

# **CEC Policy Brief on Flood Costing**

**Understanding the Comprehensive  
Economic Impacts of Floods in Canada,  
Mexico, and the United States**

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## Preamble

The Commission for Environmental Cooperation (CEC) recognized information gaps in estimating economic impacts of floods in Canada, Mexico, and the United States. It initiated in 2019 a collaborative research project, led by experts from the three countries. During 2019-2021, this project entitled “Costing Floods and Other Extreme Events” has brought together governmental agencies, academic institutions, and stakeholders from the private sector and communities. The work presented in this policy brief is based on the detailed dialogue between the project’s collaborators, three expert workshops, one consultation with Indigenous researchers and leaders, and numerous consultations.

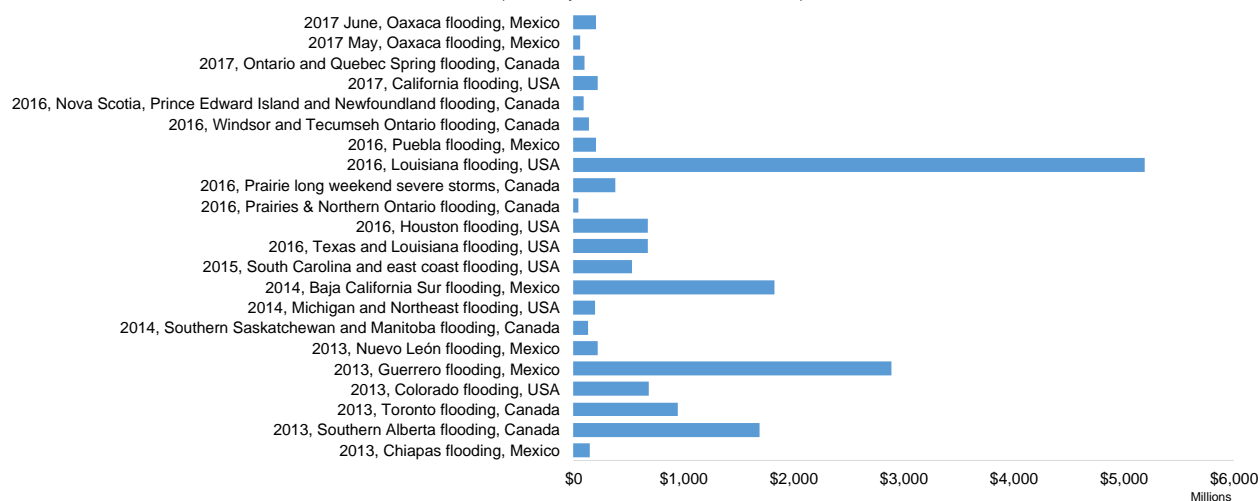
## 1 Trinational Flood Costing

### 1.1 Scope of the Flooding Challenges

**Understanding the comprehensive costs of floods is central to addressing their impacts, allocating adequate resources for monitoring and preparedness, and building resilient communities.** Flooding, including inland and coastal flooding, is one of the most devastating and costly natural hazards in North America. It is important to better understand the consequences of floods on local and regional economies, particularly their long-term impacts.

**Our analysis indicates that flooding causes billions of dollars in significant damages and losses across Canada, Mexico, and the United States.** Importantly, flood events across the international borders have led to significant economic impacts and loss of human life in recent years, including the major flooding events in the Red River and the Rio Grande/Río Bravo watersheds. Based on project data, a conservative estimate of the total consumer price index-adjusted damage for 22 large-scale flood events that occurred in the three countries between 2013 and 2017 was calculated to be approximately US\$17 billion (Fig 1).

**Fig 1. Flood-related economic impacts in Canada, Mexico, and the United States, 2013–2017**  
(Unit: adjusted millions of US\$, 2020)



**Because of the increased population and more exposed assets in flood-prone areas, more devastating and costly floods are expected in the future.** Changes in climate patterns are likely to

exacerbate this trend, bringing heavier rainfall events, sea-level rise, increased flooding from more intense hurricanes, and coastal erosion.

**At present, flood-costing methods vary greatly among federal and sub-national jurisdictions across Canada, Mexico, and the United States.** Furthermore, such information is not adequately geo-referenced or available in near-real time, and the economic impacts of cascading multi-hazards (e.g., dry season > forest fires > floods > landslides) are not well documented. As a result, government agencies and private entities cannot easily assess priorities for infrastructure and institutional investments to enhance disaster resilience. We recognize an urgent need to encourage international cooperation and coordination to develop hazard methodology and economic impact data standards.

**Significant data gaps exist which hamper the comprehensive and full-scale assessment of short-term damages and long-term losses, particularly in assessing uninsured losses.** Currently, Canada, Mexico, and the United States lack a common flood damage and cost data center or hub. There is no uniformity of information, in the absence of a standardized methodology. Flood economic damage data are unevenly collected by sectors, and most economic flood damage assessments focus on the evaluation of direct, and often only the insured damages. The lack of indirect damage data, such as those recommended by this project, results in substantial underestimation of losses. For example, economic impacts of flooding on the transportation sector and roadways are not recorded in Canada and the United States but exceed 40% of the comprehensive flood damages recorded in Mexico. Such information gaps also limit joint Canadian-Mexican-United States responses to extreme events that impact multiple jurisdictions.

## 1.2 Developing Joint Solutions

**Creating a joint, multi-year, trilateral initiative for collecting flood-costing data is a cost-effective way for consistent data gathering and synchronized responses.** Comprehensive flood damage and cost assessments are resource-intensive. Assessments could be made more cost-effective by a harmonized approach to data collection and by strengthening trilateral collaboration and better coordination. Such efforts can help identify best practices to incorporate outputs from simulation models and remote sensing, especially for assessing long-term indirect impacts.

**Awareness-raising across the board, involving politicians, policymakers, strategic planners, first responders, the insurance industry, and impacted communities is crucial.** There is a need for increased awareness among the first responders, emergency managers, and the public of the comprehensive costs of flood-related impacts (e.g., direct damages, indirect damages, and additional costs/losses). We acknowledge that including Indigenous measures of flood impact in data gathering requires in-depth engagement with Indigenous communities and leadership. Increased awareness will improve planning and attenuate damages and knock-on impacts of floods.

**The flood-costing methodology developed by this CEC project in consultation with a broad range of stakeholders aims to provide a full picture of flood impacts.** The CEC flood-costing project developed a comprehensive methodology for evaluating economic impacts of floods in Canada, Mexico, and the United States. The CEC flood-costing methodology defines impacts from three categories (direct damages, indirect effects, and losses and additional costs) and four sectors (social sector, infrastructure, economic sector, and emergency assistance)<sup>1</sup>. The CEC flood-costing framework provides a foundation to

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<sup>1</sup> For details of the methodology, please view the following paper: Adeel, Z., Alarcon, A.M., Bakkensen, L., Franco, E., Garfin, G.M., McPherson R.A., Mendez, K., Roudaut, M.B., Saffari H., Wen, X., 2020. Developing a comprehensive methodology for evaluating economic impacts of floods in Canada, Mexico and the United States, *International Journal of Disaster Risk Reduction*, 50: 1-86.

bring consistency across the three countries, while incorporating the strengths and weaknesses of data availability and access across the three countries.

**A centralized, trilateral data-gathering approach—such as that used by Mexico’s *Centro Nacional de Prevención de Desastres* (Cenapred)—can lead to more comprehensive and consistent datasets for flood-costing.** In contrast, data collection in the United States and Canada, by multiple agencies that focus on different jurisdictions and impact categories, makes data collection and assessment complicated and incomplete. It can be, therefore, argued that centralizing data gathering is more cost-effective and can yield multiple benefits—even for individual nations, because the improved diagnostics of losses, informed by comprehensive and consistent databases, forms a sounder basis for the development of new and more cost-effective policies. Given the interconnectivity of extreme weather events in Canada, Mexico, and the United States, creating a centralized data repository for the three countries can result in greater collaboration in joint flood responses, resilience building, and understanding continental-scale patterns and trends in flooding. This approach in data collection and management would also facilitate incorporation of data from multiple sources, including various governmental agencies.

**It is imperative to build institutional capacity at national and sub-national levels for comprehensive flood-costing.** We recognize that many governmental institutions—particularly at the sub-national and local scales (such as municipalities)—lack the institutional capacity, skilled workers and technological tools for comprehensive data gathering or assessment. Working collaboratively, key institutions in Canada, Mexico and the United States can build the critical institutional capacity and provide personnel training for data collection, management, and dissemination. Such collaboration can, *inter alia*, help identify and follow the best practices in data collection, management, and transparency, as well as increase preparedness and improve flood risk planning.

**A mechanism is essential for providing first responders and strategic planners with near real-time economic-impact data.** Such a mechanism can be developed through a commitment of financial and human resources to enhance data collection, management, and distribution, and to create new knowledge from the data. It should particularly link these flood-costing data to flood risk maps, informed by remotely sensed spatial data, at different scales. Near real-time data provisioning will improve estimates of damages and losses and help ensure improved protection of the interests of citizens and businesses, such as reimbursement for losses and lost labor productivity.

**Ongoing dialogue between stakeholders, at both national and trilateral scale, can aid the understanding of flood costs and their relevance to building resilience.** A broad consultative process will facilitate direction-setting and identification of short- and long-term solutions. It should also engage Indigenous leaders and researchers in resilience-building mechanisms at different levels of governments.

**The CEC flood-costing methodology can be extended to other hazards.** While the method developed by this CEC project is meant for measuring economic impacts of floods, the generic nature of its direct damage and long-term impact assessment approach makes it ideal for being applied to other natural hazards (such as wildfires, droughts, hurricanes, snowstorms, landslides, etc.) and manmade disasters. Considerable research efforts need to be made to investigate approaches for interlinking economic impacts of cascading hazards; such research could benefit from engaging with ongoing initiatives led by the World Meteorological Organization (e.g., Cataloguing of Hazardous Weather, Water, Climate, Environmental and Space Weather Events; ET-CHE) and the UN Global Assessment Report on Disaster Risk Reduction (GAR).

## 2. Policy Relevant Findings for Canada

**A more proactive approach to responding to flood impacts and mitigating short- and long-term impacts is needed at the national level.** Responses to flooding and other emergencies should be driven by high-quality data gathering and analysis. Such integration of approaches is essential because it is estimated that about 65% of economic impacts resulting from natural disasters are caused by floods across Canada. In particular, the Canadian federal government should help align the mandate objectives of several key agencies working under Environment and Climate Change Canada, Public Safety Canada, and Natural Resources Canada.

**Data gathering approaches in Canada for flood-costing need to be streamlined using the CEC methodology.** A significant effort needs to be made to fill information and data gaps that describe flood costs for major economic sectors in Canada. The CEC approach helps identify important categories and specific indicators that can be segregated by economic, social, or environmental sectors. Adopting this methodology can also help provide significant and substantive inputs to a revision and renewal of the Canadian Disaster Database maintained by Public Safety Canada.

**A Canadian Centre for Climate Data and Analytics can help better understand the long-term challenges for Canada posed by flooding and other extreme climate events.** Experts believe that such a data hub would bring multiple benefits for Canada—notably in risk mitigation and fully understanding the national risk profile. It would also aid coping with the large volumes of data that could be generated when the CEC methodology is implemented. It would lead Canada’s input to any trilateral efforts for collaborative data gathering and assessment.

**Significant efforts should be made to link the CEC flood-costing approaches to other ongoing national and international efforts.** The National Data Strategy is a new Canadian initiative that can offer multiple interlinkages with the implementation of the CEC methodology in Canada. There are also numerous Canada-wide efforts that offer another linkage point in understanding climate-related risks. Similarly, several avenues for potentially expanded collaboration with the United States across the Great Lakes basin or with the Red River watershed exist in the form of current institutional mechanisms (e.g., the International Joint Commission).

**Implement policies at the federal and provincial scales that facilitate the flow of data from and to the insurance sector, while ensuring data confidentiality.** A centralized data repository that offers secure access to first responders and strategic planners could offer the way forward. Such integration of information streams with the insurance sector can help enhance the insurance ‘safety nets’ in remote and rural underserved communities where insurance uptake is relatively minimal.

### 3. Policy Relevant Findings for Mexico

**There is a need for significant increase in coordination between various agencies at the federal and state levels in Mexico.** Considerable achievements have been made in Mexico over a 20-year period, notably led by Cenapred, to coordinate data gathering efforts.

**There is considerable need for capacity enhancement of data collection at the municipal level.** In this context, the municipality represents the first level of care in civil protection and often bears primary responsibility for preventing, managing and mitigating risks from such natural hazards as flooding. However, in many cases, the tasks associated with municipal civil protection exceed the response capacities of local governments: a situation that points to legal, institutional, and financial deficiencies. Trinational institutional collaboration could improve this situation.

**Data-gathering methods in Mexico need to be enhanced to include a few additional parameters identified by the CEC methodology.** While the data gathering approach used by Cenapred is based on the method promoted by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), some sectoral data are not included. The CEC approach describes methods to fill those sectoral information gaps.

**Implement policies at federal and state scales that facilitate the flow of data to and from the insurance sector, while ensuring data confidentiality.** A centralized data repository that offers secure access to first responders and strategic planners could offer the way forward.

## 4. Policy-Relevant Findings for the United States

**Data-gathering approaches in the United States for flood-costing are highly aggregated, inconsistent, and need considerable streamlining.** Streamlining these multiple data-gathering approaches—currently led by the US Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), the Small Business Administration (SBA), the US Department of Agriculture (USDA), the US Army Corps of Engineers (USACE), and numerous state-level agencies—by using the CEC method can help identify important parameters that can be segregated by economic, social, or environmental sectors. However, current U.S. federal policies may constrain some agencies, e.g., FEMA, to use cost-benefit analysis methods, and thus, prohibit the agencies from using the CEC method. The synchronization of data at different geographic scales, if facilitated, would reduce the magnitude of disagreement between various datasets. Streamlining data gathering, which would require relaxation of the aforementioned policy constraints, would avoid the duplicated reporting of damages and losses across programs and jurisdictions, identify and fill data gaps, and provide more concise information to support decision making. This enhancement in data gathering will lead to improved damage and loss estimates, improved post-flood recovery, and cost-saving investments that will increase resilience to future flood hazards.

**Implement policies at the federal and state level to facilitate flow of data to/from the insurance sector, including the National Flood Insurance Program (NFIP), while ensuring confidentiality of data.** A centralized data repository that offers secure access to first responders, disaster managers, and strategic planners could offer the way forward. While significant NFIP policy and claims data are publicly available, these datasets are updated infrequently. Working with public and private the insurance market provides an opportunity to improve data access across government sectors and academia. Economic impact data could be enhanced with real-time local data to identify insurance uptake rates at the community level, while differentiating between categories of insured versus uninsured damages and losses. Such integration can help enhance the insurance ‘safety nets’ in remote and underserved communities where insurance uptake is relatively minimal.

**Significant efforts should be made to link the CEC flood-costing approaches to other ongoing national and international efforts.** Many national meteorological organizations are collecting and storing relevant data on flood impacts. These data will have wide-ranging spatial and temporal implications for assessing flood risks. As noted earlier, collaboration with international experts in cataloguing national events and establishing global standards for flood-related hazards is needed. New and emerging federal legislation around flooding can offer an umbrella mechanism under which the CEC methodology can be implemented at national scales. The United States’ engagement in the efforts to implement the Sendai Framework for Disaster Risk Reduction (2015-2030) offers another starting point. Similarly, several avenues for institutional collaboration with Canada exist across the Great Lakes basin as well as at the Red River watershed (e.g., the International Joint Commission).

**Communities and local governments should be incentivized to better understand flood impacts.** Reliable data for local damages and losses is lacking and enhanced risk management, assessment and reporting of costs by local and state agencies is needed. An incentive-based program for the collection, analysis, and sharing of data may advance planning and response at the local and community levels. Such an approach should include education on the physical and economic risks for an average person. A trilateral data approach for enhancing resilience and informing public policy can be combined with other tools, risk maps (e.g., FEMA’s National Risk Index), and data to help communities understand local-scale social vulnerabilities.