The Swiss Institute for

Dryland Environmental and Energy Research

Ben-Gurion University of the Negev

The Jacob Blaustein Institutes for Desert Research

BGU takes an innovative approach to a pressing global challenge combining ecology, physics, solar energy, appropriate architecture and planning, resources management and alternative livelihoods to find novel approaches for the sustainable development of drylands

Drylands comprise 40% of the global landmass, ranging from Mediterranean-climate regions to extreme deserts. Drylands have become a "last frontier" for the expanding global human population. Currently, more than one-third of the Earth's population lives in drylands. A great number of the inhabitants who depend on the productivity of the land itself are stricken by poverty and are becoming poorer every year due to an accelerating, largely human-induced decrease in land productivity known as desertification. Development practices that work well in non-drylands have a disastrous impact on the biodiversity and productivity of drylands with far-reaching repercussions for the global environment.

To increase the value of drylands to mankind, and to reduce the damage to the global environment caused by desertification, we need to adapt to the dryland environment by learning to manage drylands for large-scale use along scientifically guided principles of sustainable development. The interaction between physical, biological and social components of the dryland environment serves as the required basis for an integrative research program which will provide the means for sustainable development.

For over 30 years, scientists at Ben-Gurion University of the Negev's Jacob Blaustein Institutes for Desert Research (BIDR), specializing in a variety of disciplines, have been generating knowledge required for the development of deserts with resultant world-wide applications. The challenge currently at hand is to achieve true interdisciplinary (not just multidisciplinary) research of a problem solving nature in order to cope with critical issues for populations around the globe – food, water, shelter and the environment. The BIDR proposes a new approach to tackling the challenges of sustainable development of drylands by combining and integrating scientific disciplines.

Accordingly, BGU brings together the ecologists of the Marco and Louise Mitrani Department of Desert Ecology, the environmental physicists of the Department of Solar Energy and Environmental Physics and the architects, planners and social scientists of the Man in the Desert Department into a new and uniquely interactive and interdisciplinary entity - the Swiss Institute for Dryland Environmental and Energy Research (SIDEER). The Institute is located at the Sede Boqer Campus of the Ben-Gurion University of the Negev and is under the umbrella of the Jacob Blaustein Institutes for Desert Research (BIDR). SIDEER not only integrates a variety of disciplines for innovative, interdisciplinary research, but also facilitates the involvement of its researchers in national, regional and global research projects and initiatives.

The establishment of SIDEER is a high priority project for the University and is consistent with the University's current program of significant investment in infrastructure and personnel.Accordingly, a new large environmentally-friendly laboratory building has already entered the advanced planning stages. Furthermore, state-of-the-art equipment is being acquired at the same time that scholarships and fellowships are being offered to highly capable students and researchers in order to bolster the research teams involved in various projects. The activities of SIDEER include interdisciplinary research; publication of research results; a broader outreach program aimed at bringing such results to decision makers and practitioners; dissemination of tools and resources; scholarships & fellowships for graduate and post-doctoral students; an exchange program for distinguished scientists; state-of-the-art equipment; and the general upgrading of infrastructure used to support large-scale experimental facilities.

An Unconventional Approach to Environment and Development

To the general public, the term "environmental problems" means problems created by people – water pollution, air pollution, noise pollution, garbage disposal, etc. The Swiss Institute of Dryland Environmental and Energy Research (SIDEER) differs from other environmental research organizations in that rather than dealing with what people do to the environment it is engaged in what the environment can do for people. SIDEER was firmly founded on the principle that the environment is our life support system: The environment controls climate; regulates water supplies; conserves soil and promotes its fertility; maintains wild plants of pharmaceutical agricultural, and industrial potential; provides energy and natural resources on which mankind is dependent; generates forage for livestock; and is a source for food, fiber and timber for people. Therefore, SIDEER embraces a subtle, but meaningful shift from an emphasis on the reduction in the conflict between development and environment to a focus on the support, development, and promotion of a healthy, functional environment.

Drylands and Desertification

SIDEER focuses on a specific environment – the drylands. It is this particular environment that currently epitomizes environmental mismanagement and which is directly responsible for the ever increasing problems associated with desertification. Dryland regions (deserts, semi-deserts and other areas affected by water scarcity) account for 40% of the global landmass. One third of humanity lives in dryland regions, attempting to generate livelihoods from these lands, whose productivity is lower than that of non-drylands. These attempts often result in the further reduction, rather than the improvement, of the productivity of the land. This anthropogenic or human-induced reduction of productivity of drylands is termed desertification, and is already evident in 20% of the drylands, whereas the other 80% are at high risk of desertification.

Desertification comes about when society, policy-makers and even scientists fail to recognize that the dryland environment differs from all other environments. The physical features of the dryland environment – exceptionally intense solar radiation and a dry atmosphere – interact with the biological components of the drylands – plants, animals and micro-organisms that jointly make the unique dryland-adapted biodiversity that is finely adapted to cope with these harsh physical conditions. This system of sensitive and delicate physical-biological interactions limits the dryland environment which can only provide support and decent livelihood for limited, small-sized human populations as traditionally existed for centuries. In a fundamentally flawed approach, land users now attempt to squeeze ever more provisions from these drylands in an unsuccessful attempt to support the land users themselves. Ironically, this reduces soil and water resources at a faster rate than their replenishment by the environment, thereby lessening the capability of the drylands to support human populations. Sadly, the result is a vicious cycle which only worsens the original problems causing even greater desertification.

The Global Dimensions of Desertification

The problems of desertification indigenous to dryland regions extend to, and affect, non-dryland regions as well. The soil in dryland regions not only loses its fertility, but also turns into dust. Dust does not recognize borders nor does it recognize proximity. This means that cross-boundary dust and sand storms further exacerbate living conditions in both dryland regions and non-dryland regions alike. The lost fertility is also linked to the transformation of the organic soil matter to greenhouse gases which are then emitted into the global atmosphere further intensifying global warming and global climate change. Desertification is the major cause of poverty in dryland countries, leading to social strife, ethnic conflicts and cross-boundary refugees and migrations. Desertification is currently recognized by the UN as a global crisis. Dealing with this crisis requires an innovative, concerted, interdisciplinary research approach.

Desertification and Environmental Research

Since desertification is an expression of flawed interaction between the physical, biological and human components of the dryland environment, an integrated approach encompassing both the physical, biological and social sciences is required for the remediation of its problems and challenges Accordingly, SIDEER co-joins environmental physicists and applied mathematicians of the Department of Solar Energy and Environmental Physics with ecologists of the Mitrani Department of Desert Ecology, and architects, planners and social scientists of the Man in the Desert Department under one umbrella. SIDEER comprises approximately 40 scientists engaged in interdisciplinary studies of the mechanisms involved in supporting human life in drylands – the circumstances under which they fail at present, the means for avoiding failure in the future, and the rehabilitation and remediation of areas currently suffering from desertification.

Mission and Methods

The mission of SIDEER is to foster integrated, interdisciplinary approaches to the study of the environment in drylands of Israel and the world. SIDEER strives to develop, implement and disseminate scientific knowledge and environmental technologies through interactions between the biological, physical, social and planning disciplines. SIDEER endeavors to improve human wellbeing in natural and man-made environments in drylands by promoting conservation of the environment and sustainable development.

The researchers of SIDEER strive to:

- Determine the extent to which drylands can be further developed by and for the growing populations, in ways that utilize rather than compromise the support of the environment;
- Assess the optimal number of people as well as the optimal mix of their traditional (e.g. rural, pastoral) and novel (e.g. ecotourism, biotechnology, intensive aquaculture, hi-tech) livelihoods that can be supported by the dryland environment in an intelligent and sustainable manner;
- Determine the extent to which harnessing the abundant desert solar radiation, combined with daring, innovative and environmentally sensitive afforestation in vast dryland expanse – two measures that reduce the emission of greenhouse gases to the atmosphere – can generate global benefits, as well as income for dryland people, under the Kyoto Protocol's carbon trading mechanisms.
- Investigate, assess and promote environment-informed, responsive and appropriate settlement and building forms, technologies and materials, towards the creation of "green" cities and buildings that can provide improved micro-climatic conditions while minimizing the utilization of fossil-fuel.

Research areas to support these objectives include:

- Developing remote-sensing capabilities for monitoring and elucidating the bio-physical desertification processes at different scales, from local to regional and global;
- Assessing the social and economic causes and implications of environmental mismanagement which lead to desertification, as well as the relative costs and benefits of preventing future desertification vs. the rehabilitation of lands currently suffering from desertification;
- Developing large scale predictive models which integrate climate, society and resources within an optimal, integrative environment-development decision-making framework;
- Using the diverse climates and dryland environments in Israel as a living laboratory for conceptualizing and then testing the models and providing them with regional and global relevance;
- Creating planning patterns and protocols towards the creation of desert-appropriate cities, aimed at lowering their dependence on water and energy inputs, creating a more favorable micro-climate, and promoting sustainable settlements based on appropriate management of energy and resources;
- Developing building forms, systems and materials appropriate for drylands, based on the utilization of local conditions and characteristics and alternative novel environmentally-friendly technologies;
- Developing means for appropriately utilizing renewable energy sources, water and materials, waste and sewage, aiming at a minimization of the ecological footprint through the assessment of life-cycle analysis of materials, systems and activities;
- Investigating and understanding historical paradigms in order to assess the applicability of alternative, low-tech solutions.

Planned activities

The activities of SIDEER emphasize the promotion of both new interdisciplinary activities and outreach activities which will bring research results to the attention of stakeholders and policy-makers in the drylands, while maintaining scientific excellence.

SIDEER promotes the following activities and programs:

- The initiation and support of novel interdisciplinary research activities;
- The acquisition of state-of-the-art equipment and upgrading of existing infrastructure for large-scale experimental facilities in remote-sensing, advanced solar collectors, large scale ecological monitoring, improved computation and communication facilities for modeling work;
- The support of an exchange program allowing distinguished scientists to carry out research jointly with SIDEER faculty and students;
- The provision of scholarships and fellowships for outstanding graduate, doctoral and post-doctoral students and fellows;
- The development and expansion of the following graduate programs (M.A./M.Sc./Ph.D.) at the Albert Katz International School for Desert Studies: Environmental Physics; Ecology, Management and Conservation; Man in the Desert (Social Studies, Architecture); Dryland Environmental Studies;
- The establishment and expansion of boundary-spanning activities such as: Initiation and support of educational and training activities of an outreach nature; Scientific workshops and conferences; Publication and dissemination of tools, technologies and resources developed at SIDEER.

The Departments of SIDEER

Marco and Louise Mitrani Department of Desert Ecology (MDDE)

Deserts support an amazing variety of plants and animals, whose low populations are widely dispersed. Because the interactions between ecosystem elements are easily investigated, drylands are important model systems for ecologists. Research at the MDDE is carried out from different perspectives, including the physiological, behavioral, population, community, and landscape aspects of desert plants and wildlife. A broad range of free-living and parasitic plants and animals, are under study.

Department of Solar Energy and Environmental Physics (DSEEP)

In addition to its biological resources, deserts have their unique panoply of surface elements, which include geological structures, a generally unpolluted atmosphere, and large amounts of solar radiation. Researchers in the DSEEP apply mathematics, physics, and chemistry in order to characterize processes taking place in the physical environment of drylands. The departmental interdisciplinary teams study the progress and retreat of desertification in Israel and throughout the world and are advancing the use of highly concentrated sunlight for materials research and developing new nonpolluting solar cells and light-concentrating devices for electricity production and medical applications.

Department of Man in the Desert

A major element of the desert region are the human residents, who generally live on the outer rims and are often condemned to lifelong poverty. Researchers of the Social Studies Group seek to aid various dryland peoples through activities in the areas of in anthropology, sociology, regional development, human geography, and economic history. When developed countries work to expand desert populations, it is essential to implement environmentally-friendly architectural and urban design principles. This approach is central to the work of the Desert Architecture and Urban Planning Group, which is identifying, studying, and formulating solutions to problems of desert habitation. The scientists and architects take advantage of the natural energy inputs, such as solar radiation, night ventilation, evaporation, or nocturnal sky radiation, to make buildings habitable with minimized environmental costs. They utilize the natural conditions to help resolve human issues by adapting the arid environment to support thermal comfort, reduce energy consumption, and guide construction technology.

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