Regional Training Workshop on "Advances in Remote Sensing Application in Water Resources Management" Muscat, Sultanate of Oman

17-19 February 2020

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Summary

The Regional Training Workshop on Advances in Remote Sensing Application in Water Resources Management was held in Muscat, Sultanate of Oman, 17-19 February 2020 as one of the approved proposals of the 10th RCUWM Governing Board Meeting held in Tehran, Iran, 5 December 2019.

This event was hosted by the Ministry of the Regional Municipalities and Water Resources (MRMWR), Sultanate of Oman and co-organized by MRMWR and RCUWM. Around 60 participants from member states of RCUWM Governing Board, of whom 37% were female and from states including Azerbaijan, Bangladesh, Egypt, Germany, India, Iran, Iraq, Oman, Pakistan, and Turkey participated in this event. Also participants from Kuwait (Institute of Scientific Research) and Qatar (UNESCO Doha Office) attended this workshop. Distinguished lecturers delivered their speeches as follows:

- Ms. Khadija Al Aisari, Petroleum Development Oman (PDO)
- Mr. Toshio Koike, International Centre for Water Hazard and Risk Management (ICHARM), Japan
- Mr. Mohamed Abdallah, United Nation Food and Agriculture Organization (FAO), Egypt
  Mr. Yaseen Al Mula, Sultan Qaboos University (SQU)
- Mr. Mohamed E. Hereher, Sultan Qaboos University (SQU)
- Mr. Tobias Brehm, Federal Institute of Hydrology (BfG), Germany
- Ms. Fatma Al Lawati, Petroleum Development Oman (PDO)
- Mr. Ali Chavoshian, the Regional Centre on Urban Water Management (RCUWM), Iran
- Mr. Talal Al Awadhi, Sultan Qaboos University (SQU)

Furthermore, the 1 Million Date Palm Project and 2 traditional water transfer systems of Oman similar to Qanats which are called Falaj in Oman were visited as technical tours on the third day of the workshop (19 Feb). The main goal of the date palm tour was to recognize the role of RS and GIS in date palm planning and design.

The main objectives of this regional training workshop have been to:

- introduce recent developments in remote sensing information and satellite-based products (e.g. precipitation and soil moisture) as well as their applications,
- promote the exchange of experience and knowledge among participants and,
- discuss development and application of Decision Support System (DSS) using remote sensing information.

Special thanks to Ministry of the Regional Municipalities and Water Resources (MRMWR),, Sultanate of Oman, H.E. Ahmed bin Abdullah bin Mohammed al Shuhi as the minister and H.E. Ali Al Abri, Undersecretary of MRMWR and their wonderful team for their efforts in holding this training workshop.

Workshop Presentations and Activities

The following section is a short summary from the presentations and technical tour.

Day 1

Opening

After registration and reciting holy Quran, Mr. Rashid Al Abri officially addressed the opening of the workshop by wishing the entire participants to have a fruitful workshop and that all would be benefited, as well as having a pleasant stay in Muscat.

Mr. Ali Chavoshian, the Director of RCUWM delivered a message on behalf of H.E. Reza Ardakanian, RCUWM Governing Board Chair and Minister of Energy of I.R. Iran. The full text is submitted in Annex 1.

After delivering this message, a short movie regarding water resources in Oman and His Majesty the past Sultan, Sultan Qaboos bin Said towards these valuable resources was shown.

As the first lecturer Ms. Khadija Al Aisairi (PDO) started her speech about the Role of RS in the E&P of Oil and Gas in the Sultanate of Oman.

Figure 1: Ms. Alsairi, presenting about role of RS in Oil industry of Oman

This day continued by a valuable presentation by Mr. Toshio Koike, director of International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM) submitting a lecture on "Flood and Drought Monitoring and Prediction by Satellite-based Microwave Remote Sensing". He started by defining the true meaning of remote sensing.

"Remote Sensing is a technology for identifying a target and estimating its physical, chemical and biological conditions without touching by using its inherent characteristics of emission, reflection, absorption and transmission of electromagnetic wave and its radiation transfer."

He continued on different satellites used in remote sensing and concluded by explaining various case studies in water resources management in Nigeria Flood in September 2018, Mejerda River and Guatemala.

Figure 2: Prof. Toshio Koike presenting a keynote speech

After the presentation by Prof. Koike, in a short ice breaking session, participants introduced themselves and talked briefly about water resources as well as remote sensing application in their countries and organizations.

Figure 3: Icebreaking session

By the end of ice-breaking session, Mr. Mohamed Abdallah from United Nations Food and Agriculture Organization started his presentation on The Potential of Geospatial Tech. for Applications in Water and Agriculture. He continued by stating various uses for RS in agriculture and water resources by the following:

- Irrigation water consumption
- Agriculture production change
- Drought monitoring
- Vegetation monitoring

Another interesting part of Mr. Abdallah's presentation was explaining about FAO's Water Scarcity Initiative (WSI) which was launched in 2013 to support MENA Region countries to strategically help their water resources management, food security, etc. The escalation of water scarcity in the Near East and North Africa countries is severe and unprecedented. Fresh water resources in the region are among the lowest in the world; figures confirm that water availability has decreased by two third during the last 40 years and is expected to fall by another 50 percent by 2050. If smart changes in agriculture water strategies, policies and governance are not adjusted and urgently applied, the water and food security of the region and its sustainable development will be compromised, seriously affecting the livelihood of farmers. The regional network of partners will also support member countries in the implementation of a Regional Collaborative Strategy to create broad consensus and ownership on the water reform agenda across the region

He also introduced the websites providing geo-spatial data fao.org (FAO-Geonetwork), GEOGLAM among many other ready to use data sets such as FAO Global Information and Early Warning System on Food and Agriculture (GIEWS), Group on Earth Observation Global Agricultural Monitoring (GEOGLAM), The USGS Famine Early Warning System Network (FEWS NET), The Global Food Security Analysis Data at 30 meters (GFSAD30) along with some useful links to download global coverage and data archives.

Figure 4: Mr. Mohamed Abdallah (FAO)

Mr. Yaseen Al Mulla took the floor by speaking about mapping & change detection analysis of wetland areas in Ras-Al Hadd region in Oman.

He started his presentation by introducing the Ras-Al Hadd region, explaining the projects planned and done in this region. The main aim of this project has been accurate, efficient, and repeatable mapping of changes in wetlands as critical for monitoring human, climatic, and other effects on these important systems.

He stated that the future of change detection using remote sensing in wetland would be:

- Automated image preprocessing and land-cover characterization methods will soon be a standard practice .
- These large-scale automated methods should greatly accelerate change analysis in wetlands.

Figure 5: Mr. Yaseen Al-Mulla

The presentation by Mr. Mohammed Hereher was on detection of surface water suppliers in arid regions using remote sensing.

He started by stating that measuring, monitoring, and predicting the spatial distribution, volume, movement is fundamental for Earth resources research. Unfortunately, in situ data is usually not enough to create statistically significant distribution maps of: water surface area, constituents, depth, temperature, snow-ice surface area, cloud cover, precipitation, and water vapor. Therefore, remote sensing methods have been developed to obtain quantitative, spatial, measurements of these hydrologic variables. Then he explained the remote sensing of surface water characteristics and Sun Glint Effect. He also introduced a model named MODIS for RS applications. In conclusion:

- Remote Sensing proved sufficient to study surface water Remote Sensing Proved sufficient to study surface water
- MODIS is most powerful to detect the status of previous rainstorms in terms the status of previous rainstorms in terms of frequency and amplitude.
- MODIS data could extrapolate trends of vegetation cover as a proxy to precipitation changes in arid regions.

Figure 6: Mr. Mohammed Hereher

Day 2

The second day started by Mr. Tobias Brehm from Federal Institute of Hydrology-BfG, Germany about possibilities of remote sensing and Copernicus in the area of inland waters and water resources management in 6 sections:

1. Introduction
2. RS-Data: Aspects of Use
3. Hands-on: An operational Product-Workflow: Turbidity
4. Copernicus Data and Products for Inland Water Bodies
5. The Copernicus Emergency Management Service
6. Soil-Moisture, Precipitation, Snow: H-SAF Data & Products

Mr. Brehm started his speech by briefly representing the tasks and duties of the Federal Institute of Hydrology (BfG) for research and scientific activities, mainly focusing on 4 sections as hydrology, water resources management, ecology and water conservation.

He also explained about BfG's remote sensing projects including vegetation, soil moisture, floods, oil, monitoring structure, water turbidity and temperature, etc.

Mr. Brehm also explained about the Copernicus Emergency Management Service (CEMS) and its application in extreme events including flash floods in residential areas, transportation sector and various facilities. He also presented the participants early warning and monitoring system and risk and recovery mapping for risk analysis.

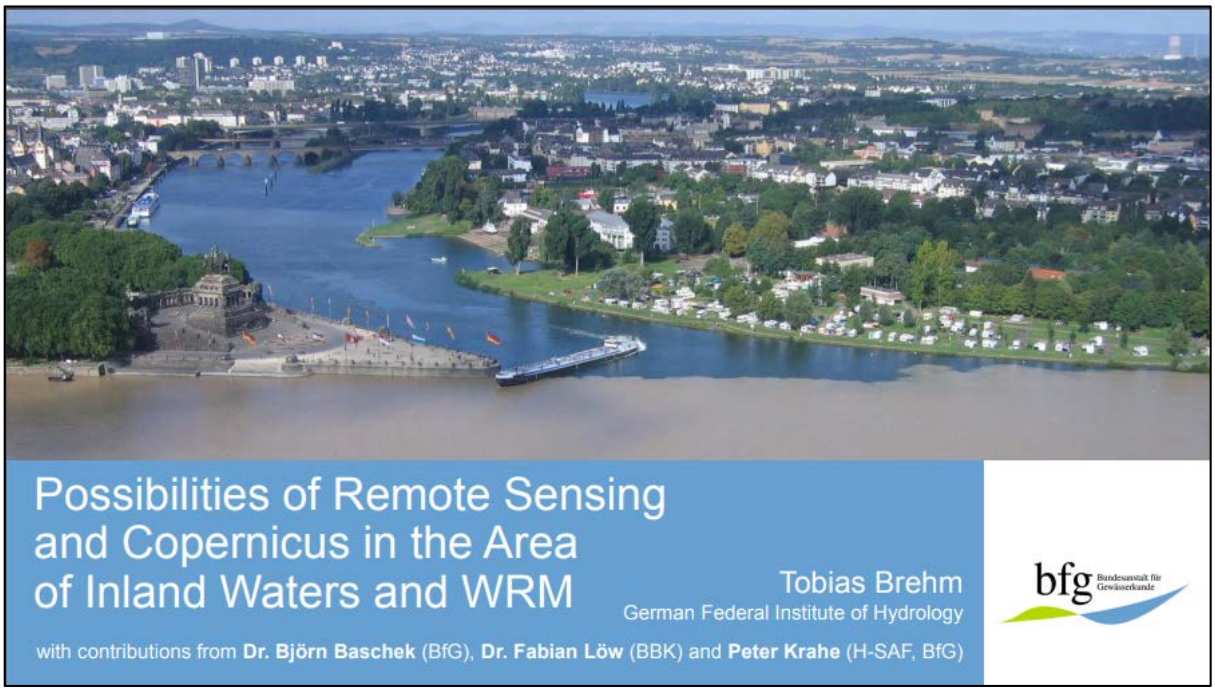

Figure 7: Mr. Brehm Presentation

Ms. Fatma Al Lawati from PDO explained terrain classification for seismic acquisition surveys using remote sensing methods; furthermore improved project planning that led to giving accurate production forecast reduced cost of the entire project was one of the results of the study. Also reduced time of running the project and improved HSE exposure was as outcomes of this study.

Results of this project were:

- ٨٣%reduction driven and days spent in the field
- Enhanced HSE planning
- Optimization of resources
- Accurate prediction of deliverables to clients
- Improved budget accuracy and compliance

To put the presentation in a nutshell he stated that:

- The approach has been proved successful capturing the desired terrain types
- Improved project planning
- Give accurate production forecast
- Reduced cost
- Reduced time
- Improve HSE exposure

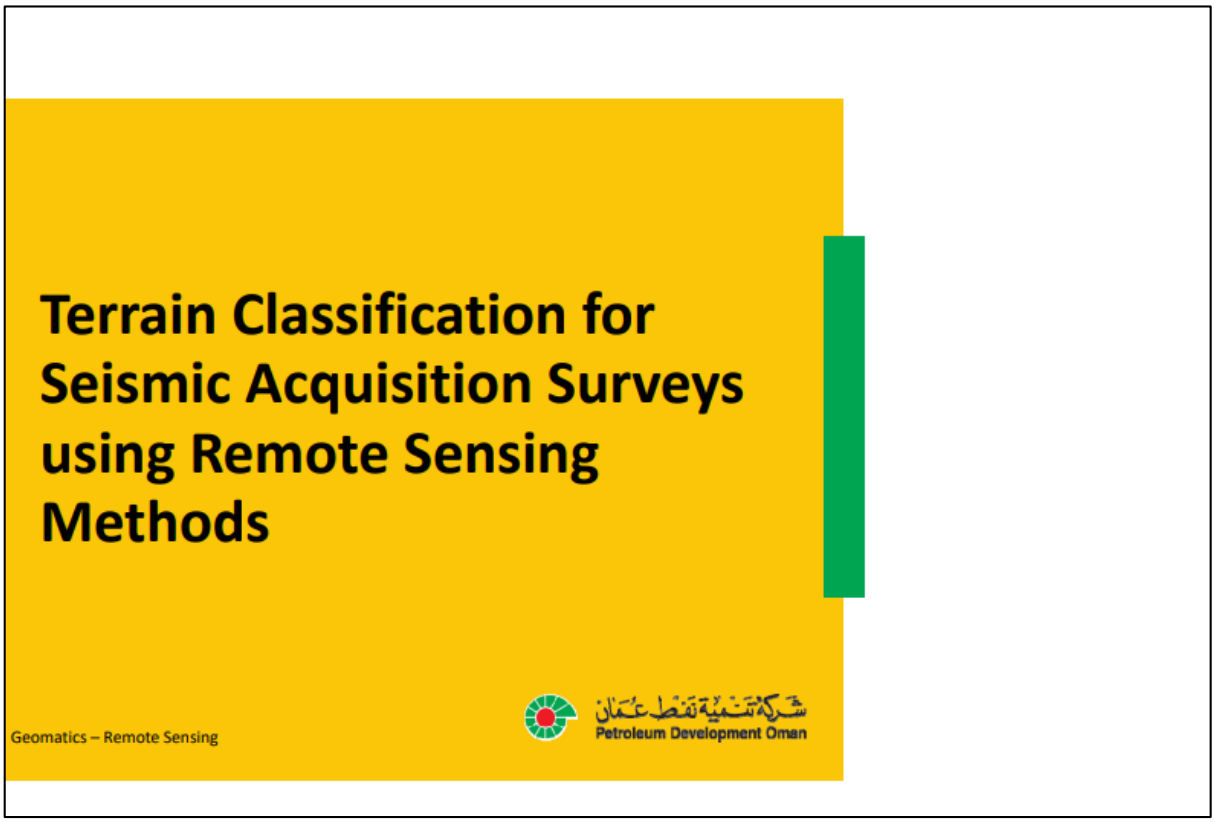

Figure 8: Ms. Al Lawati's Presentation

This session went on by the presentation of Mr. Ali Chavoshian, director of RCUWM by the title of "RS and GIS Data and Tools: A Semi hands-on Training".

Mr. Chavoshian first started his speech by presenting RCUWM and its activities. The 10th meeting of RCUWM Governing Board has been held on 5th December 2019 as for the agreement has been signed for the 3rd period of activities (2019-2024). This centre has 3 main pillars of activities:

- Training and capacity building
- Joint research and technology transfer
- Networking and information sharing

The RCUWM director also mentioned some projects and publications of Centre. After this short introduction, RS application in ungauged basins, challenges of modeling runoff generation in arid and semi-arid areas and importance of RS in transboundary basins.

He also presented an E-Learning video about QGIS, in which a complete project about catchment delineation was explained. In this e-learning video, some hydrological analyses are briefly performed focusing on stream and catchment delineation based on open data in QGIS to present them in maps. A Geographic Information System (GIS) can be a useful tool for preparing the input of models and tools. Furthermore, in this era of Open Data ample open access data is available that can easily be retrieved from the internet and integrated in open source desktop GIS software, such as Quantum GIS (or QGIS). As you know QGIS is a Free and Open Source Geographic Information System.

After following this step-by-step tutorial it would be easy to use online data and perform catchment and stream delineation.

Starting with a DEM downloaded from the online websites like SRTM product (NASA), this video will show extracting a channel network, delineating watersheds and calculate some statistics. The case study is Al Khawd watershed, located in Oman, close to Muscat city

(approximately 50 km in distance). The result is the map of delineated catchment along with DEM and main rivers are shown at the end of the video.

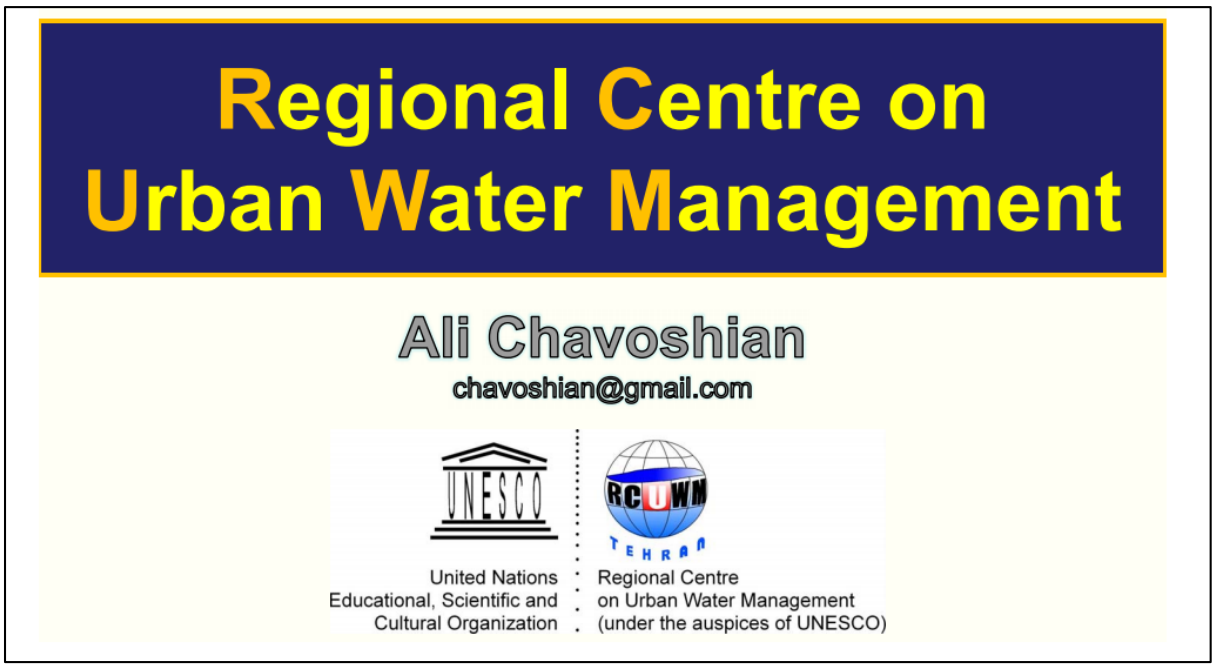

Figure 9: Mr. Ali Chavoshian, RCUWM Director Presentation

As the session continued, Mr. Talal Al Awadhi from SQU started his speech on Assessment of coastal susceptibility to non-eustatic sea level rise using the coastal sensitivity index: A case study on Muscat coast – Sultanate of Oman. This works part of HM research funds. Project title is Quantifying and Mitigating Potential Environmental Impacts Related to the Non-Eustatic Sea Level Rise along Oman Coastal Zone. The coastal zone of Muscat Governorate, Muscat coast extends to more than 250 km along the Sea of Oman. This coast holds the major urban masses of Oman and most of the capital investments in the country. The shoreline significantly varies in terms of its geomorphology, slope, width, land use and ecosystems. As stated by Mr. Talal there are two types of sea level rises:

A) Slow sea level rise due to climate changes. As IPCC (2007) reported that by the end of this century the rise in the sea level may approach only 70 cm above the current level
B) Non-eustatic sea level rise due to tsunamis or cyclones

In the past few years Muscat and east coastal of Oman received several cyclones.

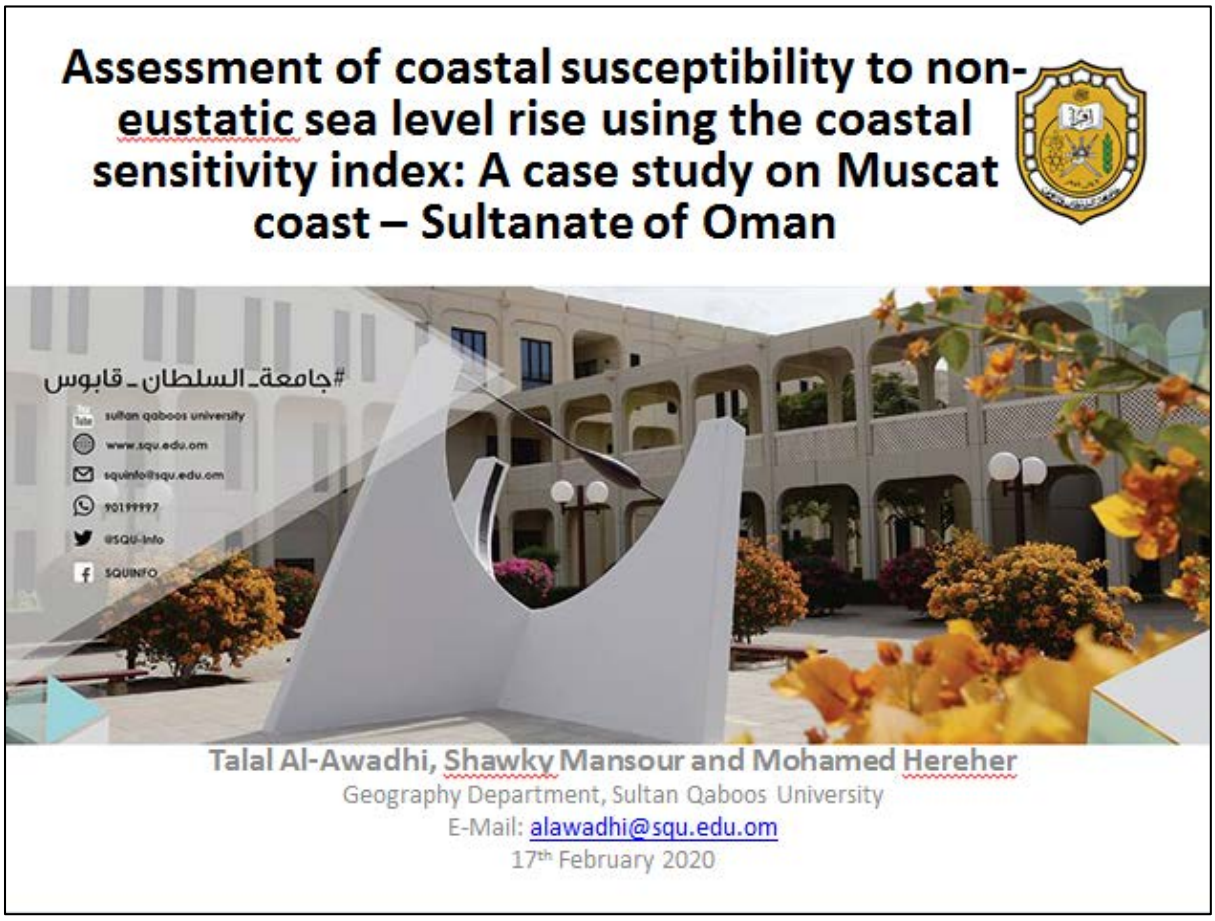

Figure 10: Mr. Alwadhi's Presentation

Day 3

The third day was planned for a technical tour to visit the project on 1 million palm date in Oman. Two major date palm farms, which are located in Dhofar Governorate and are part of the 'One Million Date Palm Project', are doing well. The governorate is home to two farms — one is located in Marmul in the Wilayat of Shalim, while the other is in Al Najd Farm. The farm located in Marmul has capacity 55,000 date palms besides accommodation for horses and other palm varieties. Al Najd Farm can accommodate 100,000 palms. Sayyid Mohammed bin Sultan al Busaidy, Minister of State and Governor of Dhofar, reviewed the project's progress along with a large number of dignitaries and senior government officials.

These two farms are major plantation sites among 11 date palms farms under the project spread in different parts of the Sultanate. These farms are equipped with the latest technology of irrigation and plant protection devices.

During the visit the date palms were inoculated by Unmanned Aerial Vehicles (UAV) and the full process was demonstrated and described.

Agriculture scientists, project engineers and officials involved in the project made video presentations, which highlighted the importance of organic farming as well as technical and research aspects of the project. The challenge in front of them is to protect the palm trees from diseases and the use of best of the technologies to develop the farm and enhance palm productivity. The presentation also highlighted the economic and industrial aspects of the project and its contribution in the national economy. A film on plantation and challenge of achieving the goal of one million date palm evoked interest from visitors.

The following was a tour on visiting 2 falajs near Muscat.

Figure 10: Technical Tour (1 million date palms)

Annex 1: Message from Minister of Energy of I.R. Iran

In the Name of God, the Merciful, the Most Compassionate

Your excellencies,
Honorable guests and distinguished participants,

It is my great pleasure as the Minister of Energy, I.R. Iran and Chair of the Governing Board of the Regional Centre on Urban Water Management to address a few words in this important event, which is being held in the beautiful city of Muscat, in one of the most pleasant seasons of the year.

At the outset of this event, I would like to send my deepest condolences to the late Sultan of Oman, His Majesty Sultan Qaboos as a pioneer in spreading messages of peace, understanding, and co-existence far beyond his country's borders.

I would also like to deliver my warm appreciations to H.E. Mr. Ahmed bin Abdullah bin Mohammed Al Shuhi, Honorable Minister of Regional Municipalities and Water Resources, H.E. Mr. Ali bin Mohammed Al Abri, Under-Secretary and your wonderful team for hosting this event and taking effective measures and endeavors during the last few months. Unfortunately, I could not attend this event in person. However, I am looking for the next opportunity to meet you soon.

Ladies & Gentlemen,
I think many of you are familiar with RCUWM activities as a regional hub for water-related cooperation. Its third period of activities has started for the period of 2019 to 2024 based on an agreement that has been recently renewed, signed and exchanged with UNESCO. Three main pillars of RCUWM activities are as follow:

1. Providing support to joint research and technology transfer projects;
2. Conducting training courses and capacity building events at various levels;
3. Partnership and networking at the regional and international levels.

RCUWM is guided and overseen by its Governing Board (GB) as the most important decision-making constituent at the highest level. I am pleased to inform you of the successful organization of the 10th Governing Board meeting on 5 December 2019 in Tehran with the participation of 16 member states and 9 organizations at the highest level.

Distinguished Participants,
Organizing this workshop was one of the projects that have been discussed in the domain of training courses during the Governing Board based on the nice proposal by the delegation of Oman. I am pleased to see the implementation of this project today.

As we all know, the availability of data is vital for sustainable water governance, especially in this region, with many ungagged or poorly gauged basins. Remote sensing is being used successfully as an alternative that provides spatially and temporally consistent data required for water resources management. Hence, the participation of the decision-makers and experts from different countries in the region and the structure applied to organize this workshop would be a step to utilize advances in RS and GIS to solve water management problems and issues.

Dear Guests,
Once again, I would like to sincerely thank Sultanate of Oman and the Ministry of Regional Municipalities and Water Resources in the Sultanate, hosting this valuable event, UNESCO for the support as it always has, and RCUWM staff for their efforts to organize this workshop.

We are now in the stage of planning to hold the 11th RCUWM Governing Board (GB) Meeting in Dushanbe, Tajikistan on 17 June 2020 and I would also like to take this occasion to invite H.E. the Minister and his delegation to attend this important event.

Last but not least, I would also like to sincerely thank the participants for attending this event from different parts of the world, including Azerbaijan, Bangladesh, Germany, India, Iran, Iraq, Italy, Japan, Kuwait, Oman, Pakistan, Qatar, and Turkey.

--End of Message—

Annex 2: Workshop Agenda

Monday 17th February 2020

Time	Opening Session
08:30 – 09:00	Registration
09:00 – 09:05	Opening and Reciting the Holy Quran
09:05 – 09:20	Opening Speech, Oman official, Dr. Rashid Al Abri (MRMWR)
09:20 – 09:35	Secretariat Report and Message from RCUWM Governing Board Chair, RCUWM Director
9:35 – 9:50	Water Resources in the Sultanate of Oman (Video) (OWS)
09:50 – 10:10	Group Photo
10:10 – 10:30	Keynote Speech: The Role of RS in the E&P of Oil and Gas in the Sultanate of Oman *Eng. Khadija Al Aisari (PDO)*
10:30 – 11:00	Keynote Lecture: Prof. Toshio Koike, (ICHARM, Japan)
11:00 – 11:30	Break
Chair: Dr. Ayisha Al Khatri (MRMWR) Co-chair: Eng. Alireza Salamat (RCUWM)	
11:30 – 12:10	Ice-breaking: Self Introduction of Invited Participants and Resource Persons
12:10 – 12:30	The Potential of Geospatial Tech. for Applications in Water and Agriculture *Mr. Mohamed Abdallah (FAO)*
12:30 - 13:10	Mapping & Change Detection Analysis of Wetland Areas in Ras-Al Hadd, *Dr. Yaseen Al Mulla (SQU)*
13:10 - 13:50	Detection of Surface Water Suppliers in Arid Regions using Remote Sensing *Dr. Mohamed E. Hereher (SQU)*
13:50 - 15:00	Lunch

Tuesday 18th February 2020

Time	Second Day Programme
Chair: Dr. Ali Chavoshian (RCUWM) Co-Chair: Eng. Khadija Al Aisari (PDO)	
09:00 – 10:30	Possibilities of RS and Copernicus in the Area of Inland Waters and WRM *Eng. Tobias Brehm (Federal Institute of Hydrology-BfG, Germany)*
10:30 – 11:00	Break
Chair: Dr. Talal Al Awadhi (SQU) Co-chair: Mr. Mohamed Abdallah (FAO)	
11:00 – 11:40	Terrain Classification using RS Application to Support Oil & Gas activities *Eng. Fatma Al Lawati (PDO)*
11:40 - 12:30	RS and GIS Data and Tools: A Semi hands-on Training *Dr. Ali Chavoshian and Eng. Alireza Salamat (RCUWM)*
12:30 – 13:10	Terrain Classification for Seismic Acquisition Surveys using Remote Sensing Methods *Dr. Talal Al Awadhi (SQU)*
13:10 – 13:25	General Discussion (Questions and Answers)
13:25 – 13:45	Short Break
Pannel: Dr. Yaseen Al Mula (SQU), Dr. Ali Chavoshian (RCUWM) and Eng. Tobias Brehm (BfG)	
13:45 – 14:00	Closing and Concluding Remarks, and Group Photo
14:00 - 15:00	Lunch

BfG: The German Federal Institute of Hydrology
FAO: Food and Agriculture Organization of the United Nations
ICHARM: International Centre for Water Hazards and Risk Management, Japan
MRMWR: Ministry of Regional Municipalities and Water Resources, Sultanate of Oman
OWS: Oman Water Society
PDO: Petroleum Development of Oman
RCUWM: Regional Centre on Urban Water Management, Iran
SQU: Soltan Qaboos University
*Day three has been for a technical tour in "1 Million Date Palm Project" located in Muscat.

Annex 3: List of Participants

No.	Name	Country	Organization	Contact
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Annex4: Photos


ROYAL TULIP
Advances in Remote Sensing Application in Water Resources Management


CERTIFICATE