



ADDRESSING ENVIRONMENTAL CHALLENGES OF ARID LANDS

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Cover Photo: Sonoran Desert with Dying Bursage (cropped), Mitch McClaran

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INTRODUCTION

The International Arid Lands Consortium (IALC) was formed in 1989 as an independent, non-profit consortium of institutions with a mission of supporting ecological sustainability of the world's drylands. The following year, IALC was authorized by U.S. Congress, facilitating over \$20M in funding over the next 30 years from U.S. Department of Agriculture (USDA), U.S. Forest Service (USFS) and U.S. AID that was used to support sustainable development and capacity building in arid and semiarid lands. The IALC funded

91 research projects, 36 demonstration projects, and 11 special initiatives such as conferences, workshops, and technical training in 8 countries. In addition, the IALC Peace Fellowship Program supported students from U.S. member institutions to conduct research in Israel or Jordan, and students from Israel and Jordan to conduct research at U.S. member institutions. More information about the history and accomplishments of the IALC is available at www.IALC.world. The IALC is proud of positively affecting the lives of people and contributing to the scientific community through refereed journal articles, books, master's theses, doctoral dissertations, and presentations at conferences, symposia, and workshops.

To commemorate 30 years of collaboration on arid lands issues, the IALC hosted the three-day international conference "Addressing the Environmental Challenges of Arid Lands" on 24-26 May 2021. A key goal was to underscore the IALC mission: promoting peace through

collaborative research and demonstration projects in the arid lands of the world. Keynote presentations and panel discussions emphasized collaborative-multinational research and problem-solving to address issues that globally confront the sustainable use and management of arid lands. The conference was co-chaired by Dr. Sharon B. Megdal, IALC President and Director of the Water Resources Research Center (WRRC) at The University of Arizona (UARizona), and Dr. Charles Hutchinson, professor emeritus, UArizona. The Honorary Chair was Joe Hess, retired U.S. Government Technical Manager, and the long time Jewish National Fund (JNF) representative to the IALC. The conference committee was comprised of experts from the U.S., Israel, and Jordan.

The conference themes were Water and Agriculture, Land and the Natural Environment, and Forest and Fire Management. Each session consisted of an overview of IALC history and successes pertaining to the day's theme,

Conference Info

More information about the conference, including links to full videos of all sessions, is available [here](#).

followed by a keynote presentation and a moderated panel discussion. Networking sessions at the conclusion of each day provided opportunity for informal discussions and were well attended. In addition, Day 2 featured six lightning talks presented by current graduate students on their activities related to conference themes. The concluding session on Day 3 featured the IALC declaration on addressing the environmental challenges of arid lands, followed by a resolution to honor and thank Joe Hess for his tireless efforts over 30 years to support and promote the IALC. Highlights from the three days' keynote presentations and panel discussions are described below.

CONFERENCE SYNOPSIS

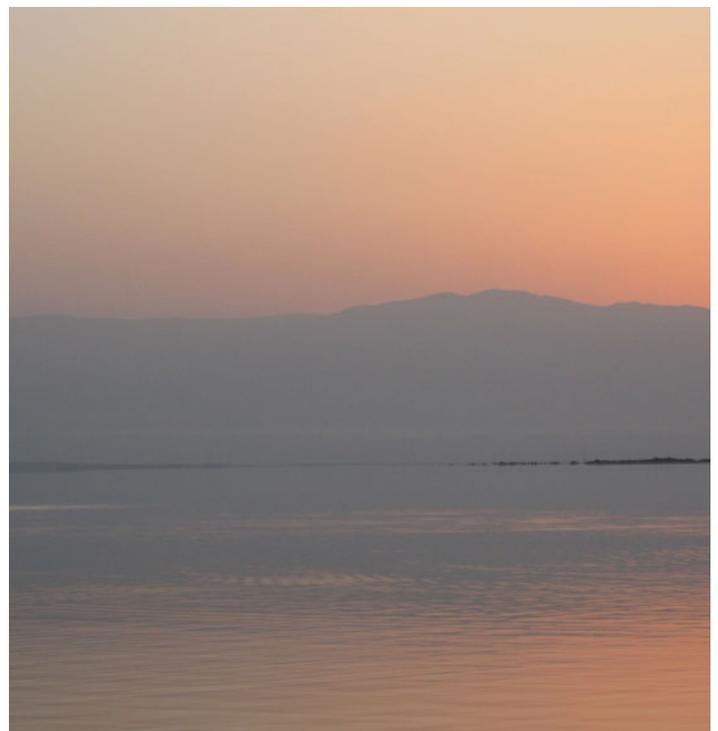
DAY 1: Water and Agriculture

Honorary Chair Joe Hess began the conference by highlighting the history and accomplishments of the IALC. The keynote was provided by **Alon Tal**, who was then at Tel Aviv University and Deputy Chair, KKL-JNF, Israel. Dr. Tal reviewed climate change, population growth, and water supply challenges facing Israel and the Middle East and how technology is being used to overcome these challenges. He stressed that using technology in food production and water supply is the drylands last best hope. Israel has transformed its water management strategy, relying on the desalination of seawater for freshwater supply. He argued we must become more

sophisticated with technology, encourage people to get involved and realize population control is part of a long-term strategy in what is ultimately a closed ecological system. Despite the challenges of climate change and water scarcity in drylands, Dr. Tal was very optimistic for the future: "When you look at what a country that is by all objective standards facing some of the hardest scarcity in the world, and the kinds of innovations that have been possible, it does make you optimistic....The technology is there. Thus, yes, I am optimistic about the water area. Furthermore, hopefully we will be able to....share these kinds of innovations to countries that are developing and facing water challenges in the future."

The panelists on Day 1 were **Abeer Albalawneh**, National Agricultural Research Center (NARC), Jordan, **Maysoon Al-Zoubi**, International Consultant on Water and Water Diplomacy, Jordan; **Uri Shani**, N-Drip, Israel; and **Anne Castle**, University of Colorado Law School, USA. The discussion was moderated by Sharon B. Megdal, assisted by Manoj Shukla, New Mexico State University.

Dr. Albalawneh and Ms. Al-Zoubi noted that Jordan is one of the water-poorest countries in the world and the rapid influx of refugees has led to a more significant imbalance between water supply and demand. Jordan is doing several things to promote sustainable water management and climate-resilient agriculture, including reusing almost 90% of treated wastewater in the agriculture sector and raising farmer awareness about climate change by providing training on how to be more adapted and resilient. Dr. Shani remarked on the economics of water use in agriculture, first noting that farmers are not motivated to reduce water use because of low fixed water tariffs, but also that these tariffs should not be increased because this would



Dead Sea (Source: Sharon B. Megdal)

Highlight Videos from the 2021 IALC Conference

Addressing the Environmental Challenges of Arid Lands

Water and Agriculture



Land and Natural Environment



Forest and Fire Management



[Watch the videos](#)

disrupt basic food supplies. Second, desalination is not a viable source for agriculture because of far greater water needs and associated higher energy costs. The solution for agriculture is to use water more efficiently and switch from flood to drip irrigation, reducing use by 50% or more. Dr. Shani also noted that wherever there is an active water agreement in the world, there is no war. So, solving water shortages by creating agreements is the solution. Ms. Castle provided an overview of the Colorado River basin (Figure 1), and the growing conflicts on water allocations, given declining precipitation and rising temperatures caused by climate change. There is a need for new discussion among stakeholders in U.S. and Mexico, including input from Native American tribes. “All those voices need to be at the table, but it makes agreeing even more difficult...we face the same challenges that all the other speakers have been describing--living within our hydrological means and we must figure out how to do that without sacrificing any one geographic area or economic sector or the environment. It can be done so long as the parties are realistic about what the future holds and do not allow political posturing to take over.”

Other issues discussed by the panel included the proposed Red Sea-Dead Sea water transfer project in the Middle East, viability of desalination in Jordan, and the need for greater inclusion of Indigenous voices in water management decisions. A common theme in the discussions was the need to promote engagement

and communication among all stakeholders to achieve successful outcomes. In the words of Dr. Shani “...we need to deal with diversity everywhere and to embrace it. If we can embrace diversity, we can solve water problems.”

Day 2: Land and the Natural Environment

To begin the session, Charles Hutchinson provided an overview of an IALC project in the Badia, Jordan, which successfully recovered land productivity by reinstating a traditional *Hima* coupled human-natural management system. The work showed that demonstration projects and a multidisciplinary team are essential to effect community change successfully.

Ibrahim Thiaw, Executive Secretary of the United Nations Convention to Combat Desertification (UNCCD), Germany, delivered the keynote address. Mr. Thiaw noted that the world’s drylands are experiencing greater conflicts due to growing populations and shrinking resources caused by desertification and climate change. He mentioned his own firsthand witness to the links between desertification, drought, and civil unrest in the Sahel, where pastoralists and farmers compete over access to ever more limited resources. Increasing adverse effects on human health have resulted from unsustainable land management, particularly when coupled with recent droughts. He emphasized using integrated solutions in restoration efforts, but these will only be successful if policymakers embrace science to enhance the lives and well-being of communities as well as households. He concluded by quoting Marie Curie: “nothing in life is to be feared--it is only to be understood” and challenged the audience to carry the torch in exploring problems and solutions that improve the lives of people living in the world’s drylands and to help ensure the next decade is a decade of action.

The panelists on Day 2 were **Moshe Shachak**, Ben Gurion University of the Negev, Israel; **Maryam Niamir-Fuller**, Private Consultant, USA; **Munqeth Mehyar**, Koplens and former director of Ecopeace Middle East, Jordan; and **Barron Orr**, UNCCD, Germany. Benjamin Turner, Texas A&M University-Kingsville, moderated the discussion, assisted by Charles Hutchinson. In his opening remarks, Dr. Shachak mentioned the need to understand the effects of extreme water cycle dynamics on natural and human-made water-limited ecosystems. Dr. Niamir-Fuller noted that information gaps on rangelands and pastoralism limit policymakers in making informed decisions, the lack of consensus definitions for rangelands and pastoralists, and indicators to monitor pastoral mobility and sustainability of livestock systems. Mr. Mehyar remarked that climate change is one of the biggest threats to humanity and transcends national borders and emphasized utilizing regional approaches and working cooperatively for a common purpose to achieve sustainable development and best utilize



Figure 1: Colorado River Basin (Source: U.S. Geological Survey)

cross-border water resources. Dr. Orr noted we are at an inflection point and the beginning of the U.N. Decade for Ecosystem Restoration. The U.N. is now focused on achieving land degradation neutrality and prevention because it is easier than curing what has been already lost.

The panel discussed the threat of climate change. Dr. Shachak provided an example of changing ecosystem dynamics in the Negev Desert, Israel, where an area was converted from shrubland to grassland. The lesson learned was that management should focus on functional restoration because you cannot recover the system to its original state. This lesson also applies to climate change, and we should accept the concept of functional restoration to adapt to the new state. Dr. Niamir-Fuller reinforced this point, mentioning that nonequilibrium theories of ecosystem dynamics predict that variability and uncertainty, especially in drylands, are the norm, and not the exception. We should accept that a system will transition from one state to another depending on pressures/drivers.

All panelists stressed the need for connectivity, partnerships, and communication to solve land degradation problems. Dr. Orr mentioned that it is not enough for science to develop solutions. Instead, science must be transferred effectively to the ground, a “high-tech high-touch approach” via a knowledge broker or extension agent. Expanding this thought, Dr. Shachak

stated we must manage the connectivity between scientists, managers, policy makers, and nations, to solve future challenges such as land degradation caused by climate change. Dr. Niamir-Fuller remarked that partnerships work best when everyone has the same levels of understanding, empowerment, and resources at their disposal. Mr. Mehyar agreed that connectivity and communication, and partnering with the local communities, are keys to success, “because at the end of the day, they are the ones who will implement whatever managers and scientists are trying to achieve.”

The panelists all expressed optimism for developing solutions to issues facing rangelands. Dr. Shachak noted that a systems approach considering physical, ecosystem, and human dimensions is needed. Dr. Niamir-Fuller mentioned that policymakers are paying more attention to science and stressed the need for raising awareness globally and filling knowledge gaps, something that the declaration of an International Year of Rangelands and Pastoralists (IYRP) hopes to build momentum for. The goal of land degradation neutrality has been adopted by 127 countries, and Dr. Orr mentioned that the UNCCD has an important role in facilitating communication among governments and stakeholders. Mr. Mehyar remarked he is neither optimistic nor pessimistic but remains realistic about the Middle East. Many people in the region are struggling with basic needs, and addressing drylands challenges is a secondary consideration, so raising awareness is vital to change public opinion to influence policy.

Graduate student lightning talk speakers

Klil Noy , Ben Gurion University	Israel
Oluwatobi Omotayo , New Mexico State University	USA
Rafael Stern , Weizmann Institute	Israel
Ivan Tellez , New Mexico State University	USA
Austin Rutherford , University of Arizona	USA
Simone Williams , University of Arizona	USA

A highlight of the conference was a series of six **lightning talks**, presented at the close of Day 2 by current graduate students on their creative contributions related to the conference themes. Amber Dalke, UArizona, introduced the talks.

Day 3: Forests and Fire Management

Honorary Chair Joe Hess started the session by noting the long relationship between IALC and USFS. The USFS and Israel have maintained a cooperative relationship of information and technology exchange on wildfire management and forestation since 1987 that has improved Israel’s fire prevention program.

The day’s keynote was presented by **Alexander Friend**, Deputy Chief for Research and Development,

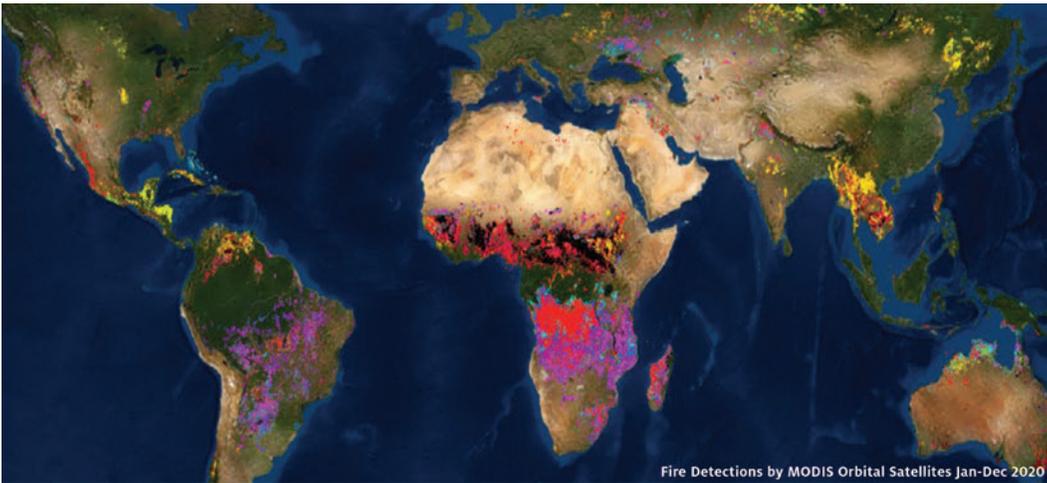


Figure 2 - Fire is a Fundamental Global Earth System Process (Image Courtesy of Don Falk)

USFS. Dr. Friend noted that we are at a point in our history where our collective human footprint drives the trajectory of global climate, threatening ecosystems on which life depends. Forests and grasslands are under pressure from expanding urban settlements, overgrazing, drought, rising temperatures, invasive species, and wildfire. He provided several examples of USFS innovations utilizing advances in science and technology that effectively respond to these threats and offer real solutions. He concluded by noting that the USFS believes international engagement makes their agency stronger and that collaborating and harnessing science and technology are essential to address local and global challenges.

The panelists for Day 3 were **Don Falk**, UArizona, **Dan Yakir**, Weizmann Institute of Science, Israel, **Alaa Wahbeh**, NARC, Jordan, and **Omri Bonne**, KKL-JNF, Israel. The moderator was Alan Gertler, Desert Research Institute, assisted by Barbara Hutchinson, UArizona. In his opening remarks, Dr. Falk noted fire is an essential earth system process (Figure 2) and the challenge is not how to get rid of fire but rather learning to understand and live with it. He noted that most fires are heterogeneous with mosaics of severity that improve wildlife habitat and help ecosystems adapt and reorganize to meet emerging climate challenges. Dr. Yakir opened by talking about the relationship between precipitation and evapotranspiration in forests, noting that sensitivity of water yield, defined as excess water not utilized by vegetation, to climate change is much larger than the sensitivity of precipitation itself. As precipitation decreases, a greater reduction in water yield can occur, and below a critical precipitation threshold, water yield becomes zero or negative, making a forest sensitive to mortality and desertification. Thus, managers have limited ability to influence water yield by switching land cover or reducing forest density. Dr. Wahbeh emphasized that sustainable forest management is a process, rather than an endpoint, and we need to balance environmental, social, and cultural objectives. She mentioned the importance of remote sensing as a tool for managing

forests and for pre- and post-fire monitoring. Dr. Bonne spoke about the increasing risk of catastrophic fires at the wildland-urban interface in Israel and that adapted fire management strategies and tactics are needed to combat this situation and empower communities to increase their resilience to fire.

The panel discussed how wildland fires in arid regions are different from more humid regions.

Drylands have lower productivity and finer fuels, leading to different fire behavior and less likelihood for spread, and restoring fire damage in harsher dryland conditions may require assisted management tactics. Fire suppression remains a primary management tactic in Israel because of slow regeneration rates and potential forest loss. In Jordan, most forest and rangeland fires are human caused, so engagement and participation of local communities are crucial to preventing fire.

The panel was then asked how climate change affects forest management and post-fire recovery efforts. Dr. Falk responded that many ecosystems have reservoirs of resilient capacity, and the question is what happens when we exceed that threshold. In North America, the preferred approach allows ecosystems to recover spontaneously but this process can happen slowly or fail, necessitating management interventions. All panelists agreed there has been a decrease in fires in many regions, compared to the early 1900s, but fires today burn faster and more intensely due to fuels buildup.

Given the challenges of climate change and associated fire and water issues, the panel was asked what can be done to improve forest resiliency in drylands. Dr. Yakir responded that fire provides an opportunity to change species and management practices, thus increasing resiliency. Dr. Bonne added that reducing planting density can improve resiliency and capacity to handle drought. Dr. Falk commented on the word resilience itself. Resilience is traditionally defined as the ability to resist disturbance and recover to the former state. However, ecosystems are always reorganizing, and the question is, should we allow this reorganization? He emphasized that reorganization is an essential process by which ecosystems adapt to change, and we must allow that to be part of our definition of resilience. The panel also discussed the importance of remote sensing technology for informing management decisions, and the need for better open-source imagery, both in terms of resolution and frequency.

In their closing remarks, the panel reiterated the need for cooperation and collaboration to solve issues.

Dr. Falk remarked we are in a period of transformation from the classical view of restoration to an emerging definition of ecological resilience. The dilemma is finding a balance between stasis and change while leaving nature in charge of the process as we recognize the emerging definition of resilience. Dr. Yakir noted we are at a crossroads, and we must be clever in thinking about recovery, resilience, restoration and how we should intervene. His final thought was regarding the interaction needed between science, management, stakeholders, and the public. Education must play a major role because it is up to the public to prompt decision-makers and governments to implement needed changes. Dr. Wahbeh emphasized the need to educate farmers and communities in adapting to climate change, and the importance of cooperation and communication of agencies, stakeholders, local communities, and the private sector to make clear decisions. Dr. Bonneh's final remarks regarded the national fire management program in Israel. He would not spend money on firefighting equipment. Instead, he would invest in capacity building of residents at the wildland-urban interface to cope with fire, and he would increase biodiversity and reduce tree density to create a more resilient environment.

SUMMARY

Although the conference focused on several different critical challenges facing drylands, a consistent message is apparent:

1. Climate change and population growth impose more significant stresses on drylands, including increased water scarcity, desertification, and wildfire intensity and frequency; these impacts cross political borders.
2. Addressing these challenges requires education, application of innovative technologies, public support and engagement, communication, and cooperation by all affected stakeholders, scientists, agency and government officials at local to the national level, and sometimes also at international level.

For over 30 years, the IALC promoted cooperation, education, and technology transfer to address issues facing the world's drylands. As demonstrated by this conference, the ideas long promoted and practiced by the IALC are as relevant going forward as they were in the beginning. Now, it is up to others to carry on this rich tradition. In the words of IALC conference Honorary Chair Joe Hess: "We recognize our work is not finished. In this era of critical climate change, there is an increased requirement to address the environmental challenges of arid lands. We, therefore, pass the baton to other consortiums, government agencies, and universities, to carry on this important endeavor that affects the well-being of all mankind and hopefully brings peace between nations."



Recycled Water Plant in Wadi Musa (Source: IALC Archives)

Acknowledgements

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Note: Affiliations for speakers and individuals are as of May 2021.

Videos, conference agenda, and additional info can be found at ialc.world

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IALC Conference Declaration

Addressing the Environmental Challenges of Arid Lands

26 May 2021

Over more than 30 years, the International Arid Lands Consortium (IALC) has demonstrated the importance of bringing together researchers and institutions from Israel, Jordan, and the United States to address the ecological sustainability of arid and semi-arid lands. While many of the concerns the IALC focused on could have been addressed in part at the local level, given the transboundary and regional nature of the environmental issues in these ecosystems, more effective solutions required regional and international cooperation coupled with multi-disciplinary capabilities. Through science diplomacy, IALC efforts broke down barriers between researchers from different countries in a region where cooperation often is a challenge. This provided opportunities to establish personal and institutional relationships that facilitated translation of the scientific outcomes into policy and promotion of peace in the region.

The Message of the IALC Conference

The theme of the conference – Addressing the Environmental Challenges of Arid Lands – highlighted the focus of IALC projects and partnerships over the past 30 years. A key point that came through clearly during the three days of this virtual event was that climate change has exacerbated the environmental challenges of arid and semi-arid lands and their people. While these challenges are not unique to arid and semi-arid lands, their people and ecosystems are likely to be the first impacted by lack of water, deforestation, and catastrophic fire. Thus, their experiences are harbingers of what other regions around the globe will face in the future if steps are not taken to ameliorate current trends. The message is clear – regional and global multi-disciplinary collaborative efforts are necessary and urgently needed to address these severe environmental challenges. Acting locally is not enough.

Call to Action

The dialogue of the three days of the conference underscored that much progress has been made on addressing critical environmental issues in arid lands, especially in light of a changing climate; however, it also emphasized that much work remains. There is a clear need to continue forward and build on the successes of the IALC by identifying and implementing new strategies that couple sound science with a strong platform for international cooperation. Conference insights highlighted the need for research and outreach collaborations that promote the sharing of ideas on potential solutions, community engagement, capacity building, empowerment of diverse voices, and translation of research findings. At the same time, connecting with policy makers was seen as essential for translating science into effective policies within a multinational framework.

As the International Arid Lands Consortium reflects on and wraps up its activities, Honorary Conference Chair Joe Hess provided a challenge to all: “We therefore pass the baton to other consortiums, government agencies and universities to carry on this important endeavor that affects the well-being of all mankind and brings peace between nations.”

IALC Conference Committee*

Honorary Chair

Joseph Hess, Retired, Jewish National Fund, USA, and Government Technical Manager and International Aerospace Consultant Responsible for Transition of New Technology into the U.S. Space Program

Conference Co-chairs

- **Sharon B. Megdal**, IALC President, Director, Water Resources Research Center, The University of Arizona, USA
- **Charles Hutchinson**, Professor Emeritus, School of Natural Resources and the Environment, The University of Arizona, USA

Members of the Conference Committee

- **Hakam Al Alami**, Advisor to HRH Prince El Hassan Bin Talal, Majlis El Hassan on Water and Sanitation, Jordan
- **Alan Gertler**, Research Professor Emeritus, Division of Atmospheric Sciences, Desert Research Institute (DRI), USA
- **Barbara Hutchinson**, IALC Secretary-Treasurer, Librarian Emerita of Natural Resources and the Environment, The University of Arizona, USA

- **Arnon Karnieli**, Professor, Head of Remote Sensing Laboratory, Ben-Gurion University of the Negev, Israel
- **Doron Markel**, Chief Scientist, Keren Kayemeth Lelsrael-Jewish National Fund, Israel
- **Isam Mustafa**, Assistant President, National Center for Research and Development (NCRD), Jordan
- **Manoj Shuckla**, Director of ACES Global Programs and Aggies Go Global and Professor of Soil Physics in the College of Agriculture Consumer and Environmental Sciences, New Mexico State University, USA
- **Benjamin Turner**, Assistant Professor, Agriculture, Agribusiness, and Environmental Sciences, Texas A&M University Kingsville, USA

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Student Participation Coordinator

Amber Dalke, Senior Research Specialist, School of Natural Resources and the Environment, The University of Arizona, USA

*Note: Affiliations for speakers and individuals are as of May 2021.

IALC Member Institutions

The University of Arizona, USA; Desert Research Institute, USA; Jewish National Fund-USA, USA; New Mexico State University, USA; Daugherty Water for Food Global Institute at the University of Nebraska, USA; South Dakota State University, USA; Texas A&M, Kingsville, USA; The Higher Council for Science and Technology, Jordan