Abstract: School closures during the COVID-19 pandemic compromised access to essential meals for many children. In response, a public/private partnership known as the Emergency Meals-to-You program was established to deliver meals in affected rural areas of the United States. This study builds on this using a scorecard approach adapted from the United Nations Ten Essentials for Making Cities Resilient to identify...
and prioritize actions for strengthening food system resilience. A pilot food system resilience scorecard facilitated data collection from five workshops with professionals familiar with the program, emergency management, public health, or food systems. Data analysis and interpretation identified nine priority actions. These included integrating the food sector and schools within emergency management, mapping local food sector capacities, working with schools to receive de-identified data about nutritional, allergy and other health needs, developing disaster plans for sustaining food access at the school district level, and protecting ecosystem services and agricultural areas. There is an urgent need to embed the food sector and schools within emergency management. These systems are local, designed to coordinate complicated tasks in crises, multidisciplinary, and are used in many countries. Providing a ready-made framework for locally driven initiatives to strengthen food systems now and into the future.

**Keywords:** food security; emergency management; resilience; COVID-19

## 1 Introduction

Food system resilience can help mitigate the health, societal and economic consequences of disasters and other crisis situations (Boyaci-Gündüz et al. 2021). The COVID-19 pandemic demonstrated how food systems can be impacted, especially for vulnerable populations such as children. School closures were used to help mitigate the spread of COVID-19, and progressively expanded across the United States from March 2020. Many schools were recommended or ordered to close for the academic year, affecting approximately 124,000 U.S. public and private schools, and 55 million students (Education Week 2021). This removed a much-needed safety net for students as schools provide essential services beyond education, including meals, health promotion, and other activities (O’Neill et al. 2020). Closed schools compromised essential meals for the 15 million students involved in the School Breakfast Program (SBP) and the 30 million children in the National School Lunch Program (NSLP), resulting in significant increases in food insecurity (Dunn et al. 2020; McLoughlin et al. 2020).

To address this food security crisis, the federal government put a range of programs in-place across the United States. This included congress expanding nutrition assistance to families impacted through the Pandemic Electronic Benefits Transfer (P-EBT), which allowed food benefits to be loaded onto EBT cards, and administration flexibilities created for the United States Department of Agriculture (USDA) school-based nutrition programs (McLoughlin et al. 2020; USDA 2022). However, in low population densities and rural areas many could not access these food
programs, which are suited to condensed urban areas (Ryan et al. 2022). This gap in services was identified prior to the COVID-19 pandemic by the Baylor Collaborative on Hunger and Poverty (BCHP), which created the Meals-to-You (MTY) pilot in partnership with the USDA. This program provided summer meals (when schools were closed) to students in rural areas who could not access traditional congregate feeding sites. This three-year pilot was in the second summer with plans to expand from Texas to New Mexico and Alaska when the COVID-19 pandemic emerged.

The USDA, BCHP, McLane Hunger Solutions, PepsiCo's Food for Good, and Chartwell's K-12 used this nontraditional MTY model to create Emergency Meals-to-You (eMTY) (BCHP 2021). This was a public/private partnership to deliver meals to students in rural areas affected by COVID-19 school closures (BCHP 2021). The initial aim was to provide one million meals per week for children affected by nationwide school closures, however, this rapidly increased from April to May 2020 to five million meals per week (Baylor University 2022; USDA 2021). Actions included delivering directly to the student home what would normally be received at school over a two-week period using boxes containing 20 meals (10 breakfasts and 10 lunches) (USDA 2021). This program provided 38.7 million meals to approximately 270,000 children in rural communities across 43 states and Puerto Rico between April and August 2020 (Dunwoody 2020; Norman 2020).

By leveraging the knowledge and experiences of eMTY, we conducted workshops to identify strategies for strengthening food system access and resilience before, during, and after disasters and crisis situations. This included exploring what strategies could be used to mitigate the health, societal, and economic consequences of food related emergencies in the short, medium, and long-term. Due to the interdisciplinary nature of this study and the geographical areas covered, the findings could be translated into existing multidisciplinary emergency management structures and systems, and potentially applied in low, middle, and high-income settings. Ultimately, the goal of this study was to develop and advance strategies for strengthening food system resilience for school-age children after the COVID-19 pandemic and beyond.

2 Methodology

The study was conducted using workshops to identify, rank and prioritize strategies for strengthening food system resilience (Figure 1). Individual workshops were conducted to collect data using a scorecard approach. This was followed by data interpretation and analysis. A consensus-based discussion process was used to
develop and rank priority actions. After individual workshops, the data were combined, aggregated, and interpreted to remove duplicates and develop priority actions representative of all locations.

The workshops methodology was selected because it provides a platform to explore and identify factors for understanding complex work and knowledge processes such as eMTY (Ørngreen and Levinsen 2017). The interactive and participatory nature of workshops is particularly helpful when the aim of data collection is to influence future processes (Ørngreen and Levinsen 2017; Shamsuddin et al. 2021). Workshops also support the identification of factors which are not obvious to the researchers or the participants prior to commencing the process (Ørngreen and Levinsen 2017). The facilitators applied a scorecard during the workshops to identify, rank and prioritize areas for action. This is a process that offers an opportunity to unlock community-based knowledge and is conducive to new understandings
around local challenges and possibilities (Sanchez-Betancourt and Vivier 2019). An overview of the scorecard approach, data collection, data analysis and interpretation, and the sampling strategy is provided below.

2.1 Scorecard Approach

The scorecard approach for this project was based on a method developed as a contribution to the Making Cities Resilience (MCR) Campaign by Architecture, Engineering, Construction, Operations, and Management (AECOM) and IBM with support from the United States Agency for International Development (USAID) and the European Commission (UNDRR 2020a). It was then tested with cities and expert focus groups. The scorecard is directly related to the Ten Essentials for Making Cities Resilient (Ten Essentials), which were developed to accelerate implementation of the United Nations Sendai Framework for Disaster Risk Reduction (2015–2030) at the local level (UNDRR 2022). These include:

- Essential 1: Organize for disaster resilience
- Essential 2: Identify, understand, and use current and future risk scenarios
- Essential 3: Strengthen financial capacity for resilience
- Essential 4: Pursue resilient urban development and design
- Essential 5: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
- Essential 6: Strengthen institutional capacity for resilience
- Essential 7: Understand and strengthen societal capacity for resilience
- Essential 8: Increase infrastructure resilience
- Essential 9: Ensure effective preparedness and disaster response
- Essential 10: Expedite recovery and build back better.

The Public Health System Scorecard (Health Scorecard) addendum was developed after application of the Disaster Resilience Scorecard for Cities revealed a need for a deep dive into the health sector. The Health Scorecard was developed with input from a group of multisectoral experts, including the United Nations Office for Disaster Risk Reduction (UNDRR) and the World Health Organization (UNDRR 2020b). Version 1.0 was launched in July 2018 and Version 2.0 in April 2020, which included contributions from the first author of the current paper (UNDRR 2020c). The Health Scorecard has been used by local and national governments to identify priorities and develop action plans for strengthening resilience. It is freely downloadable and available in over ten languages. A modified version of the Health Scorecard with a direct link to the Ten Essentials was used in the workshops (UNDRR 2020b). This
modified version, the Food System Resilience (Food Scorecard), was developed for this project and piloted by the research team. The indicators (questions) used are in the results section.

2.2 Data Collection

Data were collected through five workshops from August 2020 to January 2021 across the United States. The locations included Waco, Texas (August 3, 2021), Montgomery, Alabama (August 5, 2021), Fargo, North Dakota (August 12, 2021), St. Louis, Missouri (September 15, 2021), and Charleston, South Carolina (January 11, 2022). The USDA regions covered were the Heartland (St. Louis), Northern Plains (Fargo), Southern Plains (Waco), and Southern (Charleston and Montgomery).

To allow online and in-person participation, the Food Scorecard was developed into a novel cell phone application through ExPo Go © 2022. The App was used by participants to document and submit their scores (and comments, if applicable) for each indicator of the Scorecard. This allowed for streamlined data input and analyses. Those that were not able to use the App were given hard copies or alternate forms of access via Google Documents. Their scores were manually inputted to the database for data analysis. Workshop participants used the App to score the level of preparedness from 0 to 5 (5 being the highest score) for 21 food security indicators.

The workshops were completed in two parts and in-total each workshop took approximately 6 h. During the first 4 h participants completed the Scorecard with two facilitators providing clarifying information about each indicator. Each indicator assessment generally took between 5 and 10 min to complete. Participants were encouraged to complete the Food Scorecard based on their role and expertise, experiences, and perspectives. The final 2 h focused on anonymized data interpretation and analysis.

2.3 Data Interpretation and Analysis

The scorecard results from each participant were aggregated and then a mean for each indicator was calculated. The results were presented to the workshop participants as a table with the lowest ranking four to five indicators highlighted for group discussion. The decision on removal, clarification, and ranking of an indicator for discussion was determined by workshop participants through a consensus approach (Hsu and Sandford 2007). Once consensus was reached on the indicators to be discussed, workshop participants began developing priority actions for each selected indicator. When finalized, the priority actions were applied to a ranking grid
This impact versus difficulty process allowed workshop participants to discuss and visualize the priority actions in terms of which should be addressed initially according to the impact on food systems and difficulty to solve (Simon and Canacari 2012). When complete, the priority actions were presented to the participants for input and finalization.

Following the individual workshops, data were collated, interpreted, and analysed by the research team. The mean scores for each indicator from the workshops were combined and then averaged. This was conducted to aid interpretation and identify priority actions from all five workshops. All priority actions were collated and grouped into different themes. We then identified where there was duplication and interpreted the data to develop consolidated priority actions. At this point no ranking for the priority actions across all workshops was applied because the goal was to provide representative recommendations.

The interpretation and analysis of the data from all workshops was initially performed by one researcher. This person helped develop the Food Scorecard, had applied different versions of this tool, and previously published research papers in this area. This initial analysis was then preliminary reviewed by two researchers before being presented to all authors for review and input. This specific process was thus designed to ensure reliability of the findings and recommendations (for example, confirming/reviewing results) (McDonald, Schoenebeck, and Forte 2019).
2.4 Sampling Strategy

A purposeful sampling strategy was used to select participants and workshop locations (Creswell 2013). Participants were invited through an e-mail or discussion with appropriate organizational representatives. As the program lead for eMTY, BCHP was the first point of contact to identify participants. After contacting possible participants, the researchers asked if they were aware of anyone else who should be invited to participate. The approach towards recruitment was consistent with snowball sampling (Sadler et al. 2010).

Workshop locations were selected based on a combination of access, convenience, and an effort to ensure variety among rural and urbanized settings. The study was conducted during the COVID-19 pandemic, which also limited the locations for these hybrid workshops. Additionally, BCHP provided input on the workshop locations. The target audience were professionals familiar with the eMTY program, emergency management, public health, or food systems.

2.5 Human Subjects Approval Statement

This study was determined by Baylor University to meet the exclusion criteria for Institutional Review Board approval per 45 CFR 46.102(e) & (f).

3 Results

There were 69 participants across the five workshops (Table 1). The workshop in Montgomery, AL, had the most participants with 20 (16 in-person and 4 virtual). This was followed by Waco, TX, with 15 participants (10 in-person and 5 virtual), Fargo, ND, 14 (11 in-person and 3 virtual) and 10 in-person participants at both the St. Louis, MO, and Charleston, SC, workshops. All participants were over 21 years old. Participants included school administrators and regional managers, emergency preparedness representatives, child nutrition specialists, companies and organizations involved in supplying and coordinating food delivery, and government officials familiar with the eMTY program, transportation experts, and environmental health professionals. The others included public health professionals, registered dieticians, human resources, facilities and operations managers, and academics. Results from the workshops and the priority actions developed from this study are provided in the following.
3.1 Workshops

After combining and calculating mean workshop scores, the three indicators with the lowest scores, indicating the areas most in need of improvement, were A1.2 (2.05), A2.3 (2.18) and A10.1 (2.19) (Table 2). Indicator A1.2 was identified as the lowest scoring indicator in Fargo and St. Louis. There were three workshops where A2.3 was in the three lowest scores, Fargo, St. Louis, and Waco. Both Charleston and Waco identified A10.1 as a priority. Based on these results, the priority Ten Essentials are integrating the food sector and governance (Essential 1), including food availability and access emergencies in disaster scenarios (Essential 2), and inclusion of the food sector in recovery/building back better (Essential 10).

The three indicators with the highest scores across all workshops were A7.2 (3.04), A8.3 (2.92) and A2.69 (2.1). This reflects the areas with the highest level of

<table>
<thead>
<tr>
<th>Table 1: Demographic information for workshop participants.</th>
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<tbody>
<tr>
<td>Demographic</td>
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<tr>
<td>Gender</td>
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<td>Sector</td>
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Table 2: Workshop scores from Charleston (C), Fargo (F), Montgomery (M), St Louis (S) and Waco (W).

<table>
<thead>
<tr>
<th>Essential</th>
<th>Ref</th>
<th>Indicator/assessment area</th>
<th>C</th>
<th>F</th>
<th>M</th>
<th>S</th>
<th>W</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of the food sector and governance (Essential 1)</td>
<td>A1.1</td>
<td>To what extent does/do the governance mechanism(s) for disaster risk management integrate the full breadth of food availability and access needs?</td>
<td>1.75</td>
<td>2.4</td>
<td>2.5</td>
<td>2.11</td>
<td>2.6</td>
<td>2.27</td>
</tr>
<tr>
<td>A1.2</td>
<td></td>
<td>To what extent did the governance mechanism(s) for disaster risk management integrate the emergency meals-to-you program during the COVID-19 response?</td>
<td>2.25</td>
<td>0.55</td>
<td>3</td>
<td>1.56</td>
<td>2.9</td>
<td>2.05</td>
</tr>
<tr>
<td>Integration of food availability and access emergencies in disaster scenarios (Essential 2)</td>
<td>A2.1</td>
<td>To what extent is food availability and access included in disaster risk planning for disease outbreaks, pandemics, water shortages and other events?</td>
<td>2.43</td>
<td>2.3</td>
<td>3.6</td>
<td>2.34</td>
<td>2.8</td>
<td>2.69</td>
</tr>
<tr>
<td>A2.2</td>
<td></td>
<td>To what extent is food supply chain and logistical impacts included in scenario planning for disasters such as a flood, hurricane, tornado, or earthquake?</td>
<td>2.43</td>
<td>1.9</td>
<td>2.65</td>
<td>2</td>
<td>2.4</td>
<td>2.28</td>
</tr>
<tr>
<td>A2.3</td>
<td></td>
<td>To what extent are pre-existing chronic health issues and nutritional needs included in disaster scenarios where food availability and access are likely to impede recovery?</td>
<td>3</td>
<td>1.5</td>
<td>2.4</td>
<td>2.11</td>
<td>1.9</td>
<td>2.18</td>
</tr>
<tr>
<td>Integration of the food sector and finances (Essential 3)</td>
<td>A3.1</td>
<td>To what extent is emergency and regular funding identified and available to address food availability and access risks and impacts of disasters?</td>
<td>2.43</td>
<td>2.2</td>
<td>2.9</td>
<td>2.78</td>
<td>2.3</td>
<td>2.52</td>
</tr>
<tr>
<td>Integration of the food sector and land use/building codes (Essential 4)</td>
<td>A4.1</td>
<td>To what extent are key food sector facilities located and built in a manner that will allow them to continue to be operational after a disaster?</td>
<td>2.17</td>
<td>2.5</td>
<td>2.7</td>
<td>2.11</td>
<td>2.1</td>
<td>2.32</td>
</tr>
<tr>
<td>Management of ecosystem services that affect the food sector (Essential 5)</td>
<td>A5.1</td>
<td>To what extent are ecosystem services that provide food availability and access benefits identified and protected?</td>
<td>2.17</td>
<td>2.6</td>
<td>2.63</td>
<td>1.89</td>
<td>2.6</td>
<td>2.38</td>
</tr>
</tbody>
</table>
### Table 2: (continued)

<table>
<thead>
<tr>
<th>Essential</th>
<th>Ref</th>
<th>Indicator/assessment area</th>
<th>C</th>
<th>F</th>
<th>M</th>
<th>S</th>
<th>W</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of the food sector and institutional capacity (Essential 6)</td>
<td>A6.1</td>
<td>To what extent are the relevant food sector workforce, competencies and skills required to maintain food access available to the city?</td>
<td>2.5</td>
<td>2.9</td>
<td>3.6</td>
<td>1.89</td>
<td>2.4</td>
<td>2.66</td>
</tr>
<tr>
<td>A6.2</td>
<td></td>
<td>To what extent are food availability and access data on vulnerabilities and capacities shared with other stakeholders who need it?</td>
<td>2</td>
<td>2.8</td>
<td>3.1</td>
<td>2.11</td>
<td>2.7</td>
<td>2.54</td>
</tr>
<tr>
<td>Integration of the food sector and societal capacity (Essential 7)</td>
<td>A7.1</td>
<td>To what extent do communities understand and are able to fulfil their roles in maintaining food availability and access before, during and after a disaster?</td>
<td>1.33</td>
<td>2.7</td>
<td>2.56</td>
<td>2.23</td>
<td>2.4</td>
<td>2.24</td>
</tr>
<tr>
<td>A7.1.1</td>
<td></td>
<td>To what extent did communities receive and act upon the emergency meals-to-you program?</td>
<td>2</td>
<td>1.1</td>
<td>3.7</td>
<td>2.56</td>
<td>2.4</td>
<td>2.35</td>
</tr>
<tr>
<td>A7.2</td>
<td></td>
<td>To what extent could the communities’ food availability and access needs be addressed by the Emergency Meals-to-You program?</td>
<td>2.33</td>
<td>3.8</td>
<td>4</td>
<td>2.25</td>
<td>2.8</td>
<td>3.04</td>
</tr>
<tr>
<td>Integration of the food sector and infrastructure resilience (Essential 8)</td>
<td>A8.1</td>
<td>To what extent is food availability and access infrastructure resilient?</td>
<td>2.17</td>
<td>3.5</td>
<td>2.9</td>
<td>2.11</td>
<td>2</td>
<td>2.54</td>
</tr>
<tr>
<td>A8.2</td>
<td></td>
<td>To what extent are emergency systems able to handle a sudden demand in food availability and access?</td>
<td>2.17</td>
<td>2.9</td>
<td>2.9</td>
<td>2.11</td>
<td>2.1</td>
<td>2.44</td>
</tr>
<tr>
<td>A8.3</td>
<td></td>
<td>To what extent can the required infrastructure be maintained to continue food service delivering at schools before, during and after a disaster?</td>
<td>2.17</td>
<td>3.5</td>
<td>3.2</td>
<td>3.12</td>
<td>2.6</td>
<td>2.92</td>
</tr>
<tr>
<td>Integration of the food system and disaster response (Essential 9)</td>
<td>A9.1</td>
<td>To what extent do early warning systems exist for impending food availability and access emergencies?</td>
<td>1.83</td>
<td>2.9</td>
<td>3.3</td>
<td>1.89</td>
<td>2.5</td>
<td>2.48</td>
</tr>
</tbody>
</table>
resilience. A7.2 was identified as the highest scoring indicator in Fargo and Montgomery. This related to how food availability and access needs could be addressed by the eMTY. Meanwhile, A8.3 was only the highest score in St. Louis and A2.1 was not identified in any workshop but came in as number three overall. Based on these results, the Ten Essentials with the highest level of resilience related to the integration of the food sector with societal capacity (Essential 7), infrastructure (Essential 8), and food availability and access emergencies in disaster scenarios (Essential 2). Essential 2 was the only one to have indicators considered in the top three for both highest and lowest overall scores.

3.1.1 Charleston, South Carolina

After application of the scorecard, the priority indicators identified by the Charleston participants (based on lowest score) were A7.1 (average 1.33), A10.1 (average 1.33), A1.1 (average 1.75), and A9.1 (average 1.83). The highest scoring indicators were A7.2 (average 4.0), A9.2 (average 2.67), and A6.1 (average 2.5). After discussing the results, developing actions, and applying the priority grid, workshop participants recommended:

1. Promote, monitor, and assess school and community food service needs through local emergency management structures (A10.1)
2. Leverage existing food sector capacities to establish and improve disaster risk management mechanisms (A1.1)

3. Identify stakeholders and engage responders to understand local food access needs (A7.1)

4. Develop and establish early warning systems for local food sector disruption (A9.1)

A common theme was the need to focus locally on surge capacity. It was recommended a partnership be created among farmers, retailers, and the emergency sector to preserve farm-to-food processes. This would bolster the economy, shorten supply chains, and help protect local agricultural ecosystems. For example, schools provide good locations for food preparation and service, however, storage space is often limited to one week worth of supplies. Participants recommended that an early warning system should be established for local food sector disruption. This could incorporate a composite of indicators such as nutritional needs at the school level, global food supply chain risks, local capacity of the food sector, workforce skills and availability, and understanding likely impacts of a disaster on food access.

3.1.2 Fargo, North Dakota

The priority indicators identified during the scorecard process (based on lowest score) at the Fargo workshop were A1.2 (average 0.55), A7.1.1 (average 1.1), A2.3 (average 1.50), A2.2 (average 1.9), A3.1 (average 2.2) and A2.1 (average 2.3). The highest scoring indicators were A7.2 (average 3.8), A8.1 (average 3.5), and A8.3 (average 3.5). Here again, the results from the scorecard application were discussed and adjustments made through group consensus. This included removing A2.2 as this was covered in A2.3 and the removal of A7.1.1 as this referred to eMTY and there was limited knowledge of this amongst the participants. Following discussion and adjustments, participants developed actions and applied these to the priority grid. The recommendations from this workshop were:

1. Incorporate eMTY program into disaster governance at local levels (A1.2)
2. Include food availability/access emergencies as disaster scenarios (A2.1)
3. Include pre-existing chronic health issues and nutritional needs in food sector disaster planning (A2.3)
4. Increase local community awareness (schools and organizations) and linkages with emergency funding for food availability, access, and dissemination (A3.1)

Overall, participants believed incorporating eMTY (or a similar program) and integrating food availability/access into disaster scenarios within local emergency management governance structures would help enhance food system resilience.
Also, from an environmental public health perspective, food availability and access generally are not discussed in emergency planning but should be included. There is also a need to increase local knowledge, community awareness, and community linkages to funding and food. These could be achieved by conducting table-top exercises and strengthening existing partnerships and organizations, which are already well-versed in food supply and surge capacity.

3.1.3 Montgomery, Alabama

After application of the scorecard, the priority indicators identified (based on lowest score) during the Montgomery workshop were A1.1 (average 2.5), A2.3 (average 2.4), A7.1 (average 2.56), A9.2 (average 2.4), and A10.1 (average 2.61). The highest scoring indicators were A7.2 (average 4), A7.1.1 (average 3.7), A2.1 (average 3.6) and A6.1 (average 3.6). These results were discussed with the group agreeing the challenges associated with A7.1 could be addressed in A10.1. After developing actions and applying the priority grid, workshop participants recommended:

1. Representation of schools and food sectors on the local emergency committee (school and food sector) (A9.2)
2. Representation on multi-sectoral committees (school) (A1.1)
3. Local level plans to maintain food availability and access (for example, school districts aligned with sporting clubs, churches and other local organizations) (A10.1)
4. Sharing nutritional needs and allergy information with local emergency committee (A2.3)

In general, participants highlighted the important role of schools and teachers within the food system during disasters. It was recommended school-collected data (nutritional and health needs) and logistical capacities (use of school kitchens) be considered during disaster planning and emergency management processes. Complementary to this would be planning to use school bus routes to deliver meals to children and their families. Partnerships should also be developed with local churches and other influential entities in the community, which are not directly related to the food systems but vital in connecting families in need.

3.1.4 St. Louis, Missouri

The priority indicators identified during the scorecard process (based on lowest score) in St. Louis were A1.2 (average 1.56), A10.1 and A10.2 (average 1.63), A5.1 (average 1.89), A6.1 (average 1.89), and A9.1 (average 1.89). The highest scoring indicators were A8.3 (average 3.12), A3.1 (average 2.78), and A7.1 (average 2.56). Results
from the scorecard application were discussed and an adjustment made through group consensus with indicator A10.2 removed as this was similar to A10.1. The indicators were then used to develop priority actions before ranking. The recommendations from this workshop were:

1. Protecting ecosystem services that provide food sector benefits (A5.1)
2. Making the eMTY program part of disaster governance (A1.2)
3. Mitigating long-term impacts of disasters on the food sector and well-being (A10.1)
4. Ensuring availability of the food sector workforce with relevant competencies and skills for disaster resilience (A6.1)
5. Establish early warning systems for food-related emergencies (A9.1)

Preserving local ecosystems was considered important by workshop participants. This is because urban environmental degradation reduces the ability to produce local food. There is also a need for more coordinated community networks of pantries, food banks, warehouses, and retail outlets, which can pivot quickly to emergency production and distribution. However, there may be institutional and regulatory barriers. For example, schools are limited in the food options that can be provided and how this is served in emergency situations. It was recommended this be reviewed to allow faster and more flexible responses of food preparation and delivery when needed. The group also suggested an eMTY-type effort to address elder hunger, which could begin with co-ordination and rationalization of existing programs. Overall, participants suggested current supply chains are too long and vulnerable. More diverse and local food sources are required.

3.1.5 Waco, Texas

After application of the scorecard at the Waco workshop, the priority indicators identified (based on lowest score) were A2.3 (average 1.9), A4.1 (average 2.1), A8.1 (average 2.0), and A8.2 (average 2.1). The highest scoring indicators were A1.2 (average 2.9), A2.1 (average 2.8), A7.2 (average 2.8), and A7.2 (average 2.8). Workshop participants agreed with the results, developed actions, and applied the priority grid. The priority actions recommended were:

1. Sharing of data about nutritional needs at the school level (A2.3)
2. Mapping farm-to-school-to-table to identify resilience needs (A4.1)
3. Strengthening of local food providers (A8.1)
4. Surge capacity for rural locations (A8.2)

A common theme was the need to integrate the food and school sectors within the emergency management system. For example, the schools closed for instruction during COVID-19 often had their kitchens open and were able to prepare food and
cook meals. However, in some instances this was an untapped resource for surging food supply. By expanding emergency management systems to include the existing capacities of the food and school sectors, which are already well-versed in food supply and surge capacity, they would become part of disaster mitigation, preparedness, response, and recovery actions. In addition, data mapping of chronic health issues, co-morbidities, geography, climate and weather, farm-to-table needs, historical disaster footprints, and transportation routes would help in predicting and determining food supply needs. More specifically, determining the origin, collection, flow of food need, supply information and the way in which it could be shared pre-disaster would allow for current and consistent food needs data for schools and suppliers to be available. Key aspects include enabling a rapid response by shortening the supply chain and improving food system resilience.

3.2 Integrated Priority Actions

Each workshop emphasized different aspects of the Food Scorecard indicators, and their summarized recommended actions are also compiled in Table 3. Several indicators, including A2.3 sharing nutritional needs and allergy information with local emergency committee, were found to be priority topics by multiple workshops, and the nature of input from the workshops suggested further compilation of integrated priority actions. Based on the discussion and feedback from the workshops, the authors further organized the priority actions identified into the following themes: coordination, early warning systems, ecosystems, governance, mitigation, nutrition, planning, supply chain, and workforce. All the UNDRR Ten Essentials areas of coverage were represented, which include governance and financial capacity (Essentials 1–3), planning and disaster preparation (Essentials 4–8), and disaster response and post-event recovery (Essentials 9–10) (UNDRR 2017).

The nine integrated priority actions represent the areas in greater need of investment and effort to improve food security and community resilience. The actions include:

1. Coordination: Local emergency managers identify food sector stakeholders, explore food access needs, and share findings with community organizations, private sector, and government agencies.
2. Early Warning Systems: Establish early warning systems for food-related emergencies.
3. Ecosystems: Preservation and management of ecosystem services that provide food sector benefits.
4. Governance: Local emergency committee to include representatives from schools and the food sector.
Table 3: Integrated priority actions.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Scorecard Ref</th>
<th>UNDRR Ten Essential area of coverage</th>
<th>Workshop</th>
<th>Action identified in workshop</th>
<th>Integrated priority action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordination</td>
<td>A3.1</td>
<td>Governance and financial capacity</td>
<td>Fargo</td>
<td>Increase local community awareness (schools and organizations) and linkages with emergency funding for food availability, access, and dissemination</td>
<td>Local emergency managers identify food sector stakeholders, explore food access needs and share findings with community organizations, private sector, and government agencies</td>
</tr>
<tr>
<td>Early warning systems</td>
<td>A7.1</td>
<td>Planning and disaster preparation</td>
<td>Charleston</td>
<td>Identify stakeholders and engage responders on local food access needs</td>
<td>Establish early warning systems for food-related emergencies</td>
</tr>
<tr>
<td></td>
<td>A9.1</td>
<td>Disaster response and post-event recovery</td>
<td>Charleston</td>
<td>Develop and establish adaptable early warning systems for local food sector disruption</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A9.1</td>
<td>Disaster response and post-event recovery</td>
<td>St. Louis</td>
<td>Establishing early warning systems for food-related emergencies</td>
<td></td>
</tr>
<tr>
<td>Ecosystems</td>
<td>A5.1</td>
<td>Planning and disaster preparation</td>
<td>St. Louis</td>
<td>Protecting ecosystem services that provide food sector benefits</td>
<td>N/A</td>
</tr>
<tr>
<td>Governance</td>
<td>A1.1</td>
<td>Governance and financial capacity</td>
<td>Montgomery</td>
<td>Representation on multi-sectoral committees (school)</td>
<td>Local emergency committee include representatives from schools and the food sector</td>
</tr>
<tr>
<td></td>
<td>A1.1</td>
<td>Governance and financial capacity</td>
<td>Charleston</td>
<td>Leverage existing food sector capacities to establish and improve disaster risk management mechanisms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A1.2</td>
<td>Governance and financial capacity</td>
<td>Fargo</td>
<td>Incorporate eMTY program into disaster governance at local levels</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Scorecard Ref</th>
<th>UNDRR Ten Essential area of coverage</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Governance and financial capacity</td>
<td>St. Louis</td>
<td>Making the eMTY program part of disaster governance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disaster response and post-event recovery</td>
<td>Montgomery</td>
<td>Representation of schools and food sectors on local emergency committee (school and food sector)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disaster response and post-event recovery</td>
<td>Charleston</td>
<td>Promote, monitor, and assess school and community food service needs through local emergency management structures</td>
<td></td>
</tr>
<tr>
<td>Mitigation</td>
<td>A2.1</td>
<td>Governance and financial capacity</td>
<td>Fargo</td>
<td>Include food availability/access emergencies as disaster scenarios</td>
<td>Explore food availability/access risks and identify strategies for mitigating impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disaster response and post-event recovery</td>
<td>St. Louis</td>
<td>Mitigating long-term impacts of disasters on the food sector and well-being</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>A2.3</td>
<td>Governance and financial capacity</td>
<td>Montgomery</td>
<td>Sharing nutritional needs and allergy information with the local emergency committee</td>
<td>Sharing data about nutritional and allergy needs from schools with the local emergency management committee</td>
</tr>
<tr>
<td></td>
<td>A2.3</td>
<td>Governance and financial capacity</td>
<td>Waco</td>
<td>Sharing of data about nutritional needs at the school level</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>A2.3</td>
<td>Governance and financial capacity</td>
<td>Fargo</td>
<td>Include pre-existing chronic health issues and nutritional needs in food sector disaster planning</td>
<td>Develop disaster plans for sustaining food supply and access at the school district level</td>
</tr>
</tbody>
</table>
5. Mitigation: Explore food availability/access risks and identify strategies for mitigating impacts.

6. Nutrition: Share data about nutritional and chronic health (e.g. allergies) needs from schools with the local emergency management committee.

7. Planning: Develop disaster plans for sustaining food supply and access at the school district level.

8. Supply Chain: Map local food sector capacities and surge needs, including from farm-to-table.

9. Workforce: Availability of the food sector workforce with relevant competencies and skills.

### Table 3: (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Scorecard Ref</th>
<th>UNDRR Ten Essential area of coverage</th>
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<th>Action identified in workshop</th>
<th>Integrated priority action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workforce</td>
<td>A6.1</td>
<td>Planning and disaster preparation</td>
<td>St. Louis</td>
<td>Ensuring availability of the food sector workforce with relevant competencies and skills for disaster resilience</td>
<td>N/A</td>
</tr>
<tr>
<td>A8.1</td>
<td>Planning and disaster preparation</td>
<td>Waco</td>
<td>Surge capacity for rural locations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A8.2</td>
<td>Planning and disaster preparation</td>
<td>Waco</td>
<td>Strengthening of local food providers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply chain</td>
<td>A4.1</td>
<td>Planning and disaster preparation</td>
<td>Waco</td>
<td>Mapping farm-to-school-to-table to identify resilience needs</td>
<td>Map local food sector capacities and surge needs, including from farm-to-table</td>
</tr>
<tr>
<td>A10.1</td>
<td>Disaster response and post-event recovery</td>
<td>Montgomery</td>
<td>Local level plans to maintain food availability and access (for example, school districts aligned with sporting clubs, churches, and other local organizations)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The overarching aspect of these actions is to ensure better integration of the food sector with the emergency management system, data sharing and ensuring access to nutritious food before, during and after disasters. Most of these actions could be implemented as part of the mitigation and preparedness phases of emergency management.

4 Discussion

Strengthening food system resilience is vital to help mitigate the health, societal and economic consequences of disasters and other crises in the short, medium, and long-term (Ryan et al. 2020). Achieving such resiliency is increasingly urgent because an estimated fifty million people are food insecure in the United States, making this one of the leading public health and nutrition issues for the nation (Gundersen and Ziliak 2015; Ziliak and Gundersen 2016). For example, inadequate access to nutritious food is associated with higher healthcare costs and poor health outcomes for both adults and children, suggesting it may be an important driver of health disparities (Gundersen et al. 2017). Poor nutrition is also related to serious adverse health effects such as suppressed body growth, accelerated ageing, reduced muscle mass and strength, reduced bone density, reduced heart contractility, lower lung capacity, limited cognitive performance, and reduced immune response to infective agents (Wells et al. 2021). Therefore, a new path towards strengthening food system resilience could be built on existing and previous programs, including eMTY.

Efforts have been made to address the food insecurity challenge through various programs. For example, the Supplemental Nutrition Assistance Program (SNAP) allows eligible people to buy food in authorized retail food outlets. However, many do not participate for the following reasons: transaction costs such as time and cost spent travelling to a SNAP office, the benefit level can be quite small, for example, for one or two person households this could be as low as $16 per month, and receiving SNAP may carry a negative stigma (Gundersen and Ziliak 2018). Complementary to this effort are the SBP and NSLP, which are supported and funded by the USDA. The unprecedented nature of COVID-19, school closures and eMTY provided an opportunity to reflect on these programs and consider alternatives for underserved populations. For example, the Urban Institute found the Meals-to-You program, including eMTY, is as effective as the NSLP in providing food to people in need and also provides a useful tool for reducing food insecurity among hard-to-reach households (Waxman et al. 2021).

The eMTY could provide another template for addressing food insecurity for older adults. The particularly vulnerable are older adults with caregiving responsibilities aged 50–59 years (Waxman 2021). Older seniors are less likely to be
food insecure compared to younger seniors (Gundersen and Ziliak 2018). Among elderly food insecurity and nutrient deficiency often result in low level of vitamins E, C, D, B2, B12, zinc, phosphorus, and calcium. These findings could serve to policy makers to build food security more oriented to risk groups (Zarei et al. 2021). Also, people struggling with food insecurity often experience limitations in their daily activities, which are equivalent to those of food-secure seniors who are 14 years older (Gundersen and Ziliak 2015). Waxman (2021) recommended five actions to address this challenge: 1. Strengthen the power of SNAP for older adults; 2. Help federal nutrition programs and charitable food providers meet older adults where they are; 3. Support grand families with additional resources; 4. Prioritize racial and ethnic equity in all public and private responses to food insecurity; 5. Resolve to not reach 2030 in the same place we are now. A modified eMTY could help achieve recommendations 2, 3 and 4 by providing nutritious, safe, and brand-named food directly to older adults.

There is a need to integrate the food sector and schools with emergency management systems. This was a common theme identified in the current study and by Ryan et al. (2022). Addressing this need could allow food related emergency scenarios to be better considered and promote coordination of community networks such pantries, food banks, warehouses, and retail outlets that can pivot quickly to emergency production and distribution. Also, the agency administering the SBP and NSLP varies by jurisdiction, however, each works directly with local educational bodies (McLoughlin et al. 2020). Decentralized food supply chain management with applied blockchain technology could provide another advantage for storage, transport and distribution on local levels with less possibilities of failure due to better monitoring of the food supply chain (Abdullah, Rahardja, and Oganda 2021). Emergency management systems are local, designed to coordinate complicated tasks in crises, multidisciplinary, and are in-place around the country and many parts of the world. These decentralized systems provide a ready-made framework for locally driven initiatives to strengthen food systems.

The Food Scorecard was effective in unpacking the requirements of the Ten Essentials and how they relate to the food system resilience. Linking to the “Ten Essentials” helped ensure a holistic coverage of the disaster resilience field, including factors indirectly influencing food systems (Williams 2016). Other versions of the scorecard have been used around the world and the popularity is demonstrated by the Health Scorecard now being available in over ten languages. The Food Scorecard also supported the perspective that resilience is a “system-of-systems” issue that affects multiple physical and social systems, and therefore needs to be addressed in each of these systems (Williams 2016). Overall, this approach is translatable to different settings and scenarios because of the level of granularity used to identify areas needing improvement to strengthen resilience (Jones et al. 2021).
The App version of the Food Scorecard was effective in facilitating input from both in-person and online participants. However, there was a challenge on the user interface with ExPo Go © 2022. This system worked well to test the methodology, but some participants were unable to download the App. The feedback from participants who were able to use the App found this to be very useful. It is recommended the Food Scorecard and others with the format be transitioned and upgraded into a more user-friendly App (for example, easily downloadable and accessible).

Further research is recommended to rank and prioritize actions and needs across the United States and beyond. The networks and connections made through the eMTY program could be leveraged to examine underserved areas across broader spatial scales. Exploring environmental public health systems and characteristics in the survey areas would be beneficial, given the inherent linkages between poverty, hunger and public health service delivery. Providing an insight into what systems exist to address and monitor risks relating to drinking water, food safety, hazardous materials, healthy homes and schools, infectious diseases, vector-borne diseases, and other issues that compromise community and individual well-being across the urban to periurban to rural gradient (Brooks and Ryan 2021). This process could also be applied to other sectors, beyond schools, to examine how closures due to disasters impact nutrition of families in poverty, and elders living alone. In addition, establishing advanced knowledge of regulatory processes and what needs to be addressed to facilitate distribution from farm to local food stores in these locations would provide another step towards strengthening food systems (Gundersen and Ziliak 2018).

To translate the priority actions identified into practice, capacity building activities should commence at the local level. This could include, for example, socializing the concept with local officials, parent teacher associations and school boards. Local emergency managers and their teams could facilitate this process with support provided as needed from state and federal agencies. The activities could include mapping local food sector capacities and surge needs, working with schools to receive de-identified data about nutritional and allergy needs, developing disaster plans for sustaining food supply and access at the school district level (including farm-to-table), and maintaining ecosystem services and the integrity of agricultural areas that provide food sector benefits. A focus on protecting ecosystem services and agricultural areas would be consistent with priorities identified by the Food and Agriculture Organization of the United Nations (FAO 2021). One approach is ecological intensification, which is based on organisms that make direct or indirect contribution to agricultural production where yield is maximized while environmental impacts minimized (Bommarco, Kleijn, and Potts 2013).

We expect this scorecard approach and actions identified in the current study can be transferred to different income settings and locations to understand and
prioritize needs. This process helped create awareness of the importance of food security and brought together stakeholders that may not interact under usual circumstances. The next step would be to develop detailed action plans to address the gaps, with roles, responsibilities, and timelines articulated. Ultimately, implementing the priority actions identified here would provide benefits for underserved communities by demonstrating a whole-of-society-needs approach to strengthening food systems.

5 Limitations

The authors’ work, research and teaching influenced this study. To minimize the impact of this limitation, a transdisciplinary research team was used to complete this research. The team had experience, for example, in food systems, emergency management, environmental health science, resilience, and the education sectors.

A limitation to this study was self-selection bias. For example, participants who attended the workshops were available, interested in the research area and willing to participate during the COVID-19 pandemic. There was no focus on a specific age (other than being over 21), ethnicity and race for the workshops. Therefore, this data was not collected during the workshops. The goal was to maximize participation. The researchers asked those interested if anyone else should be invited. Although a limitation, this approach was consistent with snowball sampling. Also, the focus of this study was to leverage the knowledge and experiences of eMTY to identify strategies for strengthening food system access and resilience. To minimize this bias, workshops were made available online and in-person in different geographical areas to prevent COVID-19 concerns from being a participation barrier. Also, many participants coordinated meal delivery to schools and other locations before the pandemic.

The research was conducted during the COVID-19 pandemic and many lessons were identified based on this experience. This was a unique situation when compared to other emergencies due to the simultaneous impacts across the country. However, due to the knowledge and experience of the researchers, authors, and participants in working and studying various disaster situations the findings could be transferable to other events such as floods and hurricanes. Caution should be applied when applying the results to these events as areas of priority and needs could vary.

Geographical location of the workshops was a limitation. However, a vital component of this study was leveraging existing knowledge and experiences with eMTY. BCHP was consulted about workshop locations along with the co-authors. The
goal was to identify locations with the ability to host workshops, knowledge of eMTY and food systems, and ensuring timely completion of this project as plans to strengthen resilience post pandemic were being developed.

6 Conclusions

Food system resilience is vital to mitigate the consequences of disasters and other crises on community and individual well-being. The COVID-19 pandemic demonstrated how food systems can be impacted, especially for vulnerable populations such as children. School closures compromised essential meals for many children across the United States. To help address this food security crisis, a nontraditional public/private partnership model, eMTY, was set up and implemented to deliver meals to students in rural areas affected. By leveraging the knowledge and experiences of this program, we were able to identify, rank and prioritize actions for strengthening food system resilience. These include integrating the food sector and schools within emergency management, mapping local food sector capacities, working with schools to receive de-identified data about nutritional, allergy and other health needs, developing disaster plans for sustaining food access at the school district level, and protecting ecosystem services and agricultural areas. Addressing this timely need would promulgate coordination of community networks that can pivot quickly to emergency production and distribution. Emergency management systems are local, designed to coordinate complicated tasks in crises, multidisciplinary, and are in-place around the country and world. Providing a ready-made framework for locally driven initiatives to strengthen food systems now and into the future.

Acknowledgements: We thank the workshop participants and organizations involved in the Emergency Meals-to-You program. This includes: the Baylor Collaborative on Hunger and Poverty, McLane Global, General Mills, PepsiCo’s Food for Good, Chartwells K12, Canteen, and United Parcel Service. Thank you to the United States Department of Agriculture for funding this project.

References


