

Natural Hazards, Losses, and Quality of Hazard Mitigation Plans in Rural Pennsylvania

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Since 1980, billion-dollar weather and climate events have increased in the United States, with 403 events accounting for a total cost of more than \$2.9 trillion (NOAA National Centers for Environmental Information, 2025). Hazard mitigation promotes community resilience and is affordable, with options ranging from elevating structures to adopting and enforcing building codes (Godschalk et al., 1999; Godschalk et al., 2009). In response to rising disaster losses, the Disaster Mitigation Act (Public Law 106-390) was passed in 2000, which institutionalized hazard mitigation planning both as a model process and as a condition for receipt of federal hazard mitigation grant funds by state and local governments (Berke, Smith, and Lyles, 2009; Mileti, 1999; Schwab, 2010).

Hazard mitigation planning provides an opportunity to proactively assess risk and discourage development away from hazard-prone areas, and as a result, has been shown to improve disaster preparedness and reduce vulnerability (Berke et al., 2010; Berke, Smith, and Lyles, 2012). However, rural communities often have neither the expertise to create their own hazard mitigation plans nor the resources to hire consultants to assist with the production of high-quality plans (Horney et al., 2012; Horney et al., 2017).

This research reviews the trends in natural hazards and losses in urban and rural counties and provides an original assessment of the quality of county hazard mitigation plans. This information is vital for making evidence-based decisions and developing strategies that successfully reduce the effects of natural hazards (Gall et al., 2011; Gall and Cutter, 2016). Sound baseline data allows for a better understanding of the geographic variability in natural hazard impacts and can aid in a comprehensive evaluation of existing hazard mitigation, disaster assistance, and disaster recovery policies.

Methods

This project identifies and analyzes the characteristics of natural hazards and losses over time, explores and compares hazard mitigation plans, identifies and analyzes characteristics of local hazard mitigation planning, and offers policy considerations to improve Pennsylvania's laws and regulations governing hazard mitigation and emergency preparedness activities for both rural and urban counties.

Research methods include three components: secondary data collection measuring hazards and losses; primary data collection and original analyses of the quality of hazard mitigation plans; and primary data collection from semi-structured interviews with 10 county emergency management

coordinators in the state of Pennsylvania. Results obtained from the interviews were interpreted, summarized, and compared to the secondary data to identify opportunities for improving hazard mitigation planning and disaster loss reduction measures in the Commonwealth.

Key Findings

- From 2000 to 2021, natural hazards cost Pennsylvania more than \$3.7 billion, with \$19 million stemming from crop losses and \$3.6 billion from property losses. This equated to over \$34,000 in total losses per capita.
- A total of 440 fatalities occurred from natural hazards and more than 1,000 injuries during the 21-year period.

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- Property losses varied by year, with losses exceeding \$100 million in 2001, 2003, 2004, 2005, 2006, 2011, and 2021, with 2006 being the costliest year on record.

- Patterns in losses correspond with a higher incidence of hazard events that resulted in Presidential Disaster Declarations (PDDs). The number of PDDs issued for individual counties ranges from three (in Elk, Erie, and Washington) to 12 (Montgomery, Sullivan, and Wyoming). Compared to urban counties, rural counties were issued a total of 287 declarations, or more than 66 percent of the total PDDs declared in Pennsylvania. Of particular note is the number of storm incidents that occurred in the years corresponding with record losses, which were classified as thunderstorm wind events. For each of these years, thunderstorm wind events exceeded all other types of storm incidents, accounting for more than half of all incidents recorded for these years.

- The deadliest hazards in Pennsylvania are heat, flooding, and wind, accounting for nearly 85 percent of all deaths that occurred from 2000 to 2021. Winter weather, lightning, wind, and heat are responsible for nearly 70 percent of injuries in Pennsylvania.

- Heat appears to pose a greater risk to those living in urban counties, accounting for 269 deaths and 168 injuries from 2000 to 2021. This finding suggests that more measures should be undertaken to mitigate the impacts of heat, especially among vulnerable populations like the elderly and those living in poverty.

- Collectively, flooding, wind, winter weather, and tornadoes accounted for nearly 97 percent of property losses. Flooding was also responsible for the highest property losses per capita.

- While flooding in rural counties accounted for \$1.1 billion in property losses, it is responsible for \$23,345.34 in property losses per capita. This is in contrast to flooding in urban counties, which accounted for \$1.8 billion in property losses and \$4,711.38 in losses per capita. This is an important finding, as approximately 25 percent of the population in Pennsylvania is rural, but 38 percent of flooding-related property losses occur there, and the per capita cost far exceeds losses in urban areas.

- Compared to their urban counterparts, rural counties experienced higher property losses per

capita for tornadoes, wind, winter weather, severe storms/thunderstorms, and hail. It is particularly striking that rural residents shouldered more than five times the financial burden from tornado hazards (\$2,099 in property losses per capita) compared to urban counties (\$367). Wind hazards showed similar patterns, as rural residents incurred three times more property losses per capita (\$1,226) than urban residents (\$373). Urban counties experienced more deaths and injuries from severe storms/thunderstorms, tornadoes, and wind than their rural counterparts.

- Most counties hired a consultant group to update their hazard mitigation plan. Of those 48 counties, roughly the same share of urban counties hired a consultant as rural counties. Only 13 counties (21 percent) completed their hazard mitigation plan updates internally.

- County hazard mitigation plans were evaluated on their achievement of seven elements or principles. Urban counties consistently scored higher than their rural counterparts for each of the principles of plan quality, with the exception of one; all counties scored equally high on the inclusion of public and stakeholder participation in the planning process.

- In laying the groundwork or fact base for their mitigation plans, all counties conducted high-quality risk assessments. This level of detail suggests a significant effort to identify community assets that have a high potential for loss if hazards occur in their jurisdictions (e.g., critical facilities, repetitive loss properties, and socially vulnerable populations).

- Counties face challenges identifying the responsible agencies, timelines, and expected costs of carrying out their mitigation plans, which together comprise their scores for “implementation.” Overall, the element of mitigation plans with the lowest average score for all counties was for implementation.

- With regard to monitoring hazard mitigation plans, only 24 of the 61 plans analyzed (39 percent) track the use of post-disaster funds. There is room for improvement in monitoring the outcomes associated with state and federal monies received.

- Based on the evaluation of mitigation strategies, it should be noted that activities related to proactive land use planning and regulations were consistently

cited by all 61 plans. Urban counties were shown to incorporate more of a variety of land-use strategies than rural counties; this includes zoning and subdivision regulations (such as density of housing and parcel size).

- With the exception of two principles (participation and monitoring), the mean scores of plans in counties that updated their plans internally are lower than those that developed them externally (with a consultant).

- While county stakeholders expressed the importance of having a hazard mitigation plan to identify and prioritize hazards and reduce impacts in their communities, if it were not a federal requirement, they likely would not have a separate plan due to lack of adequate staffing, capabilities, and expertise at both the county and municipal levels.

- Lack of clear guidance for mitigation actions was also mentioned as a weakness by interviewees across 10 counties. One respondent stated, “Sometimes we get so many mitigation actions that not everybody knows what they’re responsible for.” This confusion over the agency responsible may be related to the low implementation scores observed in the analysis of plan quality.

- Participants expressed their frustration with the grant application process, particularly its cumbersome nature that makes it daunting for municipalities that do not have time to fulfill their basic duties and responsibilities. For example, one participant stated that, “Many rural communities lack the expertise, staffing, and capacity for hazard mitigation, and they are just a one-man show.”

- Interviewed participants provided several suggestions for improving hazard mitigation planning in rural areas throughout the Commonwealth, including but not limited to, eliminating unfunded mandates, updating Title 35 and Act 165, improving the grant application process for rural communities, and revising state certification requirements for emergency managers.

- Participants repeatedly mentioned the relationship that exists between plan effectiveness and involvement from municipalities in the planning process. Two of the counties indicated that their latest plans were created with 100 percent municipality participation. However, some of the smaller, rural counties expressed frustration

with getting municipalities and members of the general public to participate in the planning process; given how much time it takes to conduct outreach, it impacts their ability to fulfill their job responsibilities outside the realm of mitigation.

Policy Considerations

- Funding levels for state and local governments have not kept up with the current needs of emergency managers and are often unpredictable from year to year, and some sources of funding to cover personnel costs have declined. The Commonwealth should consider additional staff dedicated to this often-underappreciated mission area and increased funding for pre-disaster mitigation activities.

- Given the evolving nature of hazards like substance use disorder, the Commonwealth can diversify and expand the types of funding opportunities that can be applied to hazard mitigation activities. Partnering with state and local offices related to drugs, alcohol, health, and wellness could improve the hazard mitigation planning process.

- Because heat is related to deaths and injuries, particularly in urban areas, additional measures should be undertaken to mitigate the impacts of this weather hazard, especially among vulnerable populations like the elderly and those living in poverty. The Commonwealth should consider investing in partnerships with nonprofit organizations and regional entities with a stake in hazard mitigation, which could help leverage existing resources and increase coordination and the sharing of information.

- It is vital for the Commonwealth to examine existing programs and policies to cut red tape and streamline processes for the timely and cost-effective completion of projects. For example, the Department of Environmental Protection (DEP) is responsible for issuing Chapter 105 water obstruction and encroachment permits for activities that are necessary to reduce losses to property, life, or the environment. Rural counties expressed their frustration with their inability to clear natural debris from streams due to the DEP approval process, which requires property owners to obtain permits. The accumulating debris creates dams, which increase the risk and severity of flooding in communities.

- The Commonwealth should consider supporting the monitoring of plans through the development of a standard template for tracking disaster funds, which may be particularly salient for rural counties that may lack a grant manager or paid administrative professional. County-level emergency management coordinators express an urgent need for legislators to review Title 35, PEMA Directive (D2022-02), Hazardous Material Emergency Planning and Response Act of 1990, P.L. 639, No. 165, and Pennsylvania Municipalities Planning Code (MPC) of 1968, P.L. 805, No. 247.

- Given the cascading effects of the new certification requirements on rural municipalities by PEMA, the Commonwealth should consider encouraging active participation in the hazard mitigation planning process by offering flexibility in course offerings and modalities and course substitutions for meeting the certification requirements. For example, an eight-hour class could be replaced by attendance at the risk assessment and mitigation strategy meetings. This could have numerous benefits, including aiding in the retention of municipal officials and first responders that wear multiple hats. Further, it is vital that the Commonwealth consider increasing the capacity for training courses offered to emergency management practitioners. For example, this may include the reevaluation of the class size criteria required for training to run and expand virtual courses through FEMA's

Emergency Management Institute (EMI) Independent Study (IS) Program.

- As stated by numerous interview participants, Title 35, in particular, needs to be updated to reflect the changing nature of hazards emergency management practitioners are faced with, account for the circumstances of rural areas that primarily rely on volunteers, and remove barriers that exist for effective hazard mitigation and emergency preparedness and response.

- Land-use planning should be integrated with other efforts, including stormwater management and hazard mitigation, to reduce duplication of effort and improve efficiency.

- Rural areas in particular stand to benefit from policies that require coordination between emergency managers, land-use planners, floodplain managers, watershed and

environmental protection specialists, GIS analysts, and others across a number of state agencies, such as the Departments of Environmental Protection, Health, Community and Economic Development, Transportation, and Conservation and Natural Resources.

- On April 4, 2025, FEMA announced the termination of the Building Resilient Infrastructure and Communities (BRIC) program and cancellation of all BRIC applications for Fiscal Years 2020-2023. From the program's inception in 2020, Pennsylvania has received over \$40 million for 67 projects, with more than 30 percent allocated to hazard mitigation planning in primarily rural counties. State and county governments will need to plan for additional resources in order to maintain quality mitigation planning, particularly in rural counties.

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