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It is a great pleasure to preface the first annual report of the Center for Applied Research on the Environment and Sustainability (CARES) at The American University in Cairo (AUC). This report celebrates the establishment of CARES and commemorates 40 years of AUC championship of what has now evolved to be “sustainable development,” coinciding with AUC’s centennial year in 2019.

Indeed, the establishment of CARES in academic year 2018 - 2019 reaffirms AUC’s long commitment to environmentally responsible economic growth, which was ignited with the foundation of the Desert Development Center (DDC) in 1979. The Center for Sustainable Development (CSD) and the Research Institute for a Sustainable Environment (RISE), formally DDC, merged in July 2018 to establish CARES. As the founding director of CARES and CSD, as well as the graduate program in sustainable development, it is a great honor to carry the torch of sustainable development at AUC, guided by the visionary Professor Adli Bishay, the founder of DDC.

As this report will show, 2019 has been a year of consolidation. We have built a well-constituted team that fits a set of effective and tested endeavors, all geared toward the fulfillment of CARES’s mission and objectives. We are particularly proud that Eduniversal ranked our Master of Science in sustainable development concentration in green technologies as the top program in Africa. In our conviction that collaboration and interdisciplinarity are the core of sustainable development, CARES participates in activities with other schools and units at AUC, as well as projects with Egyptian and non-Egyptian universities and institutions. Our partnership in two Erasmus+ projects, our contribution to AUC’s Center of Excellence for Water and our participation in AUC’s annual event celebrating international Earth Day and Cairo Water Week are exemplary of our networking success within AUC, Egypt and the world. In addition, new activities and projects such as the Water Academy project were initiated in 2019. Plans for the expansion of the CARES facilities for research purposes have consumed much of our technical team’s time and effort. Looking ahead to the next 40 years, we strive to continue our efforts to build on the advancement of scientific knowledge and contribute to the development of new technologies for the good of Egypt, the Middle East and beyond.

CARES’s achievements could not have been possible without the work and dedication of our exceptional team, the fine support of AUC’s administration, the collaboration of our national and international partners and the support of our donors.

Whether you are an alumnus, a current student, an academic institution, a donor, a nonacademic organization or an individual with an interest in the field of sustainable development, I hope you enjoy reading this report, and I look forward to pursuing CARES’s journey of excellence with you.

Hani Sewilam  
Professor and Founding Director  
Center for Applied Research on the Environment and Sustainability (CARES)  
March 2020
Mission
CARES guides sustainable development efforts in Egypt, the region and beyond by providing holistic academic programs, applied interdisciplinary research and community services for improving lives and livelihoods, while safeguarding natural resources for future generations.

Vision
CARES envisions a region of modern, sustainable and prosperous communities.

Goals
Education
Graduate Program in Sustainable Development
Under the umbrella of the Institute of Global Health and Human Ecology (IGHHE), CARES continues to coordinate the graduate program (two master’s degrees and one graduate diploma) in sustainable development (SSDV). The program aims to create a whole new generation of business and social entrepreneurs by educating innovative and visionary leaders with a holistic understanding of the developmental challenges in today’s world. SSDV offers a comprehensive and in-depth study of sustainability. It encourages students to engage in research that contributes to solving challenging and critical problems facing Egypt. The program adopts an innovative teaching approach and provides opportunities for participation in ongoing research projects at CARES research facilities and community projects.

Professional Certification Training Programs
CARES Professional Certification Training Program provides water professionals with the necessary knowledge and skills to achieve certification and understand the responsibility of being a professional in one or more of the offered programs.

Research
CARES research focus tackles water, energy and food as the most urgent problems in Egypt and the region through innovative, sustainable and interdisciplinary solutions. The concept of water-energy-food (WEF) nexus is a sustainable approach to ensure water, energy and food security and is at the core of CARES’s research activities. This research mainly includes the interconnections between water, energy and food; how and where these three systems intersect and the interdependencies among them.

Community Projects
CARES community projects aim to support Egypt in realizing the sustainable development strategy Egypt Vision 2030. To this end, community projects focus on the most vulnerable groups in poor and extremely poor villages through graduating a new generation of sustainability ambassadors. These ambassadors are equipped with the know-how to support a community by moving toward sustainable agriculture and to develop rural communities by increasing the income of farmers and transforming villages into more attractive destinations.
The seed of the Desert Development Center (DDC) was planted in 1979 with the approval of AUC trustees of an applied research and training project in the field of desert development, with one AUC faculty member, Professor Adli Bishay, and 525 feddans of virgin desert allocated to AUC by the Egyptian government. The land was allocated in two sites half-way between Cairo and Alexandria in the province of South Tahrir and adjoining Sadat City. In 1985, AUC trustees approved the change of the status of the project to an independent unit within AUC. The center focused on the ecological, social and economic sustainability of communities in Egypt’s arid lands. Through agricultural and socioeconomic research, training programs and community service, DDC worked for more than 30 years to improve the overall wellbeing of Egyptians living in desert areas. In November 2013, DDC was renamed as the Research Institute for a Sustainable Environment (RISE), keeping the main components of DDC’s mission yet expanding its scope.

On the other hand, the Center for Sustainable Development (CSD) was founded in 2012 to help Egypt face the challenges of sustainability by linking and integrating different parties as part of an ambitious and comprehensive movement for sustainable development. By 2018, both centers, coexisting at AUC, had an established record of success and a legacy of work in sustainable development; therefore, it was decided to merge the two units into CARES to capitalize on the accumulated expertise, research and facilities under the leadership of Professor Hani Sewilam. CARES is housed in the IGHHE, School of Sciences and Engineering (SSE).

CARES research and education facilities at AUC New Cairo include a desalination laboratory, solar energy-operated greenhouses, an aquaponics research laboratory, a soil and water laboratory, a permaculture garden, rooftop gardens and an organic community garden. At these facilities, the CARES team works with researchers, volunteers, trainees and students in educational, research and community projects.

In support of CARES’s mission, we consolidated our strategic plan, focusing on three pillars: education, research and community services.
CARES is committed to promoting the integration of sustainable development principles into the teaching practices of educators. The coordination of SSDV is one of the most important activities under the education pillar. SSDV equips graduates with the knowledge and skills required to actively contribute to upgrading slums, reduce the use of fossil fuels, meet renewable energy targets, conserve local resources, solve water problems, manage waste, reduce pressure on the local environment and support the creation of sustainable communities. Housed in SSE, SSDV is the first AUC program based on innovative collaboration among all other AUC schools: Business, Global Affairs and Public Policy and Humanities and Social Sciences. It is worth noting that the establishment of SSDV was one of the outcomes of the Green Innovation and Entrepreneurship Program (GIEP), a three-year project funded by Tempus. The program is enhanced by the advanced facilities and state-of-the-art equipment available at the University. Students can opt to pursue a Master of Science degree, a graduate diploma or double master’s degrees from AUC and Politecnico di Milano in Italy. Concentrations in engineering, business studies, public policy or social sciences may be pursued, depending on the student’s interests and background.
Water, energy and food challenges are three overlapping issues that have a multiplier effect, and a more integrated approach to solving them is crucial for any country’s sustainable development. Up until now, these issues have been dealt with separately. Integrating the study of these different, yet inseparable, issues into one coherent and interdisciplinary endeavor is key to producing lasting solutions toward building a sustainable nation.

CARES focuses on research activities related to water, energy and food while considering their interconnectedness to develop sustainable urban agriculture solutions. A multitude of untapped, nonconventional solutions is needed to bridge the gap between water scarcity and energy consumption for food production. The main challenges CARES’s research team is addressing are water scarcity, food security and high energy consumption.

**Water desalination:**
addressing water scarcity

**Advanced agriculture techniques**
(e.g., aquaponics, hydroponics and recirculating aquaculture systems)
— addressing food security

**Renewable Energy:**
addressing high energy consumption

That being said, CARES has three main research streams
CARES concentrates on involving AUC in large national projects that can have a wide impact on Egypt's communities and enable researchers and students to implement their research results, generating direct links to the real world. In our quest to serve the community and help Egypt overcome many of its challenges, CARES is involved in ambitious, large-scale national projects that focus on educational and capacity-development activities and initiatives. Sustainable development requires an active, aware and socially conscious population, equipped with the tools to pursue positive change without long-term negative repercussions. To this end, CARES has three initiatives.

First, there is Education for Sustainable Development Beyond the Campus (EduCamp), which aims to promote Education for Sustainable Development (ESD) as a tool to face the challenges experienced in informal areas. To date, three phases of this long-term project have been completed. In 2010, the EduCamp I project commenced — funded by the EU Tempus program — in public schools across seven different governorates. In 2014, Educamp II — funded by the European Union and the German government in cooperation with the Participatory Development program — was executed by developing a summer educational and recreational program for children, youth and women in El Warraq, an informal area in Giza. Finally, in 2017, EduCamp III — funded by GIZ — developed a role model for the Egyptian schools, in line with the Egypt Vision 2030, in two schools in Bulaq El Dakrour.

Second, CARES embarked on establishing a Water Academy to serve as a learning hub and research center for water efficiency best management practices.

Third, AUC — and CARES — is an Egyptian partner in two Erasmus+ educational community projects involving Egyptian and European academic and nonacademic entities. Indeed, the first project is Steering Migration through Sustainable Development: Euro-Egyptian Program for Agriculture and Rural Development (DeVilag). The second project underway is the Sustainable Resource Management Program to Solve Deserted Challenges (SuReMap). Both projects aim to contribute to the provision of qualified graduates who are equipped to support Egypt's biggest challenges in sustainable agriculture and are fully aware of the interconnectedness of the WEF nexus.
# 40 years of Sustainable Development: Memorable Moments

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>1979</td>
<td>The Dreamers: Trustee John Goelet and Professor Adli Bishay</td>
</tr>
<tr>
<td>1987</td>
<td>South Tahrir’s “White House”</td>
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<tr>
<td>1988</td>
<td>Visit of President of Egypt Hosni Mubarak to DDC</td>
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<tr>
<td>2013</td>
<td>Renaming DDC RISE</td>
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<tr>
<td>2014</td>
<td>Summer Educational and Recreational Programme for Youth and Women (EduCamp II)</td>
</tr>
<tr>
<td>2016</td>
<td>Desalination Lab visit of former prime minister of Egypt, Ibrahim Mehlib</td>
</tr>
</tbody>
</table>
1987
Visit of AUC top administration to DDC

2010
Education for Sustainable Development Beyond the Campus (EduCamp I)

2012
Establishment of CSD and Graduate Program in Sustainable Development

2017
The Schools of 2030: Education for Sustainable Development in Boualq (EduCamp III)

2018
Establishment of CARES by merging CSD and RISE

2019
COE Water
“The multidisciplinary courses offered in the SSDV program have widened my understanding of what real, sustainable development entails. As a social researcher and a future graduate of the SSDV program, I hope to advocate for the pillars of sustainability for any future policies, plans or projects I will be part of.”

Noha Elkhorazaty, SSDV Candidate
Integrated Agri-Aquaculture Systems (IAAS) Project

The concept of integrating aquaculture with agriculture (IAA) is paramount toward holistic, sustainable agriculture in semi-arid and arid areas. Also referred to as “more crop per drop,” the system uses on-farm synergy effects of both crop and fish production. CARES investigated the effect of using fish effluent as irrigation water on the growth, biomass productivity and essential oil composition of both Origanum majorana and Origanum syriacum L. in sandy soils. The purpose of this experiment is to improve efficiency, increase productivity and ultimately raise income. Oregano and sweet marjoram are economically important crops with their quality and commercial values mainly attributed by the content and composition of their essential oils.

IAAS Experiment results

Input: Fish pond capacity 6 cubic meters
Output:

- Oregano yield per harvest: 7.5 ton/feddan
- Marjoram yield per harvest: 10.8 ton/feddan
- Average fish weight: 450 gm
- Average fish weight: 450 kg
Investigating a Semi-Commercial Pilot Model for Sustainable Urban Agriculture

Developing urban agriculture solutions on the household or family level, rather than on a large scale, could be pivotal in the near future. This can be done through the aquaponics and aquaculture applications that are spreading nowadays, adopting the notion of “Grow Your Own Food.” Aquaponics and aquaculture are technologies that utilize an unconventional approach to fish and crop production. In March 2019, Professor Sewilam was awarded a three-year faculty research grant from AUC to carry out the above project. This model aims to maximize the productivity of a unit cubic meter of water in terms of valuable products such as crops and fish. The proposed solution desalinates brackish water using reverse osmosis (RO) membrane technology, which has recently evolved to be less energy-intensive. The fresh water produced will be directed to an aquaponics/aquaculture farm producing fish and crops.

Investigating the Effect of Plant Growth Regulators and Microbiota on Vegetable Growth

In October 2019, the CARES research team, in collaboration with Associate Professor Walid Fouad at AUC’s Department of Biology, embarked on this new project that aims to investigate the potential impact of using plant growth regulators to boost vegetable growth and productivity. The plants under experimentation include tomatoes and cucumbers. It is an ongoing project that is expected to be completed in August 2020.
Exploratory Field Trips
Sand Sampling and Classification

In October 2019, our research team, led by Fahad Kimera (MSc ‘18), went on a trip into different Egyptian cities, such as Minya, Bani Suef, Fayyoum and 6th of October, with the objective of sourcing the best sand that can be used for sandponics: a new urban agricultural farming technique. They took soil samples and carried out both field and lab sample analyses.

Visit to WorldFish

Our research and technical teams visited an international research organization called WorldFish, which has a national branch in Sharqiya. Their goal was to enrich their knowledge and potential in aquaculture research, as well as negotiate future research collaborations between the two institutions.

Networking Visits to CARES Research Facilities

CARES’s technical team welcomed a visit from the Technical University of Munich (TUM). In April 2019, TUM’s Johannes Sauer and Emmanuel Benjamin from the Department of Agricultural Production and Resource Economics visited the CARES facilities.

Also, on August 4, 2019, Professor Sewilam welcomed a visit from Friedrich-Ebert-Stiftung’s Richard Probst, resident representative, and Waleed Mansour, climate and energy program manager, to explore networking and cooperation avenues between the two institutions.
The Erasmus+ project DeVilag aims to support Egyptian rural communities by providing qualified graduates and University expertise to improve agricultural productivity, enable more sustainable food production, develop poor villages and enhance farmers’ income and their living conditions to prevent migration to cities or beyond.

The first phase of this project, Work Package 1 (WP1), is devoted to achieving the first project objective: to identify the push factors for migration from rural communities and the needed skills in the Egyptian organizations and market to contribute directly or indirectly to rural development, especially in the agriculture and food production sectors. With AUC as leader of WP1, in 2019, the CARES DeVilag team succeeded in completing the first milestone of this project by conducting data analysis, needs assessment and providing final recommendations to the Egyptian partners for the DeVilag curricula and service offices. The AUC team presented findings and recommendations of the needs assessment in several venues: in July 2019, during a DeVilag curricula development meeting at Heliopolis University; in September 2019, at DeVilag’s first management meeting in Cyprus and at two dissemination events on July 11 and November 26, 2019.
Data Analysis

6 target groups
contractual farmers, noncontractual farmers, faculty, students, agricultural companies, government establishments

Data Collection Tools
4 survey questionnaires
2 focus group guidelines

Data Collection

Supply side (3 universities)
205 students
59 faculty members

Demand side (Employees)
52 agricultural companies
30 government establishments

Beneficiary (farmers)
5 governorates
20 focus groups
145 farmers
Water Academy

In 2019, CARES initiated the Water Academy project in cooperation with HSBC. The Water Academy serves as a learning hub and research center for water efficiency best management practices. It includes educational sessions, activities, information and research that help make water conservation part of people’s everyday lives. The main aim of this project is to raise public awareness regarding efficient and sustainable water consumption to help alleviate the water scarcity problem and achieve the sustainable development goal of clean water and sanitation by 2030.

Water Academy Objectives

<table>
<thead>
<tr>
<th>Volunteers capacity-building program</th>
<th>Professionals capacity-building program</th>
<th>Establishment of an education and research hub</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train 720 volunteers as ambassadors for sustainability</td>
<td>Qualify 25 professionals in modern irrigation techniques</td>
<td>Model Farm in water efficiency best management</td>
</tr>
</tbody>
</table>

Results

16 one-day training sessions on urban agriculture for 523 HSBC volunteers

19 days of training for 30 professionals working in the field
Integrating Community Development and Student Learning through Rooftop Farming Research and Outreach Project

In April 2019, the Integrating Community Development and Student Learning through Rooftop Farming Research and Outreach project commenced. This one-year, U.S. Forest Service-funded project aims to promote rooftop gardening and urban farming in Egypt. AUC master’s students enrolled in the Contemporary Issues in Environment, Sustainable Development and Health course in Spring and Fall 2019 engaged in research activities on campus and in the design, construction and evaluation of the off-campus gardens. The students worked in close cooperation with local community partners and garden users, and they followed the design thinking methodology and participatory approaches. They were actively involved in designing, planning and constructing the gardens. Moreover, the students performed sustainability assessments and user feedback reports at the community site and, thus, gathered practical experience in planning, carrying out and evaluating community-based sustainability initiatives.

Results

- 2 scientific shading trails
- Developing 3 rooftop gardens in informal areas in Cairo: Hattaba, Al Khalifa and Saft El Laban
- Conducting 3-week training for women in Al Khalifa area on urban agriculture
- Conducting 1-day training on how to make planters from unwanted materials in Hattaba.
Nonformal Education and Knowledge Dissemination

In addition to the formal education represented in the graduate diploma and master’s degrees in sustainable development, CARES contributed to several other informal and nonformal educational activities. Selected activities are listed below.

Water Conferences

CARES team members participated in the Third International Water Desalination Conference “Future of Water Desalination in Egypt and the Middle East” held in Cairo from February 26 to February 28, 2019. Professor Sewilam gave the keynote speech of the conference on “The Future of Desalination for Food Production.” In addition, CARES Research Consultant Peter Nasr ’99, ’02, ’16 gave a presentation on the use of forward osmosis as an alternative sustainable technology and potential applications in the water industry.

Water Desalination Conference

Cairo Water Week

Cairo Water Week (CWW) 2019 was held from October 20 to October 24, 2019. CARES faculty, staff and alumni contributed to several sessions throughout the event. On October 21, Professor Sewilam moderated the plenary session “Cooperation in Water Sector.” With 263 transboundary lake and river basins worldwide, according to UN-Water, this session was structured to present and discuss possible triggers for conflict over water-sharing and what implications that might have on the livelihoods of ordinary communities. Professor Sewilam was also a scientific committee member of CWW 2019 and chaired the session “Status Quo of the Egyptian Water Higher Education, Research and Training: The Center of Excellence for Water.” In addition, both Fahad Kimera (MSc ’18), CARES technical team, and Aya Youssef (MSc ’19), SSDV alumna, presented in the poster session under the theme Research and Innovation in Facing Water Scarcity. Kimera’s research covered organic production of high-value medicinal herbs using an integrated aquaculture-agriculture system, while Youssef’s poster presentation covered urban sprawl and its impact on farming practices.
Sixth International Forum- LafargeHolcim Foundation

On April 5, 2019, CARES team members and SSDV graduate fellows led more than 40 delegates of LafargeHolcim’s Sixth International Forum “Re-materializing Construction” in the water challenges green mobile workshop. The workshop’s objective was to provide an overview of the available water resources in Egypt and the related challenges facing the country. SSDV graduate fellows Aya Yehia, Dinaa Bahaa, Menna Mansour and Omar Safaa participated with Randa Kaldas and Professor Sewilam in the planning and execution of a full day of informative and educational sessions in El Qanater El Khayreya, visiting the barrages at the apex of the Nile Delta; the irrigation museum and the Hydraulic Research Institute.

Regional Workshop on Science Diplomacy

Professor Sewilam participated in the Regional Workshop on Science Diplomacy from June 12 to June 16, 2019, which was held at the Bibliotheca Alexandrina, Alexandria. His presentation focused on the Fourth Industrial Revolution and technology transfer.

Earth Week: Staying Sustainable at AUC

Every April, AUC celebrates Earth Day with a week of sustainability-centered programming. Last year’s theme was Earth Week: A Sustainable Second Century, which focused on the past, present and future of sustainability and environmental outreach at AUC. From April 14 to April 18, 2019, CARES and the Office of Sustainability set up food, energy and water greenhouses around Bartlett Plaza, where students, faculty and staff learned about hydroponics, aquaponics and solar panels. Each day had a different theme: Dive into the Past, The Future is NOW – Why Waste It?, Operation Internal Outreach, Promoting a Sustainable Life and Beyond AUC.
In March 2019, the Center of Excellence for Water — Alexandria Water Resilience (COE) project commenced. COE is a $30 million USAID-funded project that aims to create a center of excellence for water at Alexandria University, Egypt. The project is managed by AUC and has multiple partnerships and stakeholders. COE has three academic pillars: instructional innovation and curriculum development, high-quality applied research, and exchanges, training and scholarships. Professor Sewilam is also a lead scientist at COE and is responsible for two pillars: education and research. Given the interconnectedness between the goal and pillars of COE and the strategic plan of CARES, collaboration and synergy define the relationship between the two units. COE serves the needs of the Egyptian people and economy, including industry, and supports the government to face water challenges, develop policy and prepare a new generation of graduates and entrepreneurs to be change agents who stimulate economic growth.

COE achieved several milestones in 2019. On September 12, 2019, COE was inaugurated in Alexandria University and the first executive committee meeting was held. Also, a report on water strategies and a national water research roadmap were finalized.
The plans for the expansion of the CARES facilities are multidimensional. First, there is a plan to construct a new water desalination facility to supply all agricultural/aquacultural activities with the required amounts of water. Second, a water desalination research lab with the purpose of serving future water-related research is also in the pipeline. The planned desalination research facility is expected to contain different water desalination technologies that can be used for a wide range of research requirements. This includes technologies such as micro-filtration, ultra-filtration, nano-filtration, brackish water reverse osmosis, seawater reverse osmosis and forward osmosis.

Third, CARES is planning to construct an aquaculture research facility to serve WEF nexus research. The aquaculture research facility will be a fully automated recirculating aquaculture systems (RAS) unit. RAS is a growing technology that targets culturing fish while minimizing the use of water and energy. The aim of the aquaculture research facility is to develop techniques that further improve the efficiency, profitability and quality of intensive fish production. The facility will also support aquaculture-related research on different species through the planned small-scale, intensive-type RAS unit.

SuReMap

One of the highlights of 2019 is the award of RWTH Aachen University of its Erasmus+ grant application for the project SuReMap where CARES is one of the Egyptian partners. This is a three-year project, due to start in February 2020, which aims to establish an engineering MSc that trains suitably qualified engineers to implement the plan for reclaiming 1.5 million feddans of desert, as well as similar water-, energy- and food-related challenges in the Egypt Vision 2030 strategy.
In recent years, the productivity of CARES faculty, researchers and staff has remained high, and the support from national and international educational and noneducational institutions has been quite varied. Our work benefits from partnerships and/or funding from the following:

Special Collaborative Partnerships

- RWTH Aachen University
- SEKEM Development Foundation
- POLITECNICO MILANO 1863
- Erasmus+
- HSBC
- DAAD
- TU Graz
- IDW Group
- Bibliotheca Alexandrina
- University of Nicosia
- AUB
- ASWAN University
- Tempus
- ALEXANDRIA UNIVERSITY
- U.S. Forest Service
- IFAT Paris
- giz (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH)
- WESC
- Heliopolis University
- University of Nicosia
- Temple University
- UNESCO
- Utah State University
- Washington State University
- Montpellier SupAgro
- Participatory Development Programme in Urban Areas
- Swedish University of Agricultural Sciences
- IDRC CRDI
- Canada
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