaluated. Based on the evaluation, the drilling contract was offered to Kayan Construction International Co. The drilling has been started and upon the completion of the sites, Task 3 will be executed.

KFAS Contribution: K.D. 150,000  
Total Budget: K.D. 305,980

Household's Conservation Behavior: A Case of Electricity and Water Demand in Kuwait  
(2010-1112-02)

N. Burney and M. Al-Enezi  
Kuwait Institute for Scientific Research

Project Progress - Abstract

Total electricity and water consumption in Kuwait has risen sharply during the last four decades. This has been the direct result of many factors, including heavy subsidy on electricity and water consumption. It was estimated that between 1996/97 and 2006/07, annual subsidy on electricity and water consumption averaged approximately KD 1 billion. To meet the increasing demand, the authorities have pursued a policy of expanding the electricity generation and seawater desalination capacities on a regular basis. At the same time, the country’s hydrocarbon resources (i.e., crude oil and natural gas) are being increasingly used domestically to produce electricity and water. In recent years, 10% of the country’s annual production of crude oil and natural gas was used in the power plants. If the electricity and water consumption were allowed to grow unchecked, then more of the country’s hydrocarbon resources will be used domestically, thereby leaving less quantity for exports and at the same time negatively impacting the environment through burning of fossil fuels. The main objectives of this study, which is first of its kind for Kuwait, are to establish patterns for electricity and water consumption in Kuwait over a 12-month cycle, assess the behaviors of different population groups within Kuwait regarding consumption and conservation of electricity and water, and develop a set of policy recommendations for managing electricity and water consumption.

To accomplish the objectives requires collecting household level data on households’ electricity and water consumption and behavior. Accordingly, as a part of the study, during the year 2014, field work for the household survey was initiated. The sample for the survey consisted of 1500 randomly selected households, and the survey is being implemented in two parts. The first part consists of information on household composition, dwelling, appliance use, attitudes and practices towards electricity and water consumption and conservation, etc. The second part deals with monthly consumption of electricity and water over a 12-month period. The first part of the survey has been completed and the second part is on-going. The final report of the project is due in December 2015.

KFAS Contribution: K.D. 55,000  
Total Budget: K.D. 141,590
Monitoring and Assessment of the Natural Attenuation of Hydrocarbon Pollution of Fresh Groundwater Resources in Kuwait

(2011-1405-01)

A. Mukhopadyay and M. Quinn
Kuwait Institute for Scientific Research

Project Progress - Abstract
This study investigates the magnitude of natural attenuation of the hydrocarbon contaminants in the freshwater accumulations of the Umm Al-Aish and Al-Raudhatain areas in north Kuwait. If natural attenuation is proved to be active there, this can be taken advantage of in devising a plan that remediate the groundwater to its usable state within a reasonable time period and at a reasonable cost.

The legal problems with the insurance clause in the consultancy agreement with the Commonwealth Scientific agreement and Industrial Research Organization (CSIRO) have been sorted out and the agreement is expected to be signed in the near future. The results of the chemical analysis of the collected samples during the fourth round of sampling and their comparison with the results of previous analyses were documented.

In the future, monitoring of groundwater quality will continue. Microbiological investigation of the soil and groundwater from the study area will be undertaken and biogeochemical modeling will be taken in hand once the consultant's agreement with the Land and Water Division of CSIRO is signed.

KFAS Contribution: K.D. 140,000
Total Budget: K.D. 243,740

Testing of the Application of Surface Geophysical Methods for Mapping the Saline and Sulfide Rich Groundwater in the Urban Areas of Kuwait

(2011-2408-01)

A. Mukhopadyay
Kuwait Institute for Scientific Research

Project Progress - Abstract
The project aims to identify a surface geophysical method, or a combination of methods that provide an economic means for mapping the distribution of hydrogen sulfide-rich zones in the subsurface without resorting to costly drilling. The Lawrence Berkeley National Laboratory (LBNL) of the Department of Energy (DOE), USA, has been identified as the project’s consulting agent. The details of the technical aspects of the study to be conducted in cooperation with LBNL can be sorted out early. However, due to the conflicting rules and regulations under which DOE and KISR operate, even after a protracted negotiation, it was not possible to arrive at a mutually agreeable consultancy agreement that allowed the involvement of LBNL in the study. It was then decided to enter into an umbrella cooperation agreement with different institutions that operate under the DOE so that it would be easier to involve LBNL in the project.

KFAS Contribution: K.D. 96,920
Total Budget: K.D. 136,920
Tracer Study of Groundwater Flow System in Kuwait

(2011-2505-01)

M. Al-Senafy, S. Kumar, A. Al-Khalid, and K. Al-Fahad
Kuwait Institute for Scientific Research

Project Progress - Abstract

Kuwait has a very limited amount of useable groundwater resource. Although the general pattern of groundwater flow is known, the detailed pattern of the flow paths within the aquifer system are not known. Hence, a study on deriving hydrogeologic parameters and characterization of the main water aquifers in Kuwait, using tracer (natural and artificial) experiments, has been initiated. This study, funded by the Kuwait Foundation for the Advancement of Sciences (KFAS) and Kuwait Institute for Scientific Research (KISR), commenced on 28 December 2011 for a 54-mo duration. The project was amended due to the need for re-tendering of drilling and construction of groundwater wells, and the project tasks were rescheduled and the official approval from KFAS was obtained. This period also includes activities of Task 2 (drilling), Task 4 (tracer tests) and Task 6 (interpretation of tracer data).

Under Task 2, re-tendering was completed and the drilling bids were received from the Central Tender Committee (CTC), reviewed, and evaluated. Based on the evaluation, the drilling contract was offered to Kayan Construction International Co. The drilling has been completed at Site-11, which is shared with the other project and is underway at other sites. Under Task 4, more literature survey was made on the various types of tracer tests and their methods. Based on the experience gained from the tracer experiments conducted in a few existing wells, a guideline for conducting the tracer tests was prepared. Under Task 6, literature survey on a few analytical and numerical methods of the interpretation of tracer test results, in terms of estimation of groundwater and direction, porosity, measurement of dispersion coefficient, and interconnectivity between aquifers, was carried out.

KFAS Contribution: K.D. 200,000
Total Budget: K.D. 279,880

Desert Subsurface Exploration of Aquifers (Desert-Sea) - Phase I

(2011-5401-01)

A. Aliewi
Kuwait Institute for Scientific Research

Project Progress - Abstract

This project is a collaborative effort of Kuwait Institute for Scientific Research (KISR) and NASA/ Jet Propulsion Laboratory (JPL). We propose to address the hyper-arid desert aquifer origin, boundaries, dynamics and salinity by performing a comprehensive mapping of the subsurface hydro-geological structures in segments of the Arabian Peninsula, using dual-band airborne sounding radar combined with both Lidar and Transient Electromagnetic Method to support data interpretation. The project is analogous to the NASA Ice-Bridge airborne experiment but oriented toward understanding the desert subsurface. We will build a high-sensitivity Desert Penetrating Radar (DPR) that will be operated from a P3-B airborne platform for large-scale mapping as well as on a helicopter for high-resolution mapping. The proposed effort will be performed in five years, where in the first two years we will build the radar sounder and in the third year we will integrate the radar with the airborne platform and conduct engineering test flights in Kuwait. The fourth and fifth year will be dedicated to the science acquisition campaign over the Dammam Aquifer and the Empty Quarter desert in Saudi Arabia and United Arab Emirates.
This project addresses the preparatory phase (Phase I), which will include initial surveys in Kuwait using the existing NASA Ground Penetrating Radar (GPR) to enable more accurate design parameters for the DPR. These surveys will be conducted using the Eurocopter AS-365 N3 Dauphin covering wide variety of aquifer conditions. Ground surveys will also be conducted using both GPR and TEM. Also in this phase, partnerships with regional scientific counterparts will be established. A key element of this phase will be capacity-building through formal and informal training, so that KISR hydrologists become more familiar with the radar and how JPL carries out an investigation of this nature. JPL scientists and engineers in turn can become more familiar with the real-world problems facing arid region hydrologists.

KFAS Contribution: K.D. 300,000
Total Budget: K.D. 313,860

A Study on the Identification and Control of Filamentous Bacteria in Waste-Water Treatment Plants in Kuwait
(2012-1405-02)

A. Abusam
Kuwait Institute for Scientific Research

Project Progress - Abstract

Kuwait mainly depends on the expensive desalination of seawater to meet the demands for freshwater. The country, however, has recently adopted a vigorous campaign to reuse the treated municipal wastewater in order to augment the limited available freshwater resources. In Kuwait, municipal wastewater is treated at four main plants located at Jahra, Riqqa, Sulaibiya and Um-Al-Haiman areas. A survey conducted recently by Kuwait Institute for Scientific Research (KISR) has revealed that all these plants, except that in Sulaibiya, are encountering frequently acute episodes of filamentous sludge bulking and foaming problems. Severe sludge bulking and foaming can lead to violation of effluent quality requirements and many other operational and environmental problems.

This research project is intended: (i) to assess the design, operational and environmental factors of the wastewater secondary treatment systems in Kuwait and determine their association with the excessive growth of filamentous bacteria, and (ii) to recommend suitable control measures those prevent the excessive growth of filamentous bacteria in Kuwait’s wastewater secondary treatment systems.

This first progress report covers the period of the first 12 months of the project execution, which includes Task 1 (Mobilization), Task 2 (Filaments Identification and Quantification) and Task 3 (Wastewater Sampling and laboratory Analysis). Task 1 included mainly setting a work plan and requesting the purchase of the needed chemicals and equipment. All needed chemical supplies and equipment were delivered in due time, except the Vermicon Identification Technology (VIT) kits, which were delivered from Germany in November 2013. Delay in procurement of VIT kits has prevented the starting of Task 2 and Task 3 in time.

KFAS Contribution: K.D. 62,640
Total Budget: K.D. 97,410
Investigation of Plate Heat Exchanger Applications in Multiple Distillation: A Bench Scale Study
(2012-1505-01)

G. Al-Nuwaibit and E. El-Sayed
Kuwait Institute for Scientific Research

Project Progress - Abstract
The main aim of this project very important and much needed technical knowledge base on the Plate Heat Exchanger PHE-based Multiple Effect Desalination MED process, which will serve as a platform for further development and deployment of this technology in Kuwait and the Gulf region. The project involves design and construction of a bench-scale test unit, exhaustive hydrodynamic, thermodynamic and heat transfer testing; data interpretation and analysis leading to the development of a roadmap for a more comprehensive pilot-scale phase II project, which is considered an essential step for the actual implementation of the PHE-MED technology on a commercial scale.

The scope of work in this project includes five tasks. The first of these tasks is concerned with the design, construction and procurement of the bench scale test unit, which will be used in conducting the exhaustive experimental testing program. The first progress report highlights the progress related to the preparation of test unit process flow diagrams, manufacturing specifications, tendering and the purchase process.

KFAS Contribution: K.D. 31,600
Total Budget: K.D. 171,000

A Baseline Screening Survey of Human Pharmaceuticals in Wastewater Treatment Plants in Kuwait
(2012-2405-01)

B. Gevao
Kuwait Institute for Scientific Research

Project Progress - Abstract
Human pharmaceuticals entering the environment have been recognized as emerging contaminants of concern, particularly for aquatic organisms. They primarily reach the environment through effluent from wastewater treatment plants following excretion from the body in urine and faeces. This study is being carried out to provide baseline information on the concentrations of these compounds in wastewater and surface water and to undertake a comparative assessment of wastewater treatment plants (WWTPs) in Kuwait for their efficiencies at removing these compounds. Wastewater samples were collected from the influent and effluent streams of three of the WWTPs in normal operation in Kuwait, selected emergency outfalls, sea, and tap water. The samples were analyzed for pharmaceuticals covering a wide range of therapeutical classes including antibiotics, anagelsics, hormones, tranquilizers, diuretics, lipid lowering and cholesterol regulating statins, antihypertensive medication among others.

The concentrations of pharmaceuticals measured in the influents in all WWTPs were higher than those measured in effluents. The highest concentrations measured in influents were mostly the nalgesics/anti-inflammatory drugs acetaminophen, salicylic acid, ibuprophen, naproxen, and diclophenac, the antibiotic ciprofloxacin, the lipid regulator/cholesterol lowering statin drug bezafibrate and the hypertensive medication valsartan, and caffeine, all present in influents at the µg/L levels. In effluents, the compounds present in the highest concentrations were also same analgesics found in high
concentrations in the influents, the antibiotic ciprofloxacin, the lipid regulator/cholesterol lowering static drug bezafibrate, \(\beta\)-blocking agents, the diuretics furosemide, iopromide, and the psychiatric drug Carbamazepine and the hypertensive medication valsartan. The concentrations of hormones were largely below the method detection limits in most samples.

KFAS Contribution: K.D. 49,830
Total Budget: K.D. 81,710

**Assessment of the Potential Impacts of Oil Produced Water on the Groundwater and the Agricultural Crops in Al-Wafra Area**

*(2012-2505-01)*

M. Al-Murad and T. Saeed
Kuwait Institute for Scientific Research

**Project Progress - Abstract**

The main activities during this period were the approval of the contract to construct the monitoring wells by the Central Tenders Committee (CTC). The continuous multi-level tubes (CMT) and their accessories were purchased from Canada. Collection of field and reported data about the groundwater quality, especially at the western part of the Wafra agricultural area and adjacent to the fence of the oilfield, was done. The collected data were used to prepare an initial kriged geostatistical map for the distribution of the total dissolved solids (TDS), used to select the locations of the monitoring well that will be constructed in this project. Seventeen CMT wells were constructed. After the construction of each well, a groundwater sample was collected from each zone. The TDS was measured for each sample and the initial map was refined to select the new well location. Thirty-eight crop samples were collected from farms using groundwater for irrigation. The initial results of the analysis of the TDS showed a high concentration of the TDS in the 7th zone in all the wells constructed along the fence of the oil well field, and the concentrations reduced as the wells became far from the fence towards the east of the fence. The initial TDS results defined the distribution of the plume in the 7th zone. Up until the end of this reporting period, no analysis of the crops has yet been carried out. Henceforth, groundwater, samples, levels, crops, and fish samples will be collected and analyzed. The work in the numerical model will start soon.

KFAS Contribution: K.D. 89,480
Total Budget: K.D. 134,440
Assessment and Prediction of Urbanization Impacts on Sub-Surface Groundwater Levels and Quality in Kuwait

(2012-2505-02)

M. Al-Murad and S. Uddin
Kuwait Institute for Scientific Research

Project Progress - Abstract

The water table rise problem was first observed before 40 years in Kuwait. In the eighties and nineties of the last century, the sources and geotechnical impacts of a dewatering project were characterized. This project can be considered a continuation of the previous studies, where the main objectives are to assess the current extent of subsurface groundwater rise problem in Kuwait residential areas, identify the possible sources and to quantify their relative contribution, propose a protocol for future monitoring and design a dewatering program. The main activities carried out during the last year to achieve some of these goals were the collection of data related to water table, available monitoring wells, sources and sinks, and current and future MEW projects. In addition to the data collection, the locations of the monitoring wells were selected and the construction of 43 monitoring wells out of 60 wells was completed. Part of the activities was the generation of precipitation, metrological and drainage morphology data using the Tropical Rainfall Measuring Mission (TRMM). Preparation of the initial stage of a flow numerical model of the subsurface groundwater. Due to the delay in the approval of the well construction contractor, several tasks were delayed.

KFAS Contribution: K.D. 130,330
Total Budget: K.D. 209,010

Development of an Optimal Implementation Model for Seawater Multiple Effect Distillation Technology in Kuwait

(2012-2505-03)

G. Al-Nuwabit and E. El-Sayed
Kuwait Institute for Scientific Research

Project Progress - Abstract

This project aims at developing an optimal model to be used as a reference for future implementation of the seawater multiple effect distillation (MED) technology in Kuwait. The MED model is for spray falling film horizontal tube heat exchanger type, which is most commonly used in the industry today, with both parallel and forward feed configurations. The approach is based on establishing the basis for interaction between design parameters and efficiency of the MED systems for Kuwait’s operating conditions. The optimal model is meant to represent the interaction that yields a system with best efficiency and with minimum requirements of the materials of construction and manufacture of the working space and surfaces. Other design parameters will include number of effects, heating steam thermodynamic state, temperature difference between the effects, feed water temperature and concentration, and the process configuration in terms of feed water scheme; i.e., parallel or forward feed. The development involves mathematical modeling combined with comprehensive pilot testing over very wide range of fouling/operating conditions. For this purpose, a MED pilot unit will be designed, constructed and operated to provide means of obtaining the needed measurements and operational data.
Progress was undertaken in Tasks 1, 2 and 3, which are related to mathematical modeling, preparation of test unit process flow diagrams and manufacturing specifications and the tendering and the purchase process.

KFAS Contribution: K.D. 134,630
Total Budget: K.D. 685,160

Assessment of Seawater Treatment at Sabiya Station Using Mechanical Processes
(2013-1505-01)

Y. Al-Wazzan, M. Abdel-Jawad and M. Ahmed
Kuwait Institute for Scientific Research

Project Progress - Abstract

Long-term performance of power generation and water desalination equipment depends on proper seawater quality. At Sabiya station, the seawater quality is very high in turbidity due to the high content of silt and sand. Currently, the quality of seawater at Sabiya causes inconvenience to the operation and maintenance of the equipment at the station. Moreover, despite the availability of space for installing additional desalination and power generation units, the quality of the seawater limits the utilization of this site. The Ministry of Electricity and Water (MEW) has expressed its interest in exploring a reasonable treatment that can render the seawater to be fed with minimum silt and sand. The Kuwait Institute for Scientific Research (KISR) has explored the possible treatment using mechanical treatments, such as, using centrifuge and or hydrocyclone units, which have the potential to substantially lower the silt and sand concentration to an acceptable level, allowing the use of the seawater safely as feed for membrane and thermal desalination units, as well as for power generation equipment.

The main objective of this proposal is to assess the viability of enhancing the seawater quality for thermal and membrane desalination processes at Sabiya station. Progress was accomplished in the mobilization tasks, including installation and commissioning.

KFAS Contribution: K.D. 55,900
Total Budget: K.D. 182,000
Sustainability of Kuwait’s Built Environment
(2013-5508-01)

O. Buyukozturk, A. Hajah, S.Al-Bahar, J. Al-Qazweeni, A.Bumajalad, A. Al-Mumin, A. Bin-Nakhi
Massachusetts Institute of Technology, Kuwait Institute for Scientific Research, Kuwait University

Project Progress Abstract

The first Kuwait-MIT Signature Project, “Sustainability of Kuwait’s Built Environment,” is a joint project between Kuwait Institute for Scientific Research (KISR), Kuwait University (KU), and Massachusetts Institute of Technology (MIT). It is funded by Kuwait Foundation for the Advancement of Sciences (KFAS) through the support of Kuwait-MIT Center for the Natural Resources and the Environment (CNRE). The project aims at the development of innovative methods and solutions for the sustainability of Kuwait’s built environment with a three-level multi-scale approach of materials, buildings and urban neighborhoods. The project includes three areas of research:

- Focus Area A: Innovative Materials (nano-engineered construction materials),
- Focus Area B: Performance-based Engineering and reliability, and
- Focus Area C: Energy Efficiency and Life Cycle Analysis.

In Focus Area A, multiple cement paste compositions were tested and studied for understanding the material at the micro and nano levels. Microstructural characterization work was performed. Computational material modeling studies progressed in parallel with the experimental work, including investigation on the atomistic mechanical behavior of C-S-H under mixed mode loading and multi-scale description of cement paste systems incorporating volcanic ash. In Focus Area B, progress was accomplished in ground motion simulation, development of a full scale finite element analysis model for the Al-Hamra Tower and GPS installation on Al-Hamra and another KISR building. Additionally, vibration measurements were collected and MATLAB program for the data analysis was developed. The MATLAB program was employed for extracting the dynamic characteristics of Al-Hamra Tower structure from the measured vibration data. In Focus Area C, a neighborhood in Kuwait city using simulation models was developed, incorporating all operational and embodied energy contents. It is envisioned that the resulting urban model of parts of Kuwait City will function as a seed model that can be further extended by KISR and KU team to include other neighborhoods as well as future developments. As part of capacity-building, several workshops, training sessions and expert lectures were conducted in all the Focus Areas. In spite of these accomplishments and for a higher level of productivity and benefits from this collaborative research project, the Non-Disclosure Agreement (NDA) between MIT-KISR was sent to MIT from KISR.

In general, this signature project is progressing well with some delay the contractual process for the engagement of contractors for data collection of area B, and finalizing KISR-MIT NDA.

KFAS Contribution: K.D. 1,427,765
Total Budget: K.D. 1,427,765
NEW PROJECTS

Building Integrated Solar Photovoltaics (PV) for Kuwaiti Homes

(2013-5508-02)

A. Al-Qattan
Kuwait Institute for Scientific Research

Abstract

Solar energy is playing an increasingly important role in meeting the world energy demand. The growth in solar energy generation over the past few years has exceeded 20%. In response to His Highness, the Amir of Kuwait to support renewable energy developments toward conserving Kuwait’s hydrocarbon resources and reducing the country’s carbon footprint, Kuwait Foundation for the Advancement of Sciences (KFAS) is supporting an initiative that introduces solar photovoltaic energy to 150 Kuwaiti homes as a supplemental power generation. The project will emphasize on the commercial barriers related to photovoltaic (PV) widespread deployment in the residential sector and on developing regulations and guidelines defining the relationship between government agencies, private sector, and homeowners. The pilot project will also serve to develop local capacity in the safe and proper installation and operation of residential PV systems and be a test case for future installations of residential PV systems. This initiative will mainly help to encourage the reduction of peak load demand and decrease the environmental impact of using carbon fuels for energy generation. This proposal addresses the work related to the design, construction, operation, and monitoring of a grid-connected PV systems for 150 Kuwaiti homes, at a rate of fifty (50) homes per year over the course of three years. The proposed pilot plants will be designed to guarantee optimum energy generation, while maintaining a high standard of safety and aesthetic appearance.

KFAS Contribution: K.D. 1,963,580
Total Budget: K.D. 1,963,580
A National Green Campus Research Proposal for Kuwait Institution of Higher Education

(P314-35EA-01)

A. Al-Anzi
Kuwait University

Abstract

The purpose of this research proposal is to undertake the necessary capacity building, scoping, feasibility and engagement tasks over a one-year period, commencing spring 2014 to establish a national program to advance sustainability in Kuwait academic institutions of higher education and research. This national body, a National Green Campus Initiative (NGCI), will support the implementation of robust campus sustainability programs at leading pilot universities while also convening and coordinating best practice exchanges and sharing between all Kuwait universities.

The NGCI will target energy efficiency, green building design, water conservation, waste reduction, biodiversity, green transportation, and a systematic approach to social responsibility. These efforts will be benchmarked with other regional and international organizations. The focus of this effort is to reduce the environmental footprint of Kuwait academic institutions of higher education and research, position Kuwait in the emerging green economy by better preparing students, improve campus well-being, community outreach and public health and produce cost savings that will offset and exceed the implementation costs of the NGCI.

KFAS Contribution: K.D. 31,050
Total Budget: K.D. 91,950
Energy-Efficient and Sustainable Communications Network

(P314-35EO-01)

M. Awad
Kuwait University

Abstract

The dramatic increase in the popularity of multimedia services has propelled the development of high capacity networks to support the increasing demand. This however resulted in explosive increase in energy consumption, operational cost and complexity. For network services to remain compatible and affordable, service providers have been exploring areas to cut-down their costs. Shifting part of their consumed energy to renewable sources is one of the promising approaches. This is aligned with Kuwait government target to generate 15% of its electricity demand to renewable energy by 2030. The variation in generated energy due to weather conditions challenges the sustainability of provisioned service in green networks. The design and optimization of communication networks to achieve green and energy efficient communications networks while sustaining stringent quality of service requirements is the objective of this research.

KFAS Contribution: K.D. 61,090
Total Budget: K.D. 179,292
New Generation Brine Desalination and Management for Efficiency, Reliability and Sustainability

(P314-75EC-01)

J Han and B. Al Anzi
Massachusetts Institute of Technology and Kuwait University

Abstract

Kuwait's coast is located in one of the shallowest and most saline sections of the Arabian Gulf (up to 49,000ppm), which brings about many challenges in the seawater desalination. Discharges from Kuwait's desalination plants return high salinity brines to the Gulf, and may contain other contaminants such as chlorine or chromium, resulting in environmental impacts to the coastal region. Conversely, wastewater discharges to the Gulf have low salinity but may drive eutrophication of coastal waters. In this project, we will aim to increase both energetic and environmental sustainability of Kuwaiti water management by developing/validating novel ideas and interfacing them optimally with existing plant workflow. Three major themes of the project are:

1. Electrical desalination for brine management: We will capitalize on unique advantages of electrical desalination for pre- and post-treatment of source water to enhance the efficiency of the existing desalination plant. This will serve as our primary application. Proof-of-concept systems will be tested at both Massachusetts Institute of Technology (MIT) and Kuwait, coupled with a detailed techno-economic analysis toward optimized integration. We will use the strategy of multi-stage optimization, which achieves energy efficiency by minimizing irreversibility in the overall process through local management of concentration differentials. We will also employ a model-based engineering to both microscopic-process and system-wide optimization by taking advantage of advances in modeling multi-scale phenomena near ion selective membranes, as well as a more comprehensive understanding of irreversibility in the electrical desalination process.

2. Power generation using brine and wastewater: Pressure Retarded Osmosis (PRO) and Reverse Electrodialysis (RED) are emerging, membrane-based technologies for recovering energy from concentration differences between water streams. We will examine the potential of using PRO and/or RED to recover energy from Kuwait's desalination and wastewater plants while simultaneously reducing the salinity of the discharged brine by membrane-regulated dilution with wastewater and/or seawater. Coastal discharge configurations will be designed, and methods to fully mitigate the environmental impact of the discharged streams will be evaluated. This study will result in clear assessment of the potential of combining brine and wastewater discharge to lessen environmental impacts on the Kuwaiti coast while reducing the overall cost of water treatment through the recovery of renewable energy with reduced carbon emission via PRO or RED.

3. Engineering for Increased Reliability: We will also address the significant challenge of bio-fouling, scale formation, and particulate removal, by employing recent innovations in surface coating and microfluidic separation processes. Antifouling membrane coatings appropriate to the combined streams will be developed.

KFAS Contribution: US$ 5,500,000
Total Budget: US$ 5,500,000
Research Grant

Completed Projects

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Project Leader: S. Lahalih
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Water Research Center, Innovation Desalination Technologies Program

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Project Leader: F. Al-Ajmi
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Technological Studies, Department of Civil Engineering.

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Project Leader: W. Al-Herz
Affiliation/Beneficiary: Ministry of Health – Kuwait Institute for Medical Specialization.

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Project Leader: A. Taqi
Affiliation/Beneficiary: Public Authority for Applied Education and Training, Faculty of Business Studies.
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Project Leader: T. Al-Surrayai
Affiliation/Beneficiary: Kuwait Institute for Scientific Research, Environment and Life Sciences Research Center, Biotechnology Program

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Project Leader: A. Dashti
Affiliation/Beneficiary: Kuwait University, Faculty of Allied Health Sciences, Medical Laboratory Sciences Department.

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Project Leader: B. Alameddine
Affiliation/Beneficiary: Affiliation/Beneficiary: Gulf University for Science and Technology, College of Arts and Sciences, Department of Mathematics and Natural Sciences.

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Project Leader: A. Muhammad
Affiliation/Beneficiary: Kuwait University, College of Business Administration, Management and Marketing Department

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Project Leader: M. Al-Salman
Affiliation/Beneficiary: Kuwait University, Center of Excellence in Management, Quantitative Methods and Information Systems Department.

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(Project Code: 2012-1109-03)
Project Leader: J. Everatt
Affiliation/Beneficiary: Center for Child Evaluation and Teaching in collaboration with University of Canterbury, New Zealand.

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Project Leader: J. Haji
Affiliation/Beneficiary: Kuwait University – Center of Excellence in Management

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Project Leader: Q. Al-Sarraf
Affiliation/Beneficiary: Kuwait Society for the Advancement of Arab Children

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(Project Code: 2012-1112-04)
Project Leader: H. AlSaeid
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Technological Studies,

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Project Leader: A. Sabzali
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(Project Code: 2012-1513-02)
Project Leader: T. Al-Fozan
Affiliation/Beneficiary: Kuwait University, Faculty of Science, Information Technology Office

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Project Leader: H. Al-Amir

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(Project Code: 2013-1103-02)
Project Leader: H. Al-Fadhli
Affiliation/Beneficiary: Al-Awlama Company

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Project Leader: J. Testerman
Affiliation/Beneficiary: Gulf University for Science and Technology, English Department

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Project Leader: M. Al-Rajhi
Affiliation/Beneficiary: Kuwait University

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Project Leader: N. Scull
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(Project Code: 2006-1302-07)
Project Leader: F. Al-Mulla
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Department of Pathology.

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Project Leader: A. Behbehani
Affiliation/Beneficiary: Kuwait University, College of Sciences, Department of Biological Sciences.

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(Project Code: 2010-1103-03)
Project Leader: M. Thatcher
Affiliation/Beneficiary: London School of Economics and Political Science

Design and Development of E-Learning Software for Math and Science of all Intermediate Grades

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Project Leader: N. Marafi
Affiliation/Beneficiary: Ministry of Education in collaboration Regional Centre for the Development of Educational Software (ReDSOFT)

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Project Leader: N. Moorkath
Affiliation/Beneficiary: Kuwait University, Faculty of Medicine, Obstetrics and Gynecology Department.

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Project Leader: F. Khallaf
Affiliation/Beneficiary: Ministry of Health – Kuwait Institute for Medical Specialization.

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Affiliation/Beneficiary: Gulf University for Science and Technology, College of Arts and Sciences, English Department.

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Project Leader: M. Al-Saeed
Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Business Studies, Department of Law.

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Project Leader: A. Al-Awadi
Affiliation/Beneficiary: Association of Social Workers

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Affiliation/Beneficiary: Public Authority for Applied Education and Training, College of Health Sciences, Department of Environmental Health.

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Affiliation/Beneficiary: Kuwait University, Faculty of Science, Department of Chemistry.

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Affiliation/Beneficiary: Massachusetts Institute of Technology, Kuwait Institute for Scientific Research, Kuwait University

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