



Issue No. 4 - December 2016

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Earthquakes are natural and science reduces their impact

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The University is an accredited scientific think tank

In any society, research represents the vessel for progress, a foundation for development and leadership, and an important tool for solving problems and meeting diverse challenges. Its findings and recommendations, if put into practice, would help improve the society and enable it to overcome the ongoing difficult issues and phenomena.

No doubt, any society is dependent on its younger generations, who are capable of identifying the needs of their community, and the phenomena encountered, and finding appropriate solutions to them. That is why countries have established research centers at their universities and colleges to achieve self-sufficiency with regard to research, rather than having to resort to external expertise to promote research and utilize its findings.

Given the paramount importance of research, the Sultanate has paid great attention to supporting it at Sultan Qaboos University. As such, the University has become a scientific think tank, accredited for delivering research consultancies, conducting studies for various institutions, and relying on distinguished academics and researchers who enjoy excellent academic records and have achieved solid accomplishments at the local and global levels.

These scientific results, which have received local and global recognition, highlight the enormous research efforts at the University and emphasize the great potentials that abound in the University environment, such as research centers, advanced instruments and devices, as well as the key factor, i.e. a specialist and diligent cadre of academics, researchers and students.

Over the past years, the university has managed to achieve tangible results on the ground, as it carried out diverse research projects in collaboration with public and private institutions. This demonstrates that the University has great capabilities to carry on this performance, sometimes at a pace exceeding international think tanks.

Due to the current economic conditions, and the necessity to recycle expenditure within the Sultanate, thus contributing positively to the national economy, it is hoped that government and private institutions will rely on the university as a source that delivers research consultancies and studies for them. In this way, we will attain the goal of having the University proactively involved in the development of society in various fields.

Editors



Open House for Research Centers

SQU scholars and Industrialists discuss joint collaboration

Dr. Al-Mahrooqi: Research outcomes offer decision makers accurate data

Under the patronage of Hilal Bin Hamed Al-Hsani, the CEO of Public Establishment for Industrial Estate, the Office of Deputy Vice-Chancellor for Postgraduate Studies and Research at SQU has held an Open House event for SQU's ten research centers.

Addressing the event, Dr. Rahma Al-Mahrooqi, Deputy Vice-Chancellor for Postgraduate Studies and Research (DVC-PSR), said that research is an important foundation for the overall socio-



economic development plans for the country. She added that, apart from encouraging diverse studies, research centers collaborate with other public ef-

forts to meet the needs of Omani society in various sectors. This is based mainly on solid research outcomes that can be beneficial for decision makers by

providing them with accurate information.

Representatives of the research centers and Deanship of Research showcased their ongoing activities, future

plans and the services they delivered to their relevant sectors.

Later, Al-Hsani inaugurated the event fair which exhibits the activities of all research centers.

The goal of the research centers' Open House is to highlight their achievements, expertise and the services they deliver to various companies. It is also an opportunity to build bridges with both public and private sectors, and specifically industrial and service institutions.

New materials for opto-electronic applications

Muhammad Khan - College of Science

A research team from the College of Science is undertaking a project aimed at designing new metal-organic hybrid materials for applications in solar cells (SCs) to generate electricity, and in light emitting diodes (LEDs) to save the generated energy. Led by Dr. Muhammad Khan, the researchers will develop a reliable synthetic protocol for new hybrid materials, consisting of a π -conjugated organic framework incorporating transition and lanthanide metal ions for opto-electronic (O-E) applications.

The performance of such materials-based SCs depends on their absorption profile, band-gap, triplet excitons, charge transfer and other factors. The organic framework determines the absorption profile and the band-gap, while the metal ion plays a synergistic effect on the photo-physical properties. The metal ion also provides a redox and paramagnetic center to generate active species for charge transport and increases the conductivity of the organic materials. Overall, metal-organic hybrid materials possess improved properties for application in O-E devices.

According to the principal investigator, the project will address the following areas: (i) the development of a synthetic protocol for a series of acetylide-functionalized pyridine ligands incorporating conjugated carbocyclic/heterocyclic spacers, their Cu(I) halide based self-assembled materials, (ii) synthesis of new β -diketone ligands and their Ln(III) complexes containing varying ancillary ligands, (iii) design and development of conjugated polyyenes and poly(platina-yenes) incorporating new hybrid spacers, (iv) chemical, electro-chemical and structural characterization of the newly synthesized materials, (v) the structural, electronic and optical properties of the new materials and the structure-property relationships, (vi) fabrication of SCs and LEDs using selected Cu(I) halide clusters, Ln(III) complexes, polyyenes, poly(platina-yenes) and assess the device performance.

The project will develop scientific and research skills and expertise in the Sultanate through providing training to graduate students, technical staff, research assistants and young faculty, as well as developing laboratory facilities in the department of Chemistry at SQU. The successful implementation of the project will establish SQU as a research hub in LED and solar energy materials, and the developed scientific knowledge will boost Oman's energy sector and the economy. An attempt will be made to establish new research collaborations and strengthen ongoing collaborations with leading institutions in Europe.



Monitoring marine water quality in the Sea of Oman

Dr. Mahad Baawain - College of Engineering



Dr. Mahad Baawain, Director of the Center of Environmental Studies and Research, is carrying out a study to assess marine pollution along the Omani coast.

According to the scientist, little research has been conducted to measure the extent of ocean water pollution by oil-related sources in the Sea of Oman. Furthermore, a permanent marine water quality monitoring system does not exist along the coast of the Sultanate.

The collected data will be utilized for the calibration of numerical models and their subsequent application, to predict the pollution transport and fate in surface water. Appropriate locations for the establishment of marine water quality monitoring stations will be identified, based on the assessment results. Moreover, a list of required measuring equipment will be prepared, based on the needs of the monitoring program.

Oman is situated along one of the most important marine trade routes in the world. Huge quantities of globally produced oil is transported through the Sea of Oman by tankers. Despite the continu-

ous efforts made by the international community, the double hull tankers have yet to be in current design to avoid illegal ballast water discharges in the coastal waters. Although, high temperatures in the region are helpful in the biodegradation of hydrocarbons, soon after the ballast water is discharged, a thin film of oil covers the seawater thus blocking oxygen supply to the ocean, which in turn seriously affects the marine life. In addition, the soluble hydrocarbons found in the petroleum adversely affect the oceanic environment.



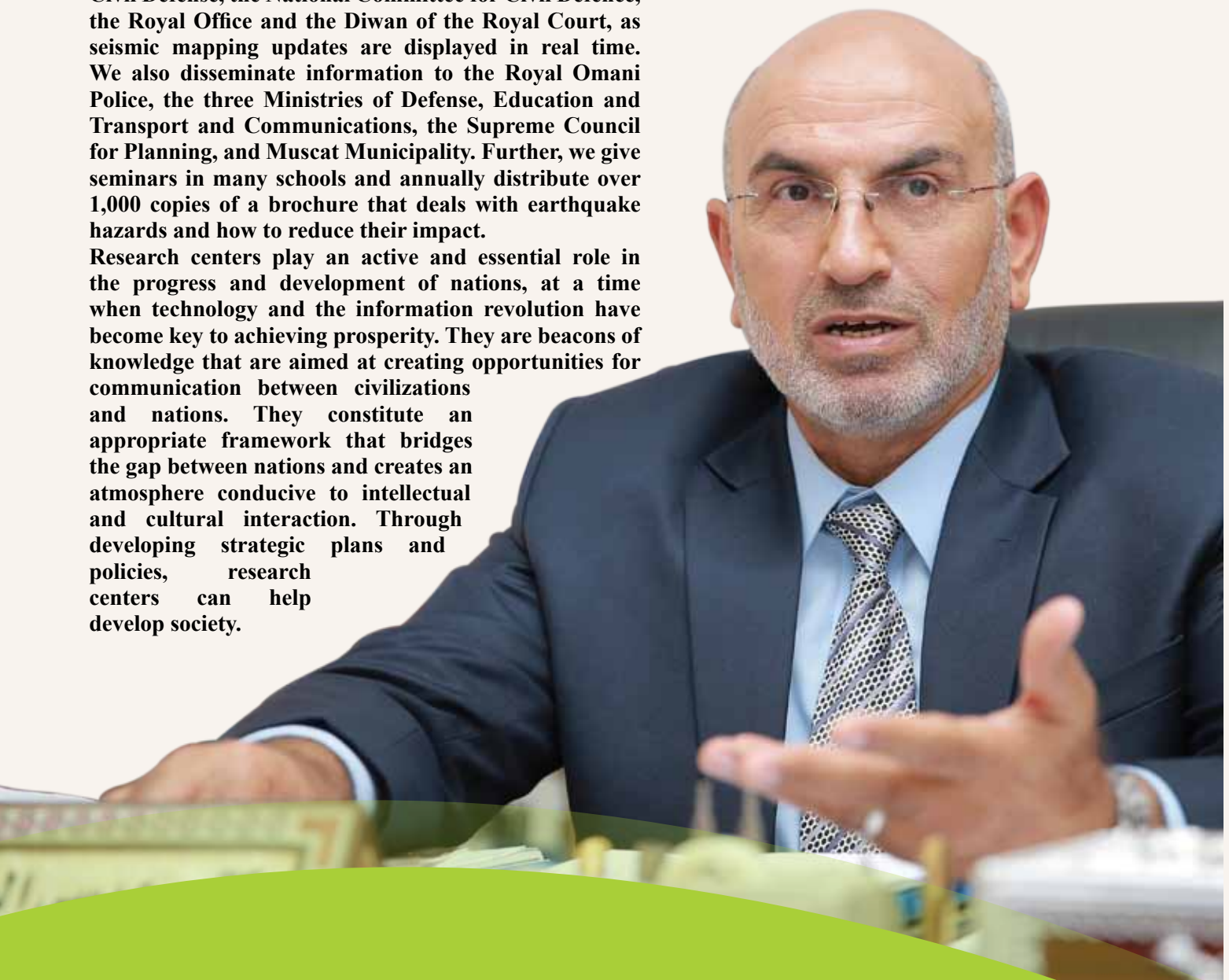
EMC director to Tawasul: Earthquakes are natural and science reduces their impact

The center is closely linked to societal institutions and government agencies outside the University. We deliver information, consultancies, studies, lectures, seminars and invitations to attend gatherings. Being the main source of data for the Centre of Early Warning (CEW) in the Public Authority of Civil Aviation, we provide them with urgent seismic information through the direct link between our monitoring stations and the CEW. There is also a direct connection between our center and the Civil Defense, the National Committee for Civil Defence, the Royal Office and the Diwan of the Royal Court, as seismic mapping updates are displayed in real time. We also disseminate information to the Royal Omani Police, the three Ministries of Defense, Education and Transport and Communications, the Supreme Council for Planning, and Muscat Municipality. Further, we give seminars in many schools and annually distribute over 1,000 copies of a brochure that deals with earthquake hazards and how to reduce their impact.

Research centers play an active and essential role in the progress and development of nations, at a time when technology and the information revolution have become key to achieving prosperity. They are beacons of knowledge that are aimed at creating opportunities for communication between civilizations and nations. They constitute an appropriate framework that bridges the gap between nations and creates an atmosphere conducive to intellectual and cultural interaction. Through developing strategic plans and policies, research centers can help develop society.

In this respect, Sultan Qaboos University (SQU) has paid much attention to the establishment of research centers through providing cadres, tools and facilities. At present there are eleven research centers and more are yet to come to light.

Tawasul has interviewed Dr. Issa Al Hussain, Director of the Earthquake Monitoring Center (EMC), at SQU, and asked him about the center's roles, accomplishments and challenges.



Could you tell us about the center's roles and duties?

The center has a number of roles, such as monitoring seismic activity in the Sultanate and the surrounding areas, reporting earthquakes recorded, and publishing an annual report for the competent authorities and regional centers. The center also publishes research findings on earthquakes in scientific journals and carries out studies on seismic hazards. We also teach a course on earthquakes and the community at the Department of Earth Sciences, in addition to providing supervision to undergraduate and postgraduate students,

including assessing seismic risks across the Sultanate by probabilistic and deterministic techniques, and gauging the impact of those risks on buildings, enterprises and individuals in Muscat, in addition to producing a manual for designing earthquake-resistant buildings in the Sultanate. We also managed to determine the characteristics of the soil and the marshy areas in Duqm, examined light earthquakes in the Jbal oil field, and seismic

network to detect micro earthquakes, now that we have twenty monitoring stations, including ten short-range stations which were established in July 2001, three in June 2004, while the other seven were set up in March 2011. In 2013, the short-range stations were upgraded to broadband ones. The center also conducted field surveys to add six new monitoring stations to enhance the effectiveness and accuracy of seismic monitor-

ing. It is natural to feel the earthquakes, at an almost constant rate, in our region as it is surrounded by a number of active seismic belts. In fact, there is no increase in the number of quakes. It is just because our stations have become more efficient, and due to the influence of social media that circulate such reports ... you get the feeling that seismic activities are on the rise. That should not be a source of concern, if you know how to react in the event of an earthquake, and what guidelines should be followed when designing buildings in a way so as to be earthquake resistant.

We have made several achievements and now have 20 stations.



taking part in committees, and giving lectures for various disciplines interested in earthquakes. We also organize specialized training courses in seismic engineering and how to calculate seismic loads when designing facilities.

What are the key research achievements of the center?

The center has had many research achievements, includ-

ing hazards and design characteristics of constructions near an oil field in northern Oman. A potential tsunami risk in the north part of the Sea of Oman on some facilities in Alglalh was assessed; we also enhanced the seismic monitor-

ing. They offer seismic information 24/7 via satellite to the center at the University.

Recently, there have been reports about frequent quakes. Are you concerned about that?

Can you tell us about those tremors?

Recently the center has issued the Omani Seismological Network bulletin for 2015. It includes the overall seismic activity in the Sultanate and nearby areas, as well as the regional and distant tremors, in both Arabic and English. It provides data about the geographical locations of earthquakes recorded during 2015.

It is important to understand how to react in the event of quakes.



There was 1009 earthquakes, 516 of which were local and regional, while the rest, i.e. 493, were monitored beyond the Sultanate. Most local and regional earthquakes were located in southern and eastern Iran, the Zagros Mountains, the Sea of Oman and along the Owen fracture zone region in the Arabian Sea and Gulf of Aden. Some of them were recorded in the territory of the Sultanate, and there were three earthquakes felt by residents in Oman in 2015.

Given your considerable effort at the center, how do you assess your collaboration with other Omani organizations?

The center is closely linked to societal institutions and government agencies outside the University. We deliver information, consultancies, studies, lectures, seminars and invitations to attend gatherings. Being the main source of data for the Centre of Early Warning (CEW) in the Public Authority of Civil Aviation, we provide them with urgent seismic information through the direct link between our monitoring sta-

Our main challenge is how to get access to data.

tions and the CEW. There is also a direct connection between our center and the Civil Defense, the National Committee for Civil Defence, the Royal Office and the Diwan of the Royal Court, as seismic mapping updates are displayed in real time. We also disseminate information to the Royal Omani Police, the three Ministries of Defense, Education and Transport and Communications, the Supreme Council for Planning,

and Muscat Municipality. Further, we give seminars in many schools and annually distribute over 1,000 copies of a brochure that deals with earthquake hazards and how to reduce their impact.

How can you invest in diligent students at the center?

The center engages the students in some tasks and recruits some of those who have already completed their graduation projects.

Is there any cooperation between your center and the media, given the effective role it plays in marketing research findings?

The center has an active role in the media. Every year, we publish articles in local newspapers and give TV and radio interviews. We have about 20 activities of the sort.

In your view, how can research support seismic monitoring efforts?

Research is key to enhancing seismic monitoring techniques with regard to locations of earthquakes, how they happen and spread, and how their impact can be minimized.

What are the big challenges facing the center?

There are at least two challenges: 1) it is difficult to obtain geological and topographical data from public agencies, and 2) it takes time to get locations suitable for installing our stations.

What are the solutions, in your opinion, to overcome such hurdles?

We hope that the geological and topographical data is offered more efficiently and quickly in order to conduct our projects properly and in due time, especially those projects designed for reducing seismic hazards, such as the seismic microzonation for the whole country.

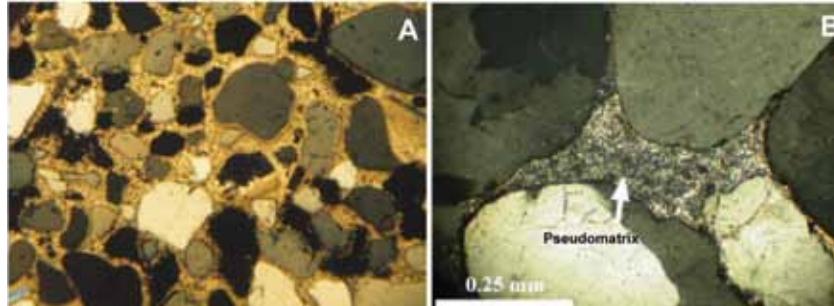


Evaluation of hydrocarbon reservoirs in Oman

Mohamed Ali El-Ghali, from the College of Science

The Omani economy is highly dependent on hydrocarbon revenue. Middle Cambrian to Early Ordovician, Haima Supergroup, e.g. Amin, Miqrat, Al-Bashair and Barik formations, are considered among the main clastic reservoirs in the South Oman and Ghaba Salt Basin oil fields.

These clastic reservoirs contain up to 36% of the stock oil and are also considered as deep gas reservoirs. The stock oil and the recoverable hydrocarbons in these reservoirs vary from one oil/gas field to another. However, the study of the spatial and temporal distribution and types of the diagenetic alterations, and their subsequent impact



on porosity and permeability distribution within Haima Supergroup reservoirs, are still poorly explored. Prediction of the spatial and temporal distribution of the diagenetic alterations and thus subsequent porosity and permeability distribution, will ultimately help in the development of more efficient drilling, production and recovery strategies and thus reduce the geologic and economic risk.

In this regard, Dr. Mohamed Ali El-Ghali, from the College of Science, is verifying a hypothesis, which will be applied in Oman for the first time. He is seeking to test whether changes in the relative sea level are accompanied by predictable changes in the primary sand mineralogical composition and texture, as well as the diagenetic modifications of clastic sequences.

A detailed assessment of the mineral content and texture of these reservoirs is tentatively integrated with facies analysis in a sequence stratigraphy context, exploring the interest of bulk rock geochemistry in scaling upwards the mineralogical information. The expected achievement is a conceptual model predicting primary sand composition and, when combined with modelling of the thermal history and the fluid-induced changes in mineralogy and porosity-permeability, an integrated tool for the evaluation of reservoir quality in middle Cambrian to early Ordovician clastic depositional environments in Oman.

Evaluate E-Learning Based on Social Networking

Yassine Jamoussi - College of Science

With the advent of digital technologies and user generated content, the ways in which the authors formalize learning are subject to change. The gap between e-learning and Web 2.0 could be bridged by, amongst other approaches, a type of Flickr for learning design, which allows users to share activities and sequences, thus meeting their diverse needs and utilizing the best of social networking approaches. Yassine Jamoussi, from the College of Science, is conducting a study aimed at developing practices for designing for and evaluating user experience in order to improve learning know-how. The research falls into two stages: (i) to gather



learners/instructors feedback from desired learning systems systematically and efficiently, and (ii) to utilize the content in the learning process. The concept of user experience includes both pragmatic and emotional/hedonic aspects of content use, and thus, design for user experience aims to satisfy learner needs beyond the merely instrumental. During this research project, tools, measures and guidelines will be developed to carry out the tasks successfully. Special emphasis will be given to cultural issues affecting user experience, and ways of reaching remote learners effectively will be explored.

A study examines the impact of imported products on Omani handicrafts

Al-Maamari: four factors can help challenge imported products

Dr. Badr Al-Maamari – College of Education

The Omani market has been saturated with increasing numbers of expat artisans, to an extent that could jeopardize the sustainability and competitiveness of national products. In 2008, a report in a foreign newspaper titled “Indian products exported to Oman worth \$ 13 million” talked about fabrics and textiles. The annual Muscat Festival hosts craftsmen, two-thirds of whom are expats. In this regard, Dr. Badr Al-Maamari, from the College of Education, has carried out a study aimed at investigating the potential impact of imported products on Oman ones.

Al-Maamari has pointed out that researchers always find it difficult to address this problem, given the international agreements that protect free trade. Cultural institutions, such as the UNESCO, often develop laws and definitions of handicrafts based on the models of large population countries, such as India, China, Egypt and Mexico, rather than smaller nations.

He added that the lack of research prompted smaller countries to address the problem in order to ensure that research outputs are in line with national handicraft protection requirements. In this regard, tremendous efforts have been made by the Public Authority for Craft Industries (PACI) during the last ten years. However, one can still feel the effects of the problem.

Regarding the stages of his research work, Al-Maamari said he met with 47 craftsmen and PACI officials and got important information first-hand. He said that the officials seemed to understand how serious the situation was. They also complained that solutions were often hindered by some institutions and laws that have



nothing to do with craft industries. However, most of the comments went on to underline the importance of steering laws and regulations to protect local industries.

Al-Maamari argued that the local or international laws could be considered as the first and second factors which should be considered by the PACI. However, these are not enough in themselves. He suggested a third and a fourth factor to

protect local handicrafts and Omani craftsmen. The third factor has to do with determining the criteria for the favorable value of local products over imported ones, in terms of product quality and the hurdles of importation, shipping, transportation and storage. National references are also important here. For example, the most common ceramic product used in many coffee shops is the traditional coffee cup, which is one of the least produced by local craft companies. The imported product carries no Omani cultural references.

Porcelain makers, the researcher recommended, should focus on producing narrow-neck ceramic pieces to compete with imported ones, because the imported ones will be difficult to ship in containers. This requires that each product should carefully be examined when arriving into the Sultanate, passing through discharging, and arriving to the consumer at the lowest cost.

The fourth factor concerns the classification of the product before starting production, whether it is a valuable or low-cost commercial one. The researcher referred to cases whereby craftsmen did not pay enough attention to their trade, producing either low-quality silver handicrafts, or spending more time on producing cheap stuff.

The researcher concluded that the four factors he suggested, namely the local laws, international laws (intellectual property regulations), standards of competitiveness of local products versus imported ones, as well as the classification criteria of products before production, could effectively contribute to challenging competitive imported products.



Measuring vocabulary among Omani tertiary-level students

Research on the importance of vocabulary in aiding successful language acquisition, particularly English as a Second Language (ESL) or English as a Foreign Language (EFL), abounds in other parts of the world. However, it is sparse in the Middle East, and particularly in the Sultanate of Oman.

This has prompted Dr. Chandrika Balasubramanian, from the Department of English, to carry out a study that aims to bridge that gap, by determining if and how vocabulary is taught at the



tertiary level in Oman, and the effect of vocabulary skills on students' communicative ability.

According to the researcher, it is indisputable that vo-

cabulary acquisition is central to successful language acquisition. A wealth of research on language learning and teaching indicates that vocabulary is one of the

most essential precursors to other language abilities. Researchers have focused on determining the most frequently occurring words in the English language. Others claim that second language readers of English need to have some knowledge of at least 3000 word families in order to understand 95 percent of the running words in a text. However, research has shown that students in an EFL context, may not know the high-frequency words, even after years of English instruction.

Study concludes:

Students' smartphone addiction stands at 33.1%

Fahd bin Nasser Al-Farsi - College of Engineering

A researcher at the College of Engineering has conducted a study to examine smartphone addiction among undergraduate students at Sultan Qaboos University.

The study, carried out by Fahd bin Nasser Al-Farsi, has applied an eclectic approach to addressing the issue of the addictive use of smartphones among the students. It sought to identify the impact of gender, field of study, academic achievement, parental education and family income on the addictive use of smartphones. It also aimed to uncover the relationship between usage and addiction of smartphones among university students.

Two questionnaires were used to investigate smartphone addiction and overuse, distributed among a stratified sample of 849 undergraduate students, di-

vided into 48.8 per cent males and 51.2 per cent females. In addition, four panel discussions were held with two focus groups to support the quantitative data collected from the questionnaires.

The results suggested that the students used mostly WhatsApp to send messages. The ordinary use of smartphones was the most common pattern, while searching information and entertainment was a major factor of smartphone addiction among them. It turned out that the prevalence of smartphone addiction was at 33.1 per cent, while downplaying the harmful effects of the smartphone was one of the most common symptoms of addiction among students.

The study also revealed statistically significant differences ($p < 0.05$) among the university

students, in terms of smartphone usage and addiction, according to the variables of gender, field of study, parental education and family income. As for the variable of academic achievement, the study found statistically significant differences in the level of significance ($p < 0.05$) among the university students concerning smartphone addiction, while showing no statistically significant differences in the level of significance ($p < 0.05$) for smartphone usage.

The qualitative approach demonstrated the underlying factors behind smartphone addiction and usage among the students. It interpreted the relationship between smartphone addiction and usage and certain demographic factors. Finally, the study put forward some solutions to the problem of smartphone addiction.



Contemporary applications of trade-offs in Islamic jurisprudence

Saleh Al Kharousi

The issue of debt, with all its jurisprudential aspects, is one of the critical matters in the Islamic jurisprudence of transactions. Surprisingly, it is predominant in almost every section of Islamic jurisprudence transactions. It has been addressed by religious scholars, who have put forward a host of research studies and manuscripts, elaborating its various aspects and many branches. They have investigated its causes, origins, forms, and trade-offs. In this regard, Saleh Al Kharousi has conducted a study as part of his doctoral requirements on trade-offs and their contemporary applications in Islamic jurisprudence.

The study shows that the earlier scholars did not hesi-

the opinions suggested by those earlier scholars and developed out of the diverse branches of trade-offs, in two categories: the debt trade-off may be in kind, or in the form of debt for debt. The former is advocated by the majority of scholars, while the latter is almost unanimously prohibited by them as it amounts to a sort of selling of debt for debt. The research points out that there are plenty of contemporary applications of the practice of trade-offs, such as in banknotes, stocks, securities and credit cards, but there are other cases whereby trade-offs cannot be determined as such. This has to do with a host of considerations that deal with various provisions and rules.



tate to discuss this aspect of debt issues. They had done in-depth studies on the question and found there were various schools of thought in this respect.

The study also indicates that it is possible to sum up all

This is the case with banking procedures with regard to commercial papers, credit cards, stocks and specifically when the stocks and Islamic instruments are debts mixed with other currencies and objects.

Classical Music and social life in contemporary Omani society:

Rahma Al Kalbani



Rahma Said Al Kalbani has investigated the social and cultural characteristics of western classical music audiences in contemporary Omani society. Her study is part of her Master's degree requirements at the College of Arts and Social Sciences. She also discusses the potential for the Royal Opera House Muscat (ROHM) to showcase the traditional music of Oman.

The study was based on a questionnaire consisting of seventy questions, distributed to 150 members of a western classical music audience in the ROHM. There were also interviews with researchers and employees in music institutions in Oman, like the Royal Omani Symphony, Oman, the Center for Traditional Music and the ROHM.

The findings have shown that the audience consisted mainly of single males between 25-34 years old, employed in governmental and artistic

sectors, residents of Muscat, whose incomes ranged between OMR 501-1000 p.m.. The study also revealed that Omanis are more interested in the visual arts like the cinema, as well as in listening to diverse types of music in different places and on different occasions.

The factors that make western classical music popular in Omani society are: having family and friends with similar interests, being students of western classical music in academic institutions, attending western classical music concerts, developing musical tastes and engaging with the western classical music audiences in the ROHM.

The study has also found that the ROHM has managed to create a modern musical environment whereby Omani groups can take part in its musical activities, and Omanis and foreigners are able to interact at concerts of traditional and classical music.

Fabrication of β -Silicon Carbide Nanowires from Carbon Powder and Silicon Wafer

Majid Al-Ruqeishi - College of Science

One-dimensional (1D) nanostructures, such as tubes, wires, belts and rings, have recently stimulated intensive research interest, because of their great potential for clarifying basic issues about dimensionalities and space confined transport phenomena. As a wide band gap semi-conducting material,

silicon carbide (SiC) exhibits many excellent properties for high temperature, high frequency and high power applications. SiC 1D nanostructures can be used in field emission display, nano-sensors and electro-devices. Thus, in the last few years, much effort has been made in the synthesis of 1D SiC nanostructures. Recently, many techniques were demonstrated, including CNT-confined growth, chemical vapor deposition (CVD), carbo-thermal, polymeric precursor pyrolysis method, laser ablation and arc discharge. However, most of these synthetic approaches involved complex processes and manipulations.

To address this issue, a new study has been conducted by Dr. Majid Al-Ruqeishi (PI) and Dr. Tariq Mohiuddin, from the Department of Physics, to utilize a direct carbo-thermal technique to synthesize ultra-long β -SiC nanowires at $T = 1200\text{ }^\circ\text{C}$ without a catalyst.

Dr. Al-Ruqeishi said the study examined the effects of rapid heating and Ar flow rates on the yield of grown β -SiC nanowires. The detailed characterizations on the resulting

nanostructures were carried out by field-emission scanning electron microscopy (FES-EM), energy-dispersed X-ray spectroscopy (EDX), X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR).

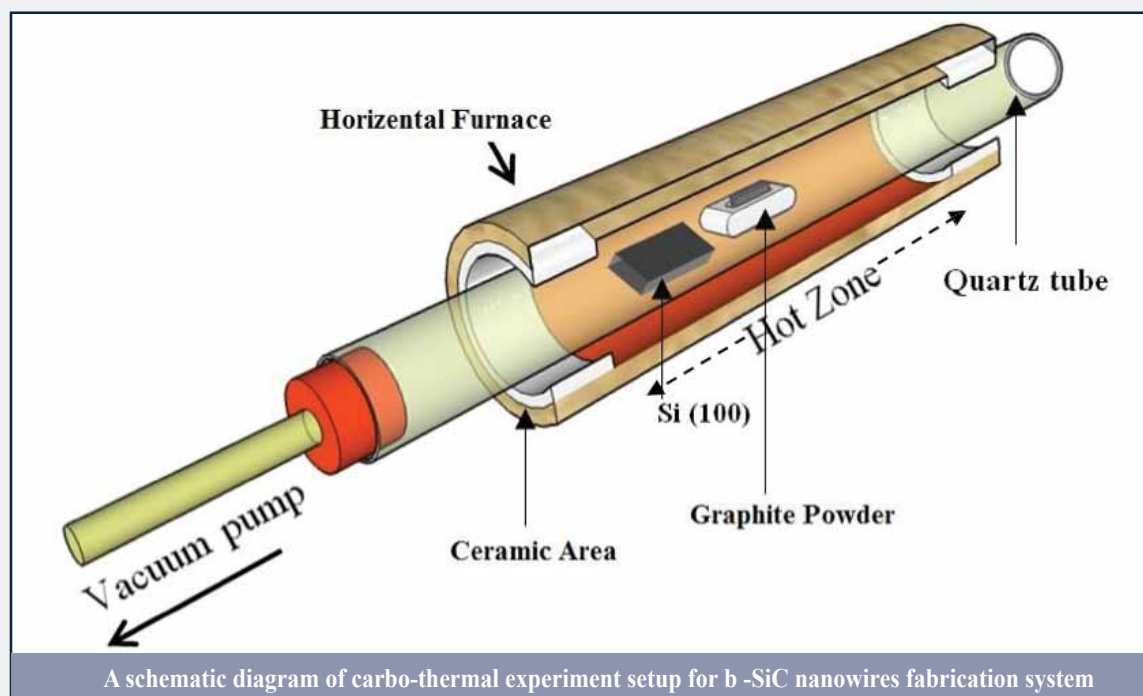
He added that the experiment was set up as follows:

“The furnace was first heated up to $1200\text{ }^\circ\text{C}$ at a heating rate of $1.2\text{ }^\circ\text{C/s}$ and kept unchanged.”

“The furnace was first heated up to $1200\text{ }^\circ\text{C}$ and a carbon boat and prepared substrates were loaded directly into the middle of the furnace. The substrate was placed 2 cm apart from the carbon boat.

$25 \pm 1\text{ mm}$ and $120 \pm 2\text{ nm}$ in average length and diameter respectively. The formation of such unique morphology is not well understood, and it will be discussed in the growth mechanism part.”

He concluded his remarks as follows: “The β -SiC nanowires were successfully



“(2 - 1) cm Si (100) substrates with a resistivity of $5.15\text{ }\Omega\text{-cm}$ - 2 were ultrasonically cleaned in acetone for 5 minutes. Then the substrates were dried in air. After that, the substrate was loaded into the middle of a 2.2 cm-inner diameter quartz tube placed at the center of a horizontal tube furnace. Carbon powder (2 g) on a porcelain boat was mounted 2 cm before the silicon substrate. The argon (99.999 %) gas was then flushed inside the quartz tube and kept at 10 standard cubic centimeters per minute (sccm) or as required. The tempera-

ture was then raised up to $1200\text{ }^\circ\text{C}$ at a heating rate of $1.2\text{ }^\circ\text{C/s}$ and kept unchanged.”

After that, the system was vacuumed and followed by Ar gas for one hour. After cooling down to room temperature, samples were taken for characterization. The obtained β -SiC nanowires were distributed in bundles, randomly over the substrate surface and the nanowires were not aligned. EDX spectrum reveals that nanowires consist of carbon, oxygen and silicon with different weight percentages. The crowded wires are grown in different directions but originate from same point. These wires are short and thick with

fabricated using simple carbo-thermal evaporation process. High heating rate produces short and thick wires while low heating rate at $1.2\text{ }^\circ\text{C/S}$ produces ultra-long wires. Also, as the Ar flow rate gas inside the heating chamber reduced, denser nanowires were obtained. The grown wires are poly crystalline revealing diffracted crystal planes of β -SiC (111) (200), (220) and (311). FTIR transmitted peaks at 798, 810 and 820 cm^{-1} are referred to the transversal optic (TO) of Si-C stretching vibration mode.

It has been applied to one of the factories and proven ..

Processing Wastewater Treatment and Reuse at Fisheries Plant: Aquaculture and Hydroponic Applications

Dr. Mahad Baawain, Director of the Center of Environmental Studies and Research

The wastewater from fisheries results from cleaning and processing the fresh fish that reaches those plants. The produced wastewater needs better handling and treatment rather than the simple collection in a septic tank that is emptied every other day via tankers. Moreover, the plants could utilize the produced water as a good source of water for beneficial applications if well treated. This would save transport costs of wastewater discharges, improve the environmental image of the plant and yield several tangible benefits,

Marsa Fisheries Plant at the Rusail Industrial Estate. The research team is led by Dr. Mahad Baawain, with the participation of Dr. Mushtaque Ahmed and Dr. Gilha Yoon from SQU, and in coordination with Dr. Saeed Al-Araimi from IIC and Bernard Durin from Al Marsa Fisheries.

In press remarks, Dr. Baawain said, "One challenging aspect is that the amount of the produced wastewater is relatively small compared to the wastewater treated by standard sewage treatment plants (STP). Designing a typical STP with all different

He added that "aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming implies some type of intervention in the rearing process to enhance production, such as a regular stocking, feeding and protection from predators. In the last three decades, world food fish production from aquaculture has expanded by almost 12 times, at an average annual rate of 8.8 per cent. Global aquaculture production has continued to grow. About 600 aquatic species are raised in captivity in about 190 countries for production in farming systems of varying input intensities and technological sophistication."

Water quality is the most important factor of the aquaculture business, he pointed out. It determines not only how well fish will grow in an aquaculture operation, but whether or not they survive. Fish influence water quality through processes like nitrogen metabolism and respiration. Some water quality factors, such as dissolved oxygen, temperature, and ammonia levels, are more likely to be involved in fish losses. Others, such as pH levels, alkalinity, hardness and clarity also affect fish, but usually are not directly toxic. Each water quality factor interacts with and influences other parameters, sometimes in complex ways. What may be toxic and cause mortalities in one situation can be harmless in another. The importance of each factor, the determination method and frequency of monitoring depends upon the type and rearing intensity of the production system used.

In this project, an innovative system using both filtration and biofloc was applied for treating the produced wastewater from the fisheries plant to yield effluents which satisfy requirements for wastewater reuse for aquaculture and hydroponic purposes. The current raw produced waste-



such as reducing odour problems and protecting the environment from different types of contaminants. Moreover, such water can be utilized for aquaculture and hydroponic applications.

To address this issue, a recent research project has developed an innovative and economic way of treating wastewater from the Al Marsa Fisheries Plant so that it can be reused in aquaculture, hydroponic applications and landscape irrigation. It is a collaboration between SQU, the Industrial Innovation Center (IIC) and Al

treating components could be relatively expensive. Hence, it is believed that before a company decides on a particular solution, it should consider other possible innovative/cost effective solutions. We at SQU have experimented with different types of alternative wastewater treatment systems. These are of physical, chemical and biological nature. Some of these may be applicable to this fisheries plant. Furthermore, the treated water can be utilized for growing certain fish species (Aquaculture) which can be an added value of this project."

Greenhouse gases emissions on dairy farms



Dr. Othman Alqaisi – Assistant Professor at the Animal and Veterinary Sciences Department – Agricultural and Marine Sciences College

water showed total suspended solids (TSS) of 110 mg/L, a biochemical oxygen demand (BOD) of about 105 mg/L, chemical oxygen demand (COD) of about 550 mg/L, ammonia nitrogen of about 190 mg/L and fecal coliform bacteria of about 48000 number/100 mL. It should be noted that Omani standards for the mentioned tests for treated wastewater reuse for irrigation purposes are: TSS of 15 mg/L, BOD of 15 mg/L, COD of 150 mg/L, ammonia nitrogen of 5 mg/L and fecal coliform bacteria of 200 number/100 mL. In addition to the existing septic tank, a new preliminary aeration system, sand filtration, and a biofloc system with aeration have been installed. The main challenge was to build an appropriate aerated biofloc system to host the fish species (aquaculture) and hydroponic units under fluctuating processing wastewater quality. The effluent quality when compared to raw processed wastewater showed significant improvement with huge reduction in turbidity, COD, BOD, suspended solids, phosphates and ammonia.

As to the findings, the researchers said that, “the information gained through the present study suggested that filtered wastewater can be used for aquaculture. However, the culture system must be reconsidered with the biofloc system. In the present experiment, the culturing tilapia reared in tanks had significantly low levels of ammonia nitrogen compared to a tank with normal water as a control. The biofloc maintained low levels of ammonia concentration, implying the usefulness of biofloc in improving water quality in the tanks. These results and earlier research indicate that microbial components, unknown growth factors or probiotic microorganisms may have contributed to significantly higher survival and growth rate in fish fed with a biofloc incorporated diet. In the current study, the biofloc had sufficient levels of protein, lipid and carbohydrates in a natural form that enhanced growth and survival of the tilapia. From the results, it can be identified that inclusion of waste biofloc at 50% level would be economically beneficial in improving growth performance of Nile tilapia fish. Moreover, different types of vegetables were grown successfully on the hydroponic rafts. The final treated water was used for landscape irrigation.”

He concluded: “In view of aquaculture, and the overlapping of demand for and shortage of water resources, it can be concluded that the reuse of wastewater can play a major role in solving these problems. In future, the main issue of reusing wastewater will be the safety of harvesting animals and plants, environmental problems, and consumer attitudes. The results from all phases of the present study strongly suggested that there are huge possibilities for growing fish and plant with simple treatment of processed wastewater. Moreover, to avoid any health or environmental problems, reuse of treated wastewater should be subjected to continuous monitoring, and fish and plant qualities should be evaluated.”

There are growing concerns over the increased anthropogenic greenhouse gas (GHG) emissions and their retention in the atmosphere. Recently, a number of nations approved individual targets in addition to the Kyoto Protocol, with legally binding measures aimed at reducing GHG emissions.

The EU, for example, has committed to reducing its GHG emissions to 8%, below the level of 1990. Thus every sector needs to contribute to the mitigation of GHG emissions. According to the FAO, the global bovine dairy sector contributes about 4% to the total global anthropogenic GHG emissions.

In 2007, the dairy sector emitted 1,969 million tons CO₂-eq, of which 1328 million tons are attributed to milk, 151 million tons to meat from culled animals, and 490 million tons to meat from fattened calves.

Mitigation of GHG emissions from farming systems must be studied at the farm scale using a systems approach. Both LCA models and GHG emission data from arid and semi-arid environments are lacking.

A case study on GHG emissions from different arid dairy farming systems was presented by Alqaisi et al. (2014), with Jordan as a case study.

In arid and semi-arid zones, commercial dairy farming systems are based on imported feeds due to the shortage of local land and water resources. This has economic and ecological implications, given the increase in global feed prices and greenhouse gas (GHG) emissions from land use change.

When comparing emissions from large and small scale dairy farming systems, the highest emissions of 188 kg CO₂ eq./100 kg ECM are observed in the small-scale farm, while the large scale farm has the lowest emissions with an estimated 90 kg CO₂ eq./100 kg ECM. The two main drivers of GHG emissions per kg of milk are the level of feed intake and the milk yield per animal.

The milk yield has a greater impact, with higher yields being associated with significantly less CO₂ eq./kg ECM milk. Therefore, yield performance is responsible for much of the variation in total CO₂ eq. emissions between different types of dairy farming systems. With up to 53 % of total GHG emissions, CH₄ is the single most important GHG in milk production.

The results suggest that inclusion of locally available food industry by-products in the rations of milk cows in semiarid production systems can be instrumental in reducing production costs and mitigating GHG emissions. Furthermore developing and transition into smart dairy farming systems that match local environmental conditions will no doubt support cleaner milk production.



Enhancing research and agricultural development

Academics identify challenges and suggest solutions

Research is the cornerstone of progress and development in both developed and developing countries. Through the application of its findings to economic and agricultural development, production is increased, improved, and sustained with modern technology and techniques introduced to contribute to the GDP and, thus, raise the national income. Since the main challenge now facing most countries in the world is how to ensure food security, it has become imperative to pay more attention to agricultural development by investing in agricultural innovation and research.

To address this issue, Tawasul has had the following interviews with specialists in agricultural and economic affairs from Sultan Qaboos University. They have expressed different views on how to use research findings to deliver solutions to the ongoing problems facing agricultural development plans, and thus achieve food self-sufficiency.

Utilizing research findings in agriculture

Dr. Hussein Boughanemi – Associate Professor at the Department of Economics of Natural Resources – has underlined the important role of agriculture in economic development:



Boughanemi: A strategy for food security is a must.

“In the Arab world, agriculture plays a key role in advancing economic development plans. The contribution of the agricultural sector is estimated at 21 per cent of the GDP, while it engages more than 10 per cent of the total workforce. Such percentages vary from one country to another depending on the natural and economic conditions, the infrastructure and the institutions in each country. For example, according to reports by the Arab Organization for Agricultural Development, in the Sudan, agriculture accounts for 37 per cent of the GDP and employs 33 per cent of the total workforce, while in Oman, it accounts for 1 per cent of the GDP and involves 20 per cent of the total workforce.”

He went on: “Agriculture plays an important role in fighting poverty, ensuring food security, preserving the environment and sustainable development. However, the agricultural sector still suffers from a number of problems in production and productivity due to several natural, economic and political factors, which force Arab countries to rely largely on imports to meet the food needs of their peoples.”

He pointed out that “[t]he solutions provided by scientists raise the level of productivity of agricultural resources, like water, land and manpower to that attained by developed countries. Currently, the grain

yield (the amount of production per hectare) in the Arab countries is barely 50 per cent of that achieved in European countries, and similar numbers are generally prevalent for other goods. But scientific research needs to address several factors before

facing the current and future challenges in the agricultural sector, such as lack of resources, climate change and fluctuations of global prices. One of the major factors is the insufficient funding for agricultural research, which is no more than one per cent of the agricultural GDP in all Arab countries, except in Oman, where the average is up to 6.5%, according to a study conducted by the International Institute for Food Policies in 2012.”

Boughanemi recommended that research circles in the Arab countries focus attention on providing scientific data to develop a food security strategy based on a number of criteria. These include strengthening the productive capacities of local agriculture, reducing exposure to fluctuations in global food markets, supporting and rationalizing safety networks for poor groups, developing integrated



rural development, and enhancing Arab cooperation as a means of improving food security.

He listed the challenges facing agricultural development in the Sultanate: “They include the scarcity of water resources, shortage of arable lands, small agricultural holdings which do not allow the introduction of agricultural machinery that could increase labor productivity, and the poor performance of water use in agriculture because the majority of farmers rely on traditional irrigation methods. Other challenges are the environmental degradation of arable lands as a result of the excessive use of groundwater, and finally the lack of structures that regulate the sector (farmers’ cooperatives) and the structures that enable the farmers to promote their products.”

Food insecurity

Hon. Dr. Rashid Yahyai – Dean of the Agricultural and

such increase in the population of countries that suffer from a shortage of food production is one the factors of food insecurity, which leads to famine, malnutrition and changes in food patterns that result in increased demand for particular commodities at the expense of others, which upsets the balance of supply and demand.”

He defined the problem, saying: “The industrial revolution has caused increased greenhouse gas emissions that triggered global warming. As a result, major agricultural regions have been hit by drought and floods, which has affected the abundance of global food, as was the case in Australia and Pakistan. Also, political turmoil has struck many countries that produce important crops, which impaired the supply of basic food items. Indeed, the exchange of goods was impacted by political instability in both producing and importing



Al Yahyai: In 5 years, the food gap in Oman will be twice as big.

Marine Sciences College – highlighted the issue of food insecurity: “Food insecurity is due to the growing population, especially in developing countries, which has increased the demand for food. Now,

countries; the domestic food output declined in a number of countries because of dwindling natural resources and the rapid spread of pests and plant diseases like smut, that hit wheat production in many producing nations two years ago. Another factor has to do with the rising prices of food due to rising oil prices that affected fuel consumption in production and transportation. Four years ago, food prices hit a record high, which disrupted food security.”

He added: “A new factor has emerged recently, i.e. bio-fuels, which has caused food insecurity, because using crops for biofuels reduces the supply of grain crops for human consumption. Growing this kind of crops has been supported by

oil-importing countries, where there is increased awareness of the harmful effects of oil on the environment.”

Dr. Al Yahyai mentioned some serious biological challenges to food security: “These include diseases such as the pest of Dubas that damages palm trees, fungi, bacteria and viruses, harmful weeds, birds and rodents. Non-biological challenges include the lack of an ideal environment for agriculture in terms of temperature, humidity, rain and wind, water shortages, traditional irrigation systems, inefficient water management for crops and lands, low irrigation water quality due to increased salinity and ineffective exploitation of other water sources, such as treated greywater. Other difficulties include the shortage of arable land – only about 0.4 per cent of the total area of the Sultanate – small agricultural holdings, land degradation due to poor fertilization and growing land conversion to other uses. There is also global warming, increased carbon dioxide factors, intermittent rainfalls, cyclones, drought, desertification, lack of skilled labor force – only 2 per cent Omanis work in agriculture versus 10 per cent of expats – and insufficient means of suitable transport, storage and marketing.”

Biological and non-biological challenges

Dr. Abdullah Al Saadi – Associate Professor at the Department of Crop Science – related scientific research to the requirements of agricultural development. He underlined that “one of the pillars of agricultural development is research, which should focus on increasing agricultural production by finding solutions to the problems in the agricultural sector.”

As to the major challenges to agricultural development, he identified two types. “There are biological challenges, such



Al Saadi: Challenges include diseases, pests, water scarcity, salinization and mismanagement.

as diseases and pests that appear from time to time, especially as epidemics in a crop of economic importance, as happened with some important crops in the Sultanate, such as the mango wilt disease, and lemon witch’s broom. The rapid spread of such diseases and pests can be attributed to several factors, most notably the entry to the Sultanate from abroad, or a change in the environmental and climatic conditions resulting in increased activity of some factors.”

“There are also non-biological challenges such as water scarcity, salinization and poor management which affect crops, not to mention the undermining of agricultural development plans. There are other challenges, including insufficient funding for research, in some cases, and lack of highly qualified professionals in various fields.”

Al Saadi has appealed to relevant officials to focus studies on different strands in order to improve this sector and, thus, increase its contribution to the national income and bridge the food security gap. He added that there are several aspects which should be taken care of, such as finding solutions to the biological and non-biological problems in the agricultural sector, developing techniques to increase and sustain productivity, as well as training professional staff in the field of scientific research to contribute to the development of the country.

Agricultural productivity and sustainability

Dr. Othman Alqaisi – Assistant Professor in the Animal and Veterinary Sciences Department, Agricultural and Marine

Sciences – stressed the necessity of utilizing scientific findings in agricultural development. He said: “There are research results published by international organizations and research insti-

gies can develop the existing production systems, increase livestock productivity and improve nutrition. In this way, agricultural production costs will be reduced, thus encouraging farmers to increase production, investments in other farms will be promoted and the overall national production will be sustained in the medium and long term.”

“Studies and surveys on



tutes, which deliver studies on an ongoing basis. By applying such research findings to the current projects in the Sultanate, we can set a solid ground for increasing the agricultural and livestock production.”

He went on: “We can build a national research institution responsible for the transfer of agricultural research results to the Sultanate and biotechnologies to farmers. Such technolo-

the performance of local farms should be made and compared with those of other countries. They can address the efficiency of production systems. There are several questions that need to be answered: for example, how does the Sultanate produce milk and meat? What are the prevailing production systems? Is production economically and environmentally sustainable? Are farm gate prices acceptable to farmers? Is Omani milk

competitive in global markets? Is Omani sheep meat competitive with the Brazilian or Australian products? How can we develop production systems to improve our global competitiveness? How can we benefit from the expertise of other producing countries in developing agricultural cooperatives that seek to produce effective local products? Conducting studies (taking the farm as a departure)

be built and should answer the questions raised.”

The academic called for engaging farmers in research experiments and applying them in their farms to identify the importance of such research. In this way, the farmer will be able to see how significant technologies, feed additives or improved breeds are to the increase of production and reduction of costs.



and collaboration with international bodies that have farm data from various countries around the world, will no doubt lead to generating basic studies upon which future research can

As to the role of research in bridging the food security gap, he said: “We must use research and technology in farm management as well as in training farmers on how to deal with



Al Wardi: Technology should be utilized to improve food security.

and exploit technology. Workshops should be organized to raise their awareness about how to deal issues related to production, animals, marketing and maintaining the environment in addition to comparing local farms with international ones in order to see whether there is any positive improvement or impact on farm productivity.”

Alqaisi also focused on the issue of the sustainability of agricultural production, saying: “We can only address the sustainability of agriculture through production data analysis, monthly or periodically, in order to understand the occasional changes in the production processes. For example, when global fodder prices rise against stable prices of local products, one should switch to a production system that reduces the cost (e.g. switching to an economical feed system). Also, we should occasionally change the production system with a view to economic sustainability and cost reduction, which should not affect the sustainability of the farm environment, i.e. there should be no increased production of greenhouse gases (one kg of carbon is equivalent to one kg of milk or meat).”

Modern technology

Dr. Malik Al Wardi - Director of Agricultural experiments station – reflected on how to develop agricultural techniques through scientific research, saying: “Research plays a major role in determining the economic and social development of any society. The relationship between studies and agricultural development is highly important, whereby research findings can be utilized in improving agricultural techniques, the qual-

ity of cultivated land and crop productivity. New methods may also be developed for pest and disease control. In this way, scientific research can contribute to providing high-quality products, food self-sufficiency and food security. For example, biotechnology and genetic engineering may be used for such purposes as enhancing varieties of farm crops which can grow in arid lands and endure water scarcity, diseases and various pests, exploiting treated wastewater in agriculture, applying new techniques in irrigation, animal husbandry, and using computers for food mixing and cow milking.”

He shared the view with other academics about the obstacles that impede agricultural development: “It is important that any scientific study on agriculture be put to practice, as the outcome of collaboration among researchers and farmers. Research findings should be quickly transferred into the farm by, say, the centers for agricultural and animal research that are spread across the Sultanate, which would provide a valuable service for farmers. This is one of the biggest challenges facing development plans in the agricultural sector.”

He concluded: “Another challenge has to do with how to develop practical solutions to the degradation of arable lands, given the effects of climate change, water shortages in many areas, salinization of soil and water, as well as the prevalence of pests and diseases that afflict crops. Therefore, scientific research plays a significant role in finding solutions to these natural challenges and achieving self-sufficiency in key crops.”



Alqaisi: Farmers should be involved in research experiments and applications in their farms.

Pictures:

Synthesis of silicon Nanowires by Chemical Vapor Deposition Technique

Abstract :

Si/SiO₂ nanowires were synthesized directly by and on silicon substrate surface without the use of a metal catalyst. Since these nanowires grow directly from the silicon substrate, they do not need to be manipulated or aligned for subsequent applications. The obtained nanowires are amorphous with diameters ranging between 50 to 200 nm and few micrometers in length. Parameters like heating temperature, deposition time, and carrier gas flow-rate were found critical in determining the size, structure, growth yield and morphology of the obtained nanowires.

Implementation phases:

1

N-type, 2 cm×2 cm, Si (100) substrates (Aldrich) with a resistivity of 5.15 . cm⁻² were ultrasonically cleaned in deionized water and acetone for 5 minutes respectively. Then it immersed in 48 wt % HF solution for 10 minutes to etch native oxide layer.



2

The substrate was then loaded into 2.2 cm ID quartz tube which was placed at the center of an electric tube furnace. Graphite powder (2g) (Aldrich, 2-12 μm , 99.95 %) on a porcelain boat was placed 2 cm away from the nearest silicon substrate. The tube was initially flushed with argon gas and was later maintained at 100 standard cubic centimeters per minute (sccm) or as required and whole system was kept under 10–2 torr vacuum. The temperature was raised up to 1200 $^{\circ}\text{C}$ at a heating rate of 1.2 $^{\circ}\text{C}/\text{s}$.



3

All samples were taken for characterization (SEM, EDX, XRD and PL)

4

Scanning electron microscope images of silicon nanowires.



The role of Social Media in teaching Art Education

Al-Hajri: Students acquired new information through positive interaction.

Salman Al-Hajri – College of Education

The twenty-first century has seen great technological changes at various levels. One of these developments is the social media, which are some of the most important technological systems that have a direct impact on the lives of people, on education, as well having various political and social implications. Social media are not merely tools aimed at delivering news and information, but rather could be used in teaching and learning. This role can provide a great opportunity for educators to extend these tools further to teaching. In this way, they can effectively contribute to the development of teaching methods and the provision of information, thus improving student achievement. Many educators have stressed the potential importance of social media in education and in raising awareness among students.

In this context, Dr. Salman Bin Amer Al-Hajri, from the Department of Art Education in the College of Education, has conducted a study aimed at exploring ways and means of utilizing some of the tools of social media to enhance teaching and learning skills among students. Another objective was to measure the effectiveness of using Instagram and YouTube in delivering

specific knowledge-based content in certain courses in theoretical art education, such as Child Art, and applied courses, such as Graphic Design.

The study was based on a qualitative and descriptive approach to experimental

practices with regard to certain concepts under investigation. In one task required by the course, the students of the Child Art course used Instagram to upload pictures and information through their free accounts. Another practice was to utilize smart

phone applications in mediating children's drawings, sharing them on the site, and getting comments and Likes. Another line of research was to experiment with the potential use of YouTube as a project for several student groups. They produced video clips displaying certain cognitive contents which were assessed by the professor and feedback from viewers.

The initial results of the study suggested that modern education curriculums should focus on developing the mental skills and abilities of students, such as imagination, motivation and creativity. This would stimulate students to learn and develop at all levels of education. For example, using social media has proven to be successful among students of Art Education, as they have shown interest in diversifying teaching methods including the new technological tools.

The findings also showed that the students positively responded to the experiment and acquired new knowledge in different educational situations. Such information remains in their electronic accounts for a long time, and therefore they can use it anytime for peer interaction. Such techniques also encouraged cooperative learning, and there is a potential





Can anti-oxidant supplements promote cancer growth?

Dr. Jumana Saleh

for application in the future in the Sultanate's schools by teachers with relevant experience. The experiment also helped to establish some kind of communication and dialogue with the students through student groups, and provided an opportunity for them to produce and share educational material and make it available to everyone. According to the researcher, this could be one of the resources for expanding understanding and cooperation outside the boundaries of the classroom.



فريق FINK



فريق اللاتي درج



فريق نعد العباد

New research has found that over-the-counter dietary supplements, hailed for their cancer-prevention benefits, may be more harmful than beneficial. Dr. Tim Byers, director for cancer prevention and control at the University of Colorado Cancer Center, conducted a meta-analysis of 20 years of research involving more than 300,000 people. The study was presented at the American Association for Cancer Research Annual Meeting in 2015. Byers observed that people who ate more fruits and vegetables reduced their risk of cancer. However, taking supplements that provide the same vitamins and minerals had the opposite effect. Byers found that a number of supplements actually increased the risk of developing certain types of cancer. People who took high doses of beta carotene supplements increased their risk for lung cancer. Selenium supplements were associated with skin cancer. Vitamin E increased the risk of prostate cancer. Excess folate could increase the risk of colon cancer.

In 2012, a comprehensive review of 78 studies was published in the Cochrane Database of Systemic Reviews that agree with the recent findings. Earlier studies showed that vitamin A and E substantially increased the incidence of lung cancer in smokers. This is of particular concern when certain anti-oxidant drugs are given to improve breathing in former smokers who developed lung disease. Functional studies by a team led by Dr. Martin Bergo in the University of Gothenburg, Sweden found that anti-oxidants increased the growth of early lung tumors in mice in a dose dependent manner (Science Translational Medicine, 2014). Recently, they have also found that anti-oxidants increased the metastasis of malignant melanomas in mice and human melanoma cell lines.

These findings provided laboratory evidence for human studies. It is still unclear why supplements have these adverse effects. Several theories have been proposed. Reactive oxygen species (ROS) are harmful reactive species produced as a result of stress, disease, unhealthy diets, life style, and pollutants. Anti-oxidants protect healthy cells from damage by surges of ROS. However, ROS species also contribute to the body's defense against cancer growth when released in the tumor microenvironment to destroy cancer cells. Recent research led by Dr. Bergo and others suggests that excess anti-oxidant intake prevents this defense mechanism by neutralizing ROS, thereby protecting cancer cells and speeding up tumor growth. Also, recent evidence showed that antioxidants inhibit the production of a key tumor-suppressing protein called p53, allowing cancer cells to keep growing.

Easy accessibility to antioxidants and misconceptions about their protective role is becoming a global concern. Experts caution against excessive supplement consumption due to the potential risks. David Tuveson of the Cold Spring Harbor Laboratory stated that people consuming high doses of antioxidants are ironically promoting the very cancers that they seek to prevent. Emma Smith, a spokesperson for Cancer Research, UK, recommended that people stick to a healthy balanced diet, which provides the nutrients needed. However, supplement intake may be necessary in case of deficiencies due to diet or disease, or during pregnancy, in line with recommended daily allowances.

A PhD student wins best research prize in France Her work is applauded in Germany



Layla Al-Naamani:

- Research at SQU is advanced, but researchers need more support.
- My study addresses the problem of marine biofouling.
- Success is achieved by hard work, dedication and determination.

No limits to ambition, no limits to success! This is what the PhD student, Layla Al- Naamani, from the Marine and Agricultural Sciences College, proved to be true when she won the best research prize at a marine sciences conference held in France this year for her research work. Her work was also applauded at a scientific conference organized last August by the University of Munster in Germany.

Al-Naamani, a final-year student at the Department of Fisheries and Marine Sciences, has reflected on her studies in an interview with Tawasul.

Her study

She said that she had carried out part of her doctoral research at Newcastle University, UK. It is titled “Chitosan-zinc oxide nanocomposite coatings for the prevention of marine biofouling”.

She explained that marine biofouling is a worldwide prob-

lem affecting maritime industries. Global concerns about the high toxicity of antifouling paints have highlighted the need to develop less toxic antifouling coatings.

She went on: “Additional antifouling properties of the coatings were investigated in a mesocosm study, using tanks containing natural sea water under controlled laboratory conditions. Each week for four weeks,

san-ZnO nanocomposite hybrid coatings, which can be used for the prevention of biofouling.”

University support

As to the support she received from Sultan Qaboos University, Al- Naamani expressed her gratitude to the university for granting her a four-year scholar-

ship, providing research facilities and materials and facilitating all procedures to conduct part of her study abroad.

research programs have made big leaps forward, they need more support and development. This can only be possible by encouraging them to achieve more, and by believing in students’ abilities and adopting their ideas. She added that it is important to hold training courses for students who are yet to conduct their research work in their respective fields. For example, they should be provided with guidance and instruction on how to use sophisticated equipment for analyzing solutions or conducting experiments. She said the university should streamline the procedures in relation to the funding resources provided to the students.

Advice

In her concluding remarks, the PhD student advised SQU students to think deeply and seriously about what they intend to do: “Any idea, no matter how simple it might sound, could be turned into a really interesting research project. Students should be confident that they are capable of doing innovative things. If they have some research ideas, they first need to find a supervisor who can help them develop their ideas into a fully-fledged scientific study, and, finally, success can only be achieved through hard work, dedication, determination and the ability to overcome potential obstacles.”



lem affecting maritime industries. Global concerns about the high toxicity of antifouling paints have highlighted the need to develop less toxic antifouling coatings.

She added that her work was focused on isolating chitosan, which is a natural polymer with antimicrobial, antifungal and anti-algal properties that is obtained from partial deacetylation of crustacean waste.

Findings

Al- Naamani pointed out that her study revealed interesting results. Nanocomposite chitosan-zinc oxide (chitosan-ZnO) nanoparticle hybrid coatings were developed and their antifouling activity was tested. Chitosan-ZnO nanoparticle coatings showed anti-diatom activity against *Navicula* sp. and antibac-

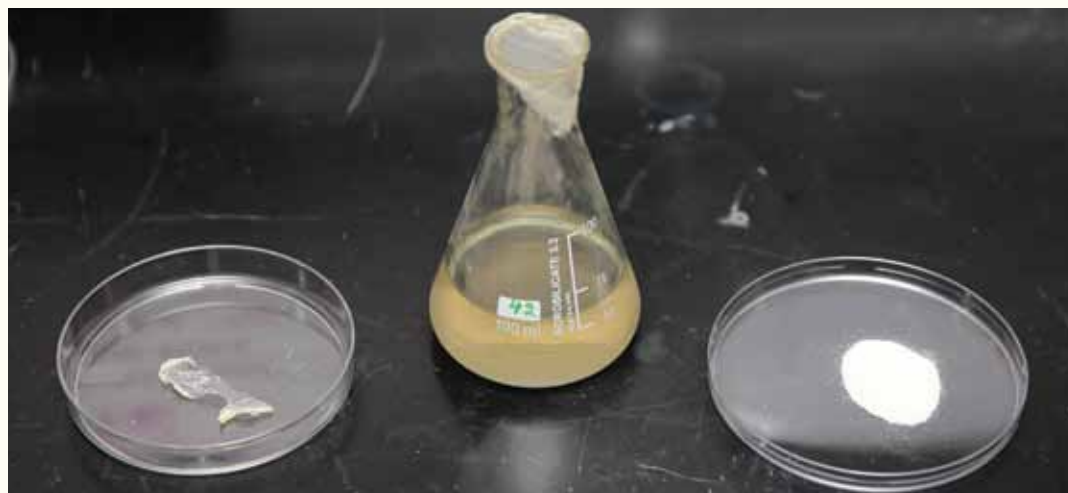
terial activity against the marine bacterium *Pseudoalteromonas nigrifaciens*.

biofilm was removed and analysed by flow cytometry to estimate total bacterial densities on the coated substrates. Chitosan-ZnO hybrid coatings led to better inhibition of bacterial growth in comparison to chitosan coatings alone, as determined by flow cytometry. This study demonstrates the antifouling potential of chito-

ship, providing research facilities and materials and facilitating all procedures to conduct part of her study abroad.

Advanced research, but ... !

Commenting on scientific research at Sultan Qaboos University, she remarked that although





The Features of Omani Cultural Heritage over Five Thousand Years:

Intangible Cultural Heritage in two parts and nine chapters Music, games, sports and museums

In this edition, we continue our review of the series of “The Features of Omani Cultural Heritage in Five Thousand Years”, compiled by Professor Fathi Abdul-Aziz Al-Haddad. The series comprises three volumes published by the Department of Academic Publication and Outreach (DAPO) at Sultan Qaboos University. In the previous edition, we talked about the first volume and here we review the second volume that covers the intangible cultural heritage of Oman.

The second volume, “Intangible Cultural Heritage”, runs to 255 pages, divided into two parts, and consists of nine chapters.

Concepts and agreements

The first part, “Intangible cultural heritage and international agreements”, is divided into three chapters. Chapter One introduces the intangible cultural heritage and its significance. Intangible cultural heritage is defined as all the inherited intangible values acquired by nations. They are manifested in a variety of expressions that reflect their individual and collective conscience and in the cumulative cultures through ages. As a concept, cultural

heritage covers all other forms of expression left by our ancestors and, at times, orally transferred through the generations and nations across the world.

Chapter Two deals with international conventions for preserving the intangible heritage. It shows there have been a number of international documents and recommendations as well as regional attempts to hold conventions and suggest recommendations that could be in favor of preserving the intangible cultural heritage. For example, in 1998, the Stockholm International Conference for Cultural Policies issued the basic document; in 2003, an agreement for the preservation of the intangible cultural heritage was signed, and in the same year, there was a recommendation for promoting multilingualism and access to cyberspace; in 2005, an agreement was penned to protect and promote the diversity of cultural expressions; in 2010, efforts were made to conclude the Arab convention for the protection of folklores.

Chapter Three sheds light on Oman’s international cooperation to sustain the intangible heritage. It shows that

the Sultanate has made great efforts to preserve this at the local, regional and global levels. It has also joined different organizations and endorsed many international agreements on intangible cultural heritage. The Sultanate has issued laws, regulations and Royal decrees aimed at protecting intellectual property of cultural heritage for Omani innovators. Further, Oman has done its best to prevent any damage inflicted on its heritage due to natural or human factors, through drafting legislations to that end.

Music, sports and museums

The second part deals with the intangible cultural heritage in the Sultanate. It is divided into six chapters. Chapter One discusses music and the performing arts and suggests that the historical dimension of Oman has had a significant impact on the richness of Oman’s intangible cultural heritage, which included oral histories, languages and various dialects, social customs, celebrations and special occasions which had their own rituals in the customs and costumes. That heritage also included traditional knowledge associated with traditional products and

trades characterized by distinctive features and rich diversity, as well as a diverse wealth of folklore and arts.

Traditional music, being part of the heritage of peoples, includes singing, dancing, stories and traditional tales, fashion, riddles and poems. Countries strive to preserve their traditional heritage through collecting, documenting and classifying its components, which is then presented to researchers for further examination. Heritage is also revived through supporting folkloric groups.

Chapter Two deals with games and popular sports, which are one of the oldest manifestations of human activity. They are living examples that mirror a real picture of the various aspects of life in different societies. They play an important role in teaching and consolidating the customs and traditions of communities, developing the personalities of children by strengthening them physically, sharpening their minds and developing their social experience and skills. They also help to spread the traditions that characterize any society, naturally and spontane-

ously from one generation to another.

Chapter Three covers customs, traditions, values, and Omani proverbs that emanate from the society's interaction with the environment and, thus, become living traditions that grow with successive

in any group in order to organize their affairs and express their thoughts and feelings to achieve their goals. He explains that Omani society is characterized by unique social traditions which constitute a vital element of its Islamic, national and cultural heritage. It is governed by

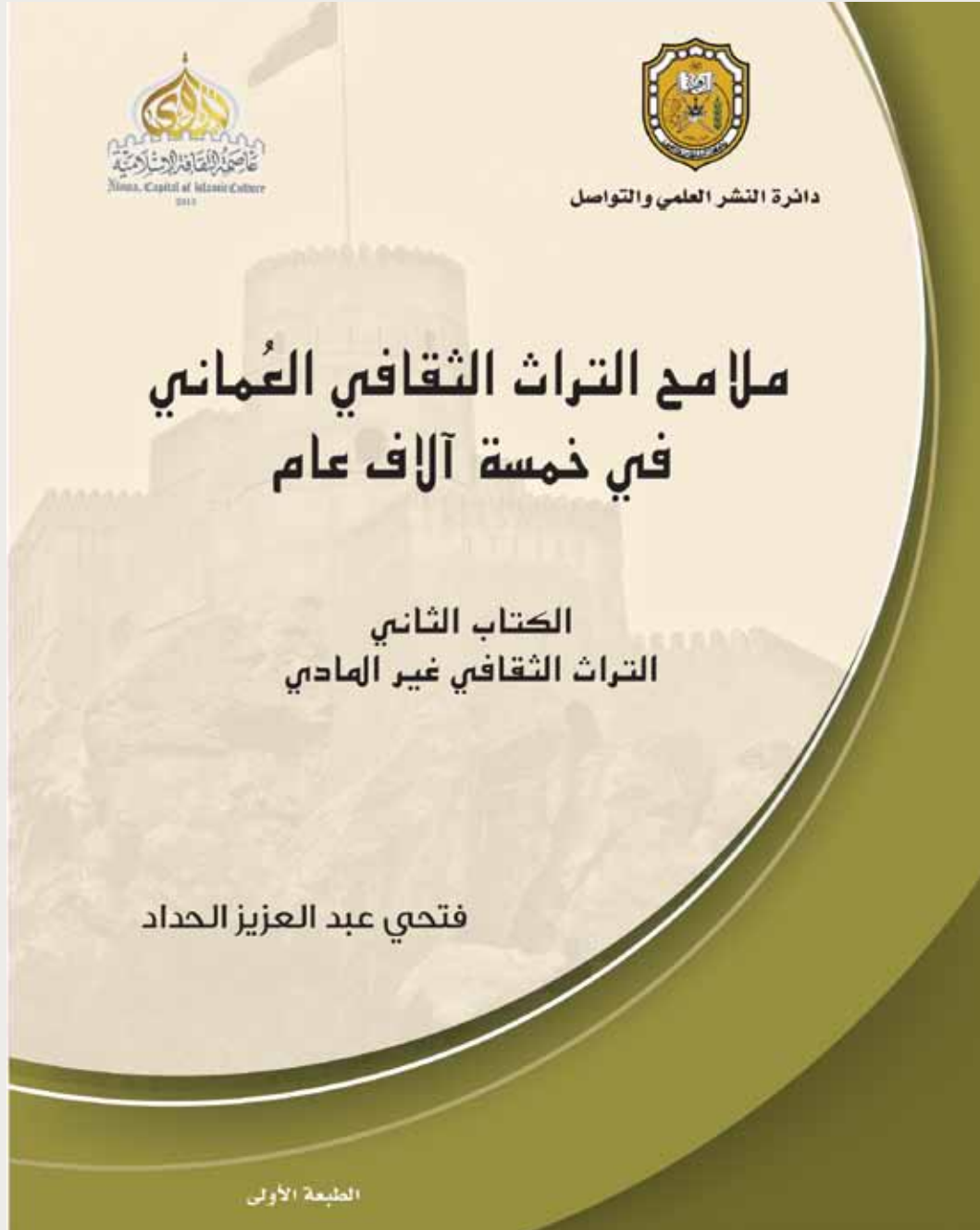
Chapter Four deals with the knowledge and skills of traditional crafts. It refers to the traditional crafts as the physical manifestation of intangible cultural heritage. Therefore, the 2003 agreement for the preservation of the intangible cultural heritage is mainly concerned

later generations. There are many forms of skills of traditional arts, such as the making of tools, clothing, jewelry, furniture, storage containers, objects used in the transportation and shelter, decorations and rituals materials, musical instruments, household items and toys for entertainment or education, as well as participating in private celebrations and performing arts. Many of these objects are to be used within a short period of time, such as those made for the purposes of ceremonial rituals, while others remain part of the heritage handed over from generation to generation. There are various skills used in producing a variety of craft items, such as making paper objects, strong baskets or thick carpets.

Chapter Five reviews the linguistic heritage, which is an essential element of cultural diversity, underlining, as always, the essential role that education plays in the protection and promotion of cultural expressions, and taking into account the importance of cultural vitality of all the people, including persons belonging to minorities and indigenous peoples. This is reflected in their freedom to express their own cultural forms, and have them published, distributed and accessed for the benefit of all. It also recognizes the essential role of cultural interaction and creativity, which nurtures and renews cultural expressions and reinforces the role of those involved in cultural development for the progress of society as a whole.

Chapter Six shed lights on the role of museums in preserving Omani folklore. It briefly introduces the features of the Omani intangible cultural heritage, and how this has attracted the attention at the national, Arab and international levels.

The author also talks about the factors that help in the development of such museums for the sake of the public.



generations. The author mentions that social customs and traditions are one of the fundamental pillars upon which the cultural heritage of any nation or people is built, because life necessitates the emergence of a set of practices and procedures followed by individuals

a series of positive relations, norms, values, customs and traditions, combined over time and through developments, which underscores the fact that Omani customs and traditions are a model of the customs and traditions of the Arab and Islamic nations.

with the skills and knowledge related to traditional arts, rather than craft products, explaining that besides focusing on the preservation of craft industries, attempts should be focused on encouraging artisans to maintain their trade and transfer their skills and know-how to

World sheep and beef production and the meat industry

Dr. Othman Alqaisi

Dr. Othman Alqaisi from the Animal and Veterinary Sciences Department has recently participated in the Agri-benchmark network conference in Spain, representing the Sultanate in this global forum, with a presentation on the farming and industry status quo of Omani sheep and goat production. Agri-benchmark network, a German public organization based in Braunschweig, works under the umbrella of Thünen-Institut.

The Beef and Sheep Conference 2016 took place in Córdoba, in the Andalusian region of Spain, between the 9th and the 16th of June. The event had a program that included internal workshops on sheep and beef farming systems, international comparisons, latest developments in beef and sheep markets and trade, farm analysis, and field trips to sheep, cow-calf and beef finishing farms.

Meanwhile, the public Global Forum was held on June 16th by the Spanish Ministry of Agriculture in Madrid and hosted an audience of more than 100 decision makers of the Spanish beef and sheep supply chain, as well as Agri-benchmark country representatives. Competitiveness in the context of sustainable beef and sheep production was the leading topic of the event.

Among the conference activities, the participants visited the OVISO (Spanish sheep producers cooperative) and the wool center, which is made up by 13 sub-cooperatives and now acts as the biggest meat producing company in Spain with a sheep population of 16.5 million head. OVISO has created a structure and consolidated a network of services to the livestock sector, ranging from production support to marketing and product transformation.



The participants also visited the COVAP (Spanish Communal Feedlot Cooperative) located in Córdoba. COVAP is formed by 10,000 associates and covers activities in the farming of dairy cattle and sheep, and meat production of sheep and beef animals.

World total meat consumption in 2013 (these are the most recent published figures) was estimated at 306 million metric tons (MMT). The consumed sheep and beef meat was estimated at about 81 MMT.

United States cattle meat production was estimated at 11.7 MMT and ranked number one in the world, followed by Brazil, with production estimated at 9.7 MMT, and the EU-28 countries with production estimated at 7.3 MMT. The picture of global sheep meat production is different, with China ranked number one with production estimated at 2.1 MMT, followed by the EU-28 with 0.85 MMT and Australia with 0.66 MMT. In price terms, the New Zealand and Australian farm-gate sheep prices were the lowest, at 2.51 and 2.79 USD/kg live weight, versus 6.74 USD/kg live weight for Spanish sheep.

In the Middle East and North Africa (MENA) region, the estimated total amounts of

meat imports were 670 thousand metric tons in 2015 and at an estimated 3 billion USD.

In 2015, the Omani meat imports of all types (poultry, beef, sheep and goat) were estimated at 143 thousand metric tons and valued at 328 million USD. However, total Omani imports of dairy, meat and livestock animal products was estimated at 1.1 billion USD.

These numbers are challenging the national food security plans and need to be evaluated in depth. They further indicate that meat and dairy production needs to be boosted to reach self-sufficiency. For instance, and concerning national milk consumption, milk equivalent per capita consumption was estimated at 90 kg/person/year, and the national milk production supplies only 26 kg/person/year, whilst the imported milk

makes up the biggest proportion of 64 kg/person/year.

There are two sources of meat products in Oman to cover the national demand: Imported meat which grows by 10% annually and, locally produced meat from livestock animals which grows by 2% annually (a total growth in the national meat demand of 12%).

By joining the Agri-benchmark network, the Omani sheep/goat and beef farming and meat industry will benefit from:

Exploring other countries' experience in developing efficient and sustainable sheep, goat and beef farming systems

Exchanging data and statistics on regional and global levels to compare and benchmark farming and production key performance indicators, and benchmark farm structure and sector production

Modeling and analyzing the impact of technologies and prices on farming systems, and developing future production scenarios to reach self-sufficiency

Providing relevant data and information to farmers and decision makers on optimizing livestock and meat trade flow and global meat prices dynamics

Exchanging ideas and experiences and initiating research work with researchers and scientists from different countries.



Metabolites from Tafar Al-Taes



In the context of global concerns over antibiotic resistance, traditional healing systems that utilize herbal remedies are emerging as an alternative source of new antibiotics. Plants have been extensively exploited for extracting their medicinal properties and the result is that many plants are endangered and are on the verge of extinction. It is the right time to wake up and conserve medicinal plants by getting the medical compounds

in vitro, without destroying the plant.

Haplophyllum Tuberculatum (Arabic, Tafar Al-Taes) is an erect branched medicinal herb that belongs to the family of Rutaceae, with a strong unpleasant odor that discourages grazing herbivores. Its aerial parts are used in folk medicine to treat malaria, rheumatoid arthritis, joint pains, broken bones, gynecological disorders, asthma and respiratory problems.

In this regard, a study has been conducted by Dr. Sardar Farooq and Sheikh Al-Sanaidy, from the College of Science, to develop a reproducible in vitro propagation system through organogenesis for Haplophyllum tuberculatum. Leaf explants were cultured aseptically on a Murashige and Skoog medium, supplemented with various concentrations of plant growth regulators. Callus was initiated with Indole butyric acid. Caulogenesis was obtained with ben-

zyladenine and Rhizogenesis in the regenerated shoots was obtained when transferred to media with naphthalene acetic acid.

Different tissues such as callus, shoots and leaves from regenerated plantlets were tested for antibacterial activity using nine pathogenic bacterial strains. This study indicates that callus from tissue culture could be utilized for the production of secondary metabolites having therapeutic value.



Research device

Kjeldahl analyzer unit-2300

The KJELTEC™ 2300 ANALYZER UNIT is a stand-alone unit for automatic determination of nitrogen and protein according to the Kjeldahl method. The Kjeldahl method lets you determine the nitrogen content of organic and inorganic substances and is used as the official method for determining the nitrogen and protein content in foods, raw materials and finished products (milk, cereals, meat), animal feeds, soils, fertilizers, waste water, sludge, lubricants, fuel oils. Three main stages stand out: Digestion: The sample is heated at a high temperature after having been mixed with concentrated sulphuric acid and other reagents. An ammonium sulphate solution is obtained from this reaction. Distillation: The sulphuric acid used for the digestion is neutralised with a concentrated sodium hydrate solution. By adding an excess of alkali, the balance is shifted from ammoni-

um ions to free ammonia (NH₃), which separates through distillation in a current of steam and is collected in a suitable solution. Titration: The quantitative determination of the ammonia produced can be done by means of acid base titration (colorimetric, potentiometric, etc.) or other systems. Afterwards, it will be easy to calculate the quantity of nitrogen proteins.



Rose water production

Dr. Msafiri Daudi Mbaga



culture positively, in line with HM Symposium in 2007 at Wilayat Samail, which, among other things, stressed the need for youth participation in agriculture.

Farmers in Jabal Akhdar have been growing and processing roses into rose water in a traditional way for many years. Traditional rose water processing has now become a leading tourist attraction in Jabal Akhdar.

An SQU scientist has investigated ways to improve the production, processing, bottling and marketing of Jabal Akhdar rose water.

Dr. Msafiri Daudi Mbaga hopes that his project will add value to this important agricultural commodity and hence increase the incomes of Jabal Akhdar rose water producers. It may also encourage and motivate youths to view agri-

Before the implementation of this project, rose water was being bottled and marketed in discarded bottles without labels to indicate its chemical composition. This is because it has never been chemically analysed for its content. Therefore no one knows what is in it, which makes it impossible to export this product, let alone sell it to tourists even locally.

Omani tourism and hospitality education: an employment dilemma

Tamer Mohamed Atef, Masooma Al-Balushi – Tourism Department, SQU

Two SQU academics have investigated the receptiveness for tourism and hospitality as a career path among students

just a step, rather than a career path. Only 21.6 per cent are willing to consider tourism and hospitality as their long-term career

tion about possible study plans and job market opportunities. An entrance exam should also be introduced in order to select only

rent and future industry trends, as well as increasing the students' exposure to the industry and employment market



in the Tourism Department, at SQU. The researchers have come up with interesting findings that would help tourism and hospitality educators, employers, and policymakers better understand students' future employment intentions.

Tourism and Hospitality education provides graduates with the diverse range of skills and qualifications required to pursue a successful career in the field. Employment indicators in the Sultanate of Oman show that few graduates join the tourism and hospitality job market, resulting in a shortage of Omanis in the field. The major drawback of this trend is the inability to achieve the planned figures for Omanization.

Findings

Conducted by Dr. Tamer Mohamed Atef and Dr. Masooma Al-Balushi, from the Tourism Department, SQU, the study has found that nearly 41 per cent of the students surveyed will continue working in tourism and hospitality for some time. For them, working in the industry is

path. Tourism and hospitality students' perceptions of the industry tend to become negatively affected as they advance in their study plan.

It was found that the main motivating factor in committing to a career in tourism and hospitality was the encouraging working conditions, whereas the least motivating was the image of employment in tourism and hospitality.

The most preferred jobs were hotel department head, meeting, convention, and event planner, and ticket agent. The least preferred jobs were dishwasher, housekeeper, laundry worker, chef and hotel front office clerk.

The major drawback of such a trend is the inability to achieve Omanization in these areas.

Recommendations

In a bid to overcome such hurdles, the researchers have suggested introducing students to the specializations and employment prospects in the Tourism Department. This includes a period of orientation, which should provide candidates with informa-

tion about possible study plans and job market opportunities. An entrance exam should also be introduced in order to select only

Other important steps that could be taken are:

Maintaining strong connections with the industry. This could be ensured partly through coordination with Ministry of Tourism officials and industry leaders who are members on the Tourism Department advisory committee, and through the organization of employment fairs

Involving experts from the industry in teaching and as guest speakers. This would help academic staff to be aware of cur-

rent and future industry trends, as well as increasing the students' exposure to the industry and employment market

Getting out of the traditional tourism and hospitality nomenclature box by reframing unattractive courses and specializations with more marketable and attractive names that describe the new employment environment needs and allow students to gain a competitive advantage in being employed in other industries. This should diversify their employment prospects and alternatives

Tackling the problem of poor industry image in the community by establishing a holding company responsible for job placement. Such a company should be affiliated with the Ministry of Tourism and outsource the required qualified manpower to tourism and hospitality institutions

Closely planning and conducting practical training courses and internship programs. Internships should be based on clearly defined criteria and steps, and should be a collaborative effort between the academic institution and industry affiliates. Continuous feedback should be sought to keep the internship experience as fruitful and positive as possible for all parties involved.



Impact of foreign labor on Arabic in the GCC: A challenge to identity

Dr. Hassan Abdel-Jawad – College of Arts and Social Sciences

A recent sociolinguistic study has highlighted the serious impact of foreign labor on the Arabic language and identity in the GCC countries, with special reference to Oman. The influx of foreign labor and its negative consequences on their language, culture and identity have been of great concern to both official and non-official circles in the region.

Conducted by Dr. Hassan Abdel-Jawad, the study is focused on the following dimensions: a) children's first language; b) the creation of a hybrid language; c) the spread of English as a lingua franca in higher education institutions, businesses and health facilities, and d) the globalization of language and culture, whereby major cities in the Gulf have become international and global centers, attracting investors and professionals world-wide. This situation has tremendous cultural, social and linguistic impacts.

The initial findings of the study have included the following:

Dominance of English: English has become more dominant in the Gulf countries than even the official National language, i.e. Arabic, as it is widely used not only as a lingua franca but also as a second language in most, if not all private educational institutions, i.e. bilingual schools, which are becoming the norm and model for good education.

Language markets: In both public and work spaces, there is a language market in which the languages heard are more likely to be the various Indian and languages, Tagalog, English, Turkish, German and Chinese, rather than Arabic.

Dominance of foreign workforce: All public facilities, such as shops, restaurants and

café shops are Asian/south and south eastern in nature.

Threat to national identity and culture: This dominance of foreign labor in most aspects and junctions of life brings with it cultural, linguistic, and identity dominance which makes nationals concerned about their national identity and culture.

Imperfect input for language acquisition for children, both of the native language as well as English. They are exposed to a mixture of low-level or imperfect form of languages so it runs like this: weak, confused, imperfect input will lead to weak acquisition and learning output.

The emergence of an inter-language, "pidgin Arabic" or "broken Arabic" as it has been widely referred to. As this is used for daily communication among the workers and the rest of the community, especially employers, it has become the everyday language of a sizeable portion of the population. Ultimately, this will have a great negative impact on their

use of the native language. Over the years, this language variety has become the dominant common means of communication among workers and nationals, as well in the gulf at large. Thus, the younger generation will be continuously exposed to this variety which will further distort their input for language acquisition. This damages the skill to use Arabic correctly, which puts the correct and proper use of Arabic in danger.

Globalization of culture and language: Due to the wide spread of all foreign cultural forms and symbols, e.g. restaurants, shopping centers, entertainment facilities, etc. a shift and erosion of the local culture is expected to take place. The younger generations will grow up with this globalized culture, which will be their model at the expense of the local cultures.

Finally, Dr. Abdel-Jawad has put forward the following recommendations, which he argues, can only be attainable through serious official policies

and plans:

1. Like most labor hosting countries around the world, the Gulf countries, including Oman, must control foreign labor in terms of quantity and quality and must make a good command of Arabic a requirement for working in the Gulf.

2. Arabic, the national language, must be made the only official language in all institutions and businesses, with English as a foreign language, not a second one.

3. The national language must be used as the language of instruction in all educational institutions, with English as a secondary one.

4. In hiring maids and house keepers, Arabic language proficiency must be a requirement; furthermore, mothers must not leave the children with maids at all times.

5. Nationals must gradually replace foreign labor in all fields.

6. Public awareness of the national language and identity must be raised.



رواد التطور التكنولوجي

العلامة التجارية الأعلى قيمة في السلطنة
وفقاً لشركة Brand Finance لعام ٢٠١٥

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