

Researchers and stakeholders address coastal vulnerability and freshwater security

Belmont Forum Synthesis Workshop

December 10-12, 2016
San Francisco, California

The Belmont Forum is a consortium of research funders in over 50 countries on 6 continents that have targeted funds toward research that actively integrates stakeholders into a co-design/co-development process with researchers. In 2009, the Forum articulated the **Belmont Challenge**:

“*To deliver knowledge needed for action.
To avoid and adapt to detrimental environmental
change including extreme hazardous events.*”



Top: Researcher Didier Mallard working alongside stakeholders in Bangladesh; Image Credit: C.K. Shum
Bottom Left: Participants of the Belmont Forum in San Francisco, CA; Image Credit: Bill Dennison
Bottom Right: Water dwelling communities in Tonle Sap, Cambodia; Image Credit: Jialiang Gao

Real Solutions to Global Problems

The Belmont Forum is committed to fostering solutions to global sustainability challenges through innovative transdisciplinary research. This synthesis of the results of the 13 funded projects in Coastal Sustainability and Freshwater Security reveals real solutions for informed and deliberative decision making about sustainable resource use and development. These results provide further evidence that intense stakeholder engagement to co-develop locally based solutions is an approach that should be continued, expanded, and refined.



Stakeholders engaged in:

- co-design **310+**
- implementation **850+**



Next generation training of:

- undergraduates **58**
- graduates **106**
- post-docs **53**

Infographic of stakeholder engagement and academic training provided by the Coastal Sustainability and Freshwater Security projects.

Synthesis Workshop

A synthesis workshop was convened by the Belmont Forum and facilitated by Future Earth Coasts and the University of Maryland Center for Environmental Science in San Francisco, CA on 10-12 December 2016. Eleven of the thirteen funded project teams from around the globe addressing complex coastal vulnerability and freshwater security issues were present. This workshop summary provides a brief overview of each project, identifies common themes that emerged and provides recommendations for future Belmont Forum projects.



Word cloud formed from key words used to describe the Belmont Forum projects in Coastal Sustainability and Freshwater Security.



Effective and sustainable responses to global change require concerted cross-sectoral collaboration to develop reliable knowledge and equitable solutions. However, the scope of the issues faced can often exceed the capacity of individual organizations or national remits to realize these goals. Therefore, the Belmont Forum, a group of the world's major and emerging funders of global environmental change research, leverages investments and interest from across a breadth of institutions to spur the critical innovation and transformation that will result in a more sustainable future.

Common Themes

There are six thematic areas that demonstrate how Belmont Forum projects move beyond established knowledge and show the implications of new findings. The cornerstone of this success is the Forum's use of integrated working relationships. Although the improvement of scientific models, tools and approaches is invariably critical to a project's findings, the Forum projects' use of collaboration between researchers and stakeholders has facilitated a variety of cascading actions.

Content: Framing the project mindsets

- Community centered approaches drive solutions that are limited by fragmented interventions.
- Adaptation is driven by values, scale and context.
- Co-production and co-design creates opportunities to extend projects' impacts, connecting stakeholders and addressing gaps between society, policy and practice.

Co-design: Involving stakeholders

- Engagement, credibility, legitimacy, and data quality are important for stakeholder buy-in and impact.
- Sensitivity to issues and contexts are necessary to solve societal problems.
- Legacies of projects and the communities are often serendipitous results that go beyond the scope and ownership of involved researchers and stakeholders.

Gaps: Identifying next steps

- Improve dissemination and communication of products to end users and decision makers.
- Coordinate among multiple actors and integrate research and engagement efforts to overcome numerous logistical challenges.
- Reconcile scales of time, space and complexity with the need for long term, large scale planning and policy for maximum impact.

Transdisciplinary benefits: Understanding the why

- Reframing questions and problems through transdisciplinary thinking provides ways of tackling complex problems with no definitive solutions.
- Bridging disciplines enhances and benefits disciplinary perspectives by strengthening the capacity, engagement and practice of each discipline.
- Developing a greater understanding of what decision-makers need from scientific studies to augment the science-policy-practice cycle can be developed.

Achievements: Moving the knowledge needle

- Integrated hazards data and human factors (e.g., values, governance, culture, economic) developed credible and appropriate adaptation actions.
- Novel approaches and innovative tools and methods have been developed.
- Facilitated learning and capacity building promoted action at multiple locations and scales.

Transdisciplinary challenges: Pushing the boundaries

- Communicating and translating from technical to common descriptions, while finding common ground between, within, and across disciplines.
- Appreciating different frames of reference by respecting the values, biases, assumptions and agendas of both researchers and stakeholders
- Building trust and relationships in the face of continuity challenges and varying levels of social memory.



The synthesis workshop served as a forum for projects to learn from each other, and the ability to knit together the results of such a diversity of projects revealed a promising approach for addressing some of the world's most pressing and difficult issues. Image Credits: Heath Kelsey & Vanessa Vargas

Approaches

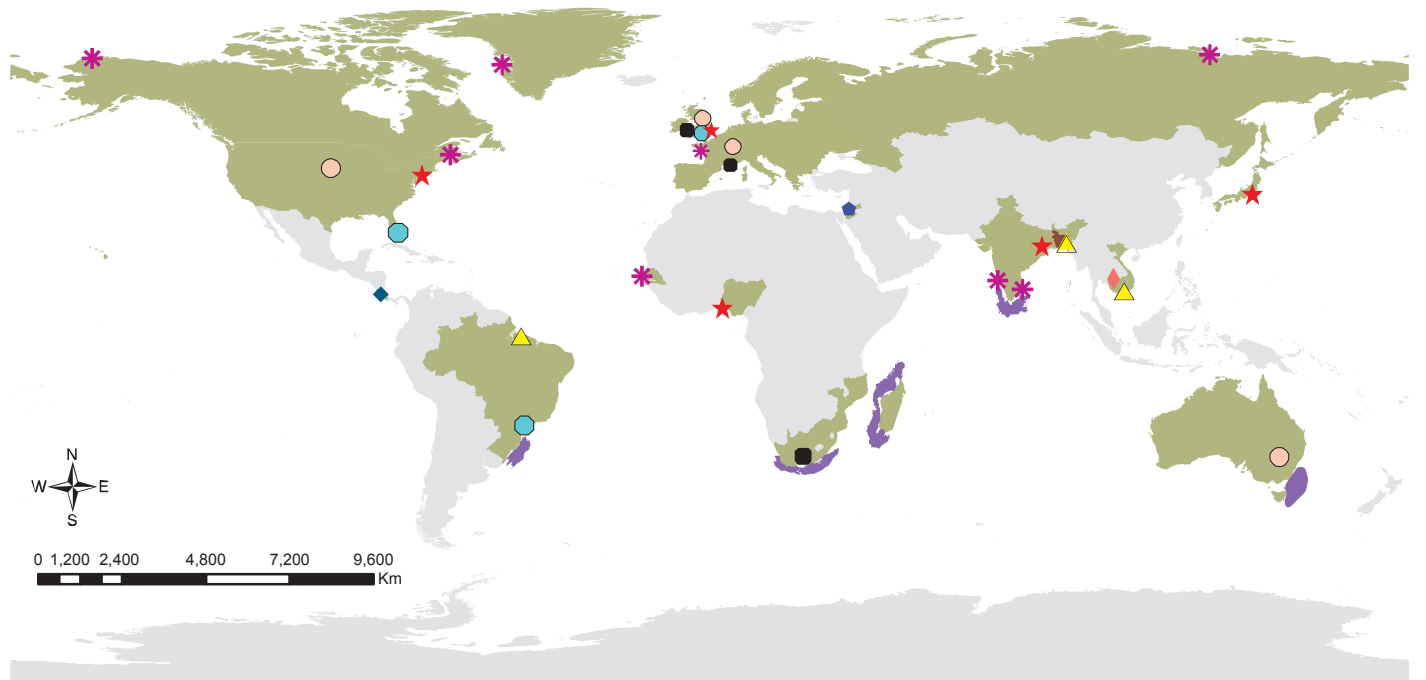
Stakeholders worked with research teams to co-design research projects to address a diversity of complex coastal vulnerability issues (e.g., sea level rise, urban development) and freshwater security issues (e.g., drought, water management). Stakeholders contributed their values and priorities and the research teams contributed tools and expertise.

The projects employed a variety of scientific tools (e.g., models, remote sensing, field measurements, geographic information systems) as well as a variety of tools for stakeholder engagement (e.g., workshops, interviews, questionnaires, videos, websites, art shows). Various options and scenarios to aid in decision making were produced to address coastal vulnerability and freshwater security issues.

The common approach developed for Belmont Forum projects was to have stakeholders and researchers co-design projects, and then a variety of stakeholder engagement tools and scientific tools were employed to produce project outputs. These outputs facilitated knowledge exchange between stakeholders and researchers for implementation into management, policy and decision-making.



Projects were transnational



- Countries included in the Coastal Vulnerability and Freshwater Security projects
- * ARTistic
- DrIVER
- ◆ FutuAgua
- ◆ TLSCC
- GULLS
- BanD-AID
- METROPOLE
- ★ TRUC
- ▲ DELTAS
- MAGIC
- ◆ JWP

World map with countries that were studied in the Coastal Vulnerability and Freshwater Security initiatives highlighted and specific locations where each of the 11 projects represented in the workshop were active.

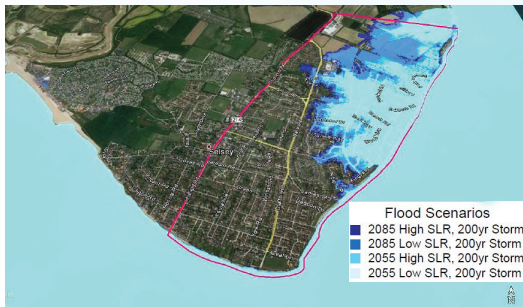
Project Summaries

Developing freshwater security in water stressed Jordan (JWP)

Exploring coupled human – natural systems during a period of rapid environmental change has provided transdisciplinary insights into the future options for managing scarce water resources in Jordan. But understanding complex human – natural system interactions and feedbacks remains challenging in the context of hierarchical decision-making. By integrating human observational research with quantitative forecasting models, the JWP team developed an integrated hydro-economic framework to evaluate water policy interventions in water-stressed countries, such as Jordan.



Government partners in Jordan
Image Credit: Samer Talazi



Study area and flooding scenarios when seawall fails
Image Credit: METROPOLE Project

Enhancing Decision-making in Coastal Cities in Brazil, United Kingdom and United States (METROPOLE)

Coastal cities face a spectrum of impacts due to flooding caused by storm surge and future sea level rise. Social and cultural factors increase the complexity of these issues, potentially hindering institutional capacity to effectively adapt. METROPOLE worked with municipal partners in Brazil, the UK, and the US to investigate how social, cultural and governance factors impact decision making and local government's capacity to adapt. METROPOLE provided flooding/sea level rise assessments, conducted workshops, and met 1:1 with policymakers and stakeholders. Municipalities gained new information about their vulnerabilities, possible adaptation options, financial challenges, and catalyzed new initiatives. Results are strengthening planner continuing education.

Reducing climate vulnerability of coastal fishing communities on four continents (GULLS)

Coastal fishing communities are vulnerable to multiple stressors including climate change. GULLS focuses on five marine hotspots, where change is most rapid: southeastern Australia, South Brazil Bight, southern India, Mozambique Channel (western Indian Ocean) and South Africa (southern Benguela). It uses transdisciplinary tools through participatory frameworks to understand the opportunities and threats and identify options for an improved future for affected communities.



Participatory mapping in Ambola, southwest Madagascar.
Image Credit: Lucy Scott



Eroding coastline of the Mekong Delta
Image Credit: Steffen Gephardt

Increasing sustainability of coastal deltas in Bangladesh, Brazil, and Vietnam (DELTAS)

Deltas are bread baskets for large global areas, and are also complex, fragile social-ecological systems. The fragility of these systems and uncertainties around climate change impacts mean that unique ecosystems and millions of people are under threat. The DELTAS project tackled this complexity by working together across disciplines and with key local stakeholders in the Amazon, Mekong, and Ganges-Brahmaputra deltas to develop comprehensive risk assessment frameworks which incorporate environmental, physical and social indicators and are applicable to deltas globally. The DELTAS approach can be adopted for other vulnerable areas, including drylands, glaciers, and urban areas to analyze contemporary and future risks and explore scenarios for risk-reducing investments.

Project Summaries Continued

Adaptation planning for global change in France, South Africa and United States (MAGIC)

Adaptation planning to address the impacts of global change is becoming increasingly common, yet lacks consistency in framing, methods and assumptions. These contradictions and contrasts often lead to maladaptation. A combination of modelling, interviews and participatory exercises with stakeholders in Cornwall (United Kingdom), South Africa and southern France has led to new insights and understanding of the resultant knock-on effects and spill-overs between plans.



Inappropriately placed engineering infrastructure can make coastal homes more vulnerable to sea surges instead of protecting them. Eden District, South Africa.



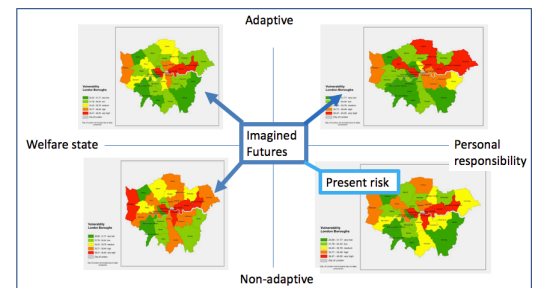
*ARTisticc's consortium retreat, Senegal
Image Credit: J.P. Vanderlinden*

Integrating art, culture and science to boost adaptation in eight cities (ARTisticc)

Diversity, culture and knowledge are key determinants of adaptation and adaptive capacity, but are not generally recognized within public policies or by decision makers. The ARTisticc project engaged a consortium of local communities and scientists that successfully implemented experimental devices integrating the arts with science, social science and the humanities, in eight sites (Brittany, France; Cocagne-Grande Digue, Canada; Vypin island and Kanyakumari region, India; Mbour, Senegal; Tiksi, Russia; Ummannaq, Greenland; Alaska, USA) on five continents.

Vulnerability assessment in coastal megacities in India, Japan, Nigeria, United Kingdom and United States (TRUC)

Megacities in the global south and north such as Kolkata (India), Lagos (Nigeria), London (United Kingdom), New York (United States), Tokyo (Japan) have widely varying levels of risk and vulnerability to current and potential future climate change. But city and neighborhood risk managers in these cities face comparable governance and administrative constraints and opportunities. The TRUC Project integrates biophysical and social science approaches to vulnerability assessment to provide a comprehensive vulnerability and adaptation analysis and policymaking tool. Similar tools could be applied across a broad range of urban risk and vulnerability contexts.



*Vulnerability scenarios for London, UK
Image Credit: TRUC project*



*Researchers and stakeholders working together
Image Credit: C.K. Shum*

Coping with monsoonal flooding and sea level rise in Bangladesh (Band-AID)

Bangladesh is under severe risk of monsoonal flooding and sea level rise in an increasingly warming world. The country is also experiencing tremendous social change accompanying unprecedented economic growth. But traditional disciplinary approaches cannot capture the complex interactions between human and natural systems that determine coastal vulnerability. The Band-AID team developed an integrated framework combining near real-time satellite-based monitoring systems with observed adaptation processes to model resilience and inform the ongoing Bangladesh Delta 2100 planning process.



Fishing family house on the Tonle Sap lake at full flood. Image Credit: M.E. Arias

Maintaining productivity of small scale freshwater fisheries in Cambodia (TLSCC)

The biological and social dynamics of small scale freshwater fisheries are poorly understood in comparison to large scale target fisheries. But these systems support the protein nutrition of 30 million people. Investigation of biological and social theories and decision support tools has provided understanding of the social dynamics and responses to foodweb ecological change at Tonle Sap lake, Cambodia. These new insights can be applied to similar systems worldwide potentially leading to more sustainable management practices.

Improving drought management and decision-making in Australia, United Kingdom and United States (DrIVER)

Droughts threaten water security in every climate and water use sector. But little research exists which assesses the relationship between widely-used physical indicators and drought impacts or adequately incorporates impacts into drought monitoring systems. Combining innovative analyses, data visualization and collaborative learning with stakeholders in Australia, the United Kingdom and the United States, the DrIVER project has improved understanding of the links between indicators and impacts and the diversity of drought in framing decision making.



Conversation map from UK workshop Image Credit: DrIVER Project



Game session on watershed management with schoolchildren. Image Credit: Pavel Bautista Solis

Enhancing resilience to drought in Costa Rica (FuturAguA)

People and institutions in Guanacaste, Costa Rica, have been coping with seasonal drought for decades, but population growth, land use intensification, and changes in the distribution of rainfall have increased water stress and governance challenges. FuturAguA addressed stakeholder concerns about water through a vision of "enough water for all", and an integrated framework for interdisciplinary science. We have built capacity for better-informed and deliberate decisions about management actions affecting water security. The framework can be transferred to other thematic and geographic areas as a way to advance science by addressing pressing societal and environmental challenges.

Addressing water resource management in Brazil (Xingu) and southern Africa (SAHEWS)

Sustainability and equity of access to water resources is a key driver of ecosystem and human well-being but is threatened by high climate variability, climate change, socio-economic uncertainty and rapid changes from agricultural land expansion. The Xingu project explored approaches to water resource governance, land management, and information transfer among regions and among water use sectors using the upper Xingu river basin in Brazil as a model example. The SAHEWS project, on the other hand, addressed several key regional knowledge gaps in southern Africa's water-energy-food nexus, working with end-users to help realize opportunities for more effective water management by improving understanding of seasonal forecast reliability and characterization of the region's hydro-economy.



Agritex - CASE IH - Fazenda Ouro Verde (Querência-MT). Image Credit: Xingu Project

Priority Actions

The Belmont Forum supported multidisciplinary teams of researchers and relevant stakeholders in their efforts to tackle complex global sustainability problems. But the limited time for projects (typically three years) meant that it was difficult to realize long term science-to-action outcomes. Thus, a variety of priority actions were identified by project leads to aid in the implementation of project outcomes for future efforts.

- Promote the **transdisciplinary approach** within academic systems and career development, especially for early career researchers.
- Specify the transformation from problem-defining to problem-solving (**solution identification**) in future cooperative research actions.
- Conduct **evaluation** processes to provide feedback and add value to project outcomes.
- Facilitate **accessibility** to data interoperability, freeware and web resources.
- Establish **communication pathways** (e.g., forums, dialogue and engagement opportunities) between researchers and resource managers to enhance the ability of project teams to aid decision-making.

- Focus on **science communication and dissemination** to translate research outputs to societally relevant outcomes.
- Coordinate **professional training** in stakeholder engagement approaches (e.g., communication, facilitation, evaluation).



Participants of the Belmont Forum Synthesis Workshop held in San Francisco, CA on 10-12 December 2016.

Workshops Participants and Affiliation



Adaptation Research, a Trans-disciplinary transnational Community and policy Centred approach (artisticcc.net). Jean-Paul Vanderlinden and Juan Baztan (Université de Versailles Saint-Quentin-en-Yvelines)



BanD-AID - Bangladesh Delta: Assessment of the Causes of Sea-level Rise Hazards and Integrated Development of Predictive Modeling Towards Mitigation and Adaptation (belmont-bandaid.org). CK Shum and Joyce Chen (Ohio State University); Zahir Khan and Monowar Hossain (Institute of Water Modelling)



Catalyzing action towards sustainability of deltaic systems with an integrated modelling framework for risk assessment (delta.umn.edu). Efi Foufoula-Georgiou (University of California, Irvine); Fabrice Renaud (United Nations University); Robert Nicholls and Zoe Matthews (University of Southampton); Tuhin Ghosh (Jadavpur University)



Drought Impacts: Vulnerability thresholds in monitoring and Early-warning Research (drought.uni-freiburg.de). Kerstin Stahl (University of Freiburg); Lucy Barker (Centre for Ecology & Hydrology); Mark Svoboda (US National Drought Mitigation Centre, University of Nebraska Lincoln)



Enhancing Adaptation and Resilience to Drought in Dry Tropical Social-Ecological Systems: The Guanacaste, Costa Rica Example (futuragua.ca/ubc/home). Tim McDaniels (University of British Columbia); Gregoire Leclerc and Pierre Bommel (French Agricultural Research Centre for International Development); Gabrielle Wong-Parodi (Carnegie Mellon University); Pavel Bautista (Universidad Nacional Costa Rica)



Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities (gullsweb.noc.ac.uk). Kevorn Cochrane (Rhodes University); Shyman Salim (Central Marine Fisheries Research Institute)



JWP - Integrated Analysis of Freshwater Resources Sustainability in Jordan (pangea.stanford.edu/researchgroups/jordan). Steve Gorelick (Stanford University)



Multi-scale adaptations to global change and their impacts on vulnerability in coastal areas. Christof Fabricius (Nelson Mandela Metropolitan University); Olivier Barreteau (Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture)



An Integrated Framework to Analyze Local Decision Making and Adaptive Capacity to Large-Scale Environmental Change: Community Case Studies in Brazil, UK and the US (metropole.marine.usf.edu). Frank Muller-Karger and CJ Reynolds (University of South Florida); Shona Paterson (Future Earth Coast); Mark Pelling (King's College London)



TLSCC - Maintaining productivity and incomes in the Tonle Sap fishery in the face of climate change (tonlesapfishery.wixsite.com/tonle-sap-fishery). Lee Hannah (Conservation International); Ratha Chea (University of Battambang)



Transformation and Resilience on Urban Coasts (bel-truc.org). Mark Pelling (King's College London); William Solecki (City University of New York)

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Matt Dobson (Natural Environment Research Council, nerc.ac.uk); Maria Uhle, Carrie Seltzer, Susanna Elhers (National Science Foundation, nsf.gov)

Facilitation and Science Communication



Martin Le Tissier and Shona Paterson (Future Earth Coasts, futureearthcoasts.org)



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