A PLAN FOR THE WORLD’S FIRST PH. D. PROGRAM IN

ENVIRONMENTAL FINANCE and RISK MANAGEMENT

Presented by

THE INTERNATIONAL CENTER FOR CLIMATE AND SOCIETY

Lorenz Magaard*, R. King Burch**, Jerome M. Comcowich**
(November 21, 2012)

*Emeritus Professor of Oceanography at the University of Hawaii,
Director of the International Center for Climate and Society
**Special Assistant to the Director of ICCS

International Center for Climate and Society
(ICCS)

http://blog.hawaii.edu/iccso
A PLAN FOR THE WORLD’S FIRST PH.D. PROGRAM IN ENVIRONMENTAL FINANCE and RISK MANAGEMENT

Executive Summary*

I. Program Rationale and Description
The International Center for Climate and Society, of the School of Ocean and Earth Science and Technology at the University of Hawaii-Manoa, presents a plan to develop the world’s first multi-disciplinary doctoral program in Environmental Finance and Risk Management (EFRM). By combining the “know-how” of modern financial engineering skills with the leading edge of knowledge in subjects such as meteorology, oceanography, climatology, geophysics, epidemiology, and mathematical biology, EFRM will assist progress towards goals for disaster preparedness, renewable energy production, food and water security, and environmental conservation and restoration.

Underlying many financial innovations are mathematical theories and techniques that are shared with the physical and environmental sciences. The fact that students of financial engineering and environmental science now study these similar subjects, but do so in isolation from one another, inhibits progress towards “sustainability”. EFRM will reunite these disciplines and communities by teaching the principles of financial engineering through a coherent focus on environmental risks and hazards and the financial innovations that have developed to manage them, such as hurricane/earthquake/pandemic catastrophe bonds, weather derivatives, carbon emissions markets, and debt-for-nature swaps.

Major NGOs, including the World Bank, United Nations, APEC, and the Asian Development Bank, advocate the use of catastrophe bonds and weather derivatives in programs for disaster preparedness and other sustainability initiatives. In fact, cat bonds have been issued by sovereign nations (e.g. Mexico) and by individual States in the U.S. (e.g. Florida). While evaluation of these types of securities requires an integrated knowledge of science and finance, no university provides such training. EFRM will be the first program to do so, thereby, providing a new model for others to follow.

The goal of the EFRM program is to help Hawaii establish itself as a worldwide authority on environmental risk management that serves academia, governments, and the global finance-insurance industries. Under this mission, four major activities will be undertaken: (a) establishing the world’s first academic educational program in Environmental Finance and Risk Management; (b) research programs integrating the sciences pertaining to natural hazards and the insurance and financial services industries in the Asia-Pacific region and elsewhere; (c) outreach programs; and (d) training programs for Asia-Pacific policy makers, insurance regulators and executives.

II. Benefits of the EFRM Program

There are numerous advantages to establishing a link between Hawaii’s world-class environmental science capabilities and the global markets that depend upon scientific observations and knowledge in order to manage environmental risks. As losses from environmental hazards have grown, it has necessitated a merging of insurance and financial markets. The State of Hawaii is the second-largest center for captive insurance companies in the United States. Furthermore, the insurance industry is a major benefactor of the University of Hawaii and a major contributor to the State economy. The EFRM program would provide a unique leadership opportunity for Hawaii as financial and insurance markets seek new ways to manage environmental risks.

A. Benefits to the International Community

As part of a global effort to promote disaster preparedness, the University of Hawaii is a leading participant in the Asia-Pacific Disaster Risk Reduction and Resiliency (APDR3) program. The APDR3 program aims to achieve its long-term goals by harnessing public and private sector initiatives and by developing programs in higher education. The EFRM program is built upon these very ideas and can serve as a scalable model for uniting social and natural sciences, industry, and public policy in a new approach to sustainability.

- Promotes global commerce, collaboration, and disaster preparedness through finance and insurance markets
- Establishes a new, scalable model for university sustainability science education and research

B. Benefits to the State of Hawaii

The EFRM program will assist progress towards several goals listed in the State of Hawaii’s Comprehensive Plan for "Growing A Sustainable Economy"

http://tinyurl.com/9xayys2

- Promote financial innovations for application in renewable energy, agriculture, water security, environmental stewardship, economic diversification, and tourism.
- Promote the State of Hawaii as the global center for insurance research activities and as the meeting place for insurance market regulators and industry leaders for policy dialogues
- Train and educate qualified professionals for the local insurance industry as well as in the Asia-Pacific region
- Enhance the reputation of the State of Hawaii as a leading captive insurance center in the world
- Promote the State of Hawaii as the insurance education leader in Asia-Pacific region
- Contribute to diversification of the State of Hawaii economic and labor force
C. Benefits to the University of Hawaii

To meet its cross-disciplinary objectives, EFRM requires the participation of several schools, departments, disciplines, and programs from across the UH campuses. Chief among these would be the School of Ocean and Earth Science and Technology (SOEST) and the Shidler College of Business (SCOB). Currently, SOEST and Shidler faculty collaborate in teaching a graduate course in environmental finance (weather derivatives and cat bonds) as part of the Master of Science in Financial Engineering program. EFRM would expand this collaboration and introduce new opportunities to increase the funding and international prominence of SOEST and SCOB. EFRM would also provide a new, useful link between other UH organizations and programs that involve environmental hazards, such as the National Disaster Preparedness Training Center, the Hazards, Climate and Environment Program, the Hawaii Natural Energy Institute, the East West Center, the Pacific Disaster Center, and the Center for Island Climate Adaptation and Policy (Sea Grant).

EFRM will assist the four goals stated in the UH Strategic Plan:
http://manoa.hawaii.edu/vision/pdf/achieving-our-destiny.pdf

- Enhance workforce development and job / industry promotion
- Create a “new transformative, trans-disciplinary educational program that spans native Hawaiian and global issues” at the frontier of pure and applied space / sea / land research
- Provide opportunities for new collaboration uniting disparate disciplines and nations
- Promote new opportunities to commercialize UH research in the environmental sciences and business
- Attract student and faculty interest in a new STEM-based program that assists under-represented and minority communities at special risk to environmental hazards
III. EFRM University of Hawaii Departments and Honolulu-based Organizations

Below are current University of Hawaii at Manoa departments and possible outside organizations where teaching and research interests might suggest a strong interest in the EFRM subject matter. The list is preliminary and incomplete but is intended to demonstrate UH Manoa’s and Honolulu-based organizations' capacities to provide expertise in the various subjects of EFRM.

Departments
Financial Economics
Meteorology
Geology / Geophysics
Geography
Information and Computer Sciences
Mathematics
Economics
Mechanical Engineering
Social Sciences Research Institute
Natural Resources and Environmental Management
Public Health
Biostatistics (Burns School of Medicine)
Oceanography

Possible Honolulu-based Organizations
Pacific Tsunami Warning Center
United Nations International Tsunami Information Center
Central Pacific Hurricane Center
Pacific Disaster Center
Insurance-Linked-Securities
IV. Tentative EFRM Curriculum Plan
Offering the EFRM program at the doctoral level will underscore the program goal of advancing basic and applied knowledge in the pertinent sciences and finance-insurance. The prospect of uncovering useful new knowledge in these fields may attract support from organizations and enterprises that are exposed to environmental and financial risks.

An overriding goal of the EFRM program is to impart sufficient competence, in science as well as finance, to allow its graduates to lead the world in understanding the integration and effects of these (coupled?) natural and human systems. Consequently, the curriculum strives to include an optional science focus track and relevant applications (emphasizing risk management or conservation) that will accommodate numerate students with a background in the natural sciences and, perhaps, other quantitative subjects.

The first year of the EFRM program is spent learning “core” principles of financial engineering as taught in the UH MFE program. After the first year, students will choose elective tracks in specific environmental disciplines (e.g. weather and climate, geology-geophysics, mathematical ecology). By the end of Year 3, students will enter a research-focused internship aimed at facilitating access to real world and private-sector data, emerging issues, and new applications, and to help expose the EFRM program to the marketplace. Finally, in Year 4, students will present a doctoral dissertation that integrates elements of environmental sciences and finance.

Basing EFRM on the mathematics of stochastic, dynamical systems the program will link finance and environmental science in a coherent, relevant manner that spans theory through real-world application. As shown in the attached sample curriculum spreadsheet, EFRM transcends many disciplines but the University’s existing course offerings provide nearly all of the necessary instruction. It is anticipated that only two, or possibly three, new courses would be needed. The existing course on Environmental Finance (Fin 659) could be reorganized to focus more intensively on weather derivatives while new courses would target, respectively, catastrophe bonds, and conservation finance. A possible third new course would be “extreme value theory”.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematical Finance</strong>&lt;br&gt;Common Core All Tracks&lt;br&gt;(Financial Engineering)</td>
<td><strong>Atmospheric Risk</strong>&lt;br&gt;(Meteorology)</td>
<td><strong>Seismic Risk</strong>&lt;br&gt;(Geophysics)</td>
<td><strong>Atmospheric Risk</strong>&lt;br&gt;(Meteorology)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Internship and Research</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ecological Risk/Epidemiological Risk</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Disertation</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>All Tracks</strong></td>
</tr>
</tbody>
</table>

**Revised Courses**
- **Environmental Markets**: expanded course covering valuation of weather derivatives, catastrophe bonds, carbon emissions certificates, debt-for-nature swaps

**New Courses Needed**
- **Extreme Value Theory**: a probability-based course on theories and models of extreme events in nature and markets
V. Social Entrepreneurship Venture (Extreme Climate Risk Insurance Fund)

Environmental Finance and Risk Management may present a distinctive and compelling new approach to fund university research and education from the private sector and foundations in addition to other, traditional sources. One potential funding concept is to create a dual-purpose investment fund. Contributors to the fund agree to forego part of the Fund’s returns in order to support the operation of the EFRM program. Contributors may retain their principal investment in the Fund although all, or a portion, of this principal may be at risk in the event of a covered natural hazard.

EXTREME CLIMATE RISK INSURANCE FUND

Action: Solicit donations and commitments to create the “Extreme Climate Risk Insurance Fund (ECRIF)”. ECRIF will invest in Cat Bonds, Weather Derivatives, and other securities that assist environmental and conservation finance.

Purpose: ECRIF will provide catastrophe reinsurance to under-served communities in the Asia – Pacific region (and elsewhere). Half of the income from ECRIF will be reinvested in the fund or distributed to investors. The remaining half of annual income will provide funding to create and operate the doctoral program in Environmental Finance and Risk Management. ECRIF will be directed / managed by a professional investment manager, but will also provide educational and research opportunities for faculty and students interested in financial engineering, environmental sciences, and risk analysis and management.