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Challenges and opportunities to increasing fruit and vegetable distribution through the US charitable feeding network: increasing food systems recovery of edible fresh produce to build healthy food access

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Abstract

This qualitative study describes opportunities and challenges to produce recovery identified by food banking executive leadership across the US (n = 33). Identified challenges included regional variation in fresh produce availability, long transportation times, and lack of refrigerated storage. Opportunities included high client demand for fresh produce, internal benchmarks for fresh produce distribution, and organizational partnerships to create regional sourcing and distribution efficiencies. This research indicates the need for cross-sector collaboration and planning efforts across the agricultural, health, and charitable feeding sectors in order to best recover and redistribute fresh produce.

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Author Contributions

MS Wetherill developed the research aims addressed in the paper, led the qualitative methods and analysis, drafted the organizational structure of the results, and synthesized the final manuscript.

KC White conducted the primary literature review, assisted with qualitative analysis, compiled Table 3, and assisted with selection of illustrative quotes.

C Rivera contributed to the development of the codebook used for the qualitative analysis and contributed to the introduction, methods, and discussion sections.

HK Seligman conceived the design for the FRESH-Foods study, obtained funding, developed the content for Figure 1, Table 1, and 2, and contributed to the introduction, methods, and discussion sections of this paper.

Keywords

Food supply; fruit; vegetable; food assistance; food bank; food pantry; food loss; food waste; food recovery; food shrink; food industry

Introduction

More than 1 in 8 US households are food insecure, defined as a household-level economic and social condition of limited or uncertain access to ade-quate food.[1,2] Food insecure households are disproportionately comprised of low-income, disabled, and minority groups[1,3] that also experience high rates of diet-related chronic conditions, such as obesity, diabetes and hypertension.[4,5] Healthy dietary intake, including regular consumption of fruits and vegetables, is critical to the prevention and management of many chronic diseases,[6–8] yet food insecure households report that they are less likely to be able to afford nutritious foods.[9]

There have been increasing efforts over the last decade to address eating disparities within food insecure households by re-directing healthy food that would otherwise be "wasted" toward the charitable feeding system, which includes food banks (FBs), food pantries, and related programs. Estimates suggest that up to 40% of food is wasted in the USA,[10] ranging between 240 and 660 pounds per person per year,[10–12] although there is large variation in estimates and many experts think 40% is vastly overestimated.[13] Of the food wasted in the US production stream, much of it is either not edible or is discarded at the level of the consumer[11] and is therefore not available to FBs. There is, however, some food within the production stream that could be reasonably diverted to FBs to support their efforts to increase access to healthy foods for the people they serve. This observation has prompted discussions between the Environmental Protection Agency (EPA) and the United States Department of Agriculture, among others, on strategies to capture some of this product.[11,14–17]

According to the EPA's Food Recovery Hierarchy, source *reduction* (i.e., preventing overproduction) is the most preferred method of reducing food waste, with *recovery* of excess food through donations to the chari-table feeding sector to feed food insecure families as the second most preferred option, followed by use of inedible food waste to feed animals or create compost, bioenergy, or natural fertilizers (*recycle*).[17] This hierarchy has been criticized for mixing two very different streams of food: those that are safe with those that are unsafe for consumption. Fresh produce presents a good example of the challenges and opportunities in diverting food from recycle to recovery because its perishability creates high poten-tial for waste at each level of the food distribution chain, from the grower to the consumer.[10] Although some produce is wasted because of failure to meet food safety standards, an unclear proportion is wasted due to insufficient market prices or to perceived quality and cosmetics,[12] such as non-standard size, color, or malformations. These factors result in the refusal or disposal of edible, nutritious produce by growers, retailers, and consumers.

The charitable feeding system is a complex ecosystem comprised of FBs, food rescue organizations, food pantries, soup kitchens/free dining rooms, shelters, and other organizations that provide food (groceries or prepared meals) whose collaborative goal is to support households with inadequate food budgets. As a central actor in this system, FBs follow a general food distribution model to source foods for partner agencies and programs. This typical model involves (1) sourcing foods, (2) warehousing and handling foods to support partner agency order fulfillment, and (3) distributing foods to partner agencies by either delivery or pick-up. In a fourth step, partner agencies distribute food to people at no cost (see Figure 1).

Originally developed for the distribution of shelf-stable foods, this four-step model may limit the capacity of FBs to handle and distribute perishable produce, which has unique sourcing, handling, and storage requirements.[18] FBs have increasingly invested in developing capacity for storage and distribution of fresh produce. However, many barriers remain. These barriers may include technical, spatial, and economic factors that limit the integration of fresh produce into the standard food banking distribution model due to high produce perishability and volume, distance between donors and FBs, and inadequate efficiency.[14]

The “Food banking Research to Enhance the Spread of Healthy Foods” (FRESH-Foods) study was designed to identify operational opportunities and challenges in fresh produce distribution from the perspective of the FB. As detailed through each step of the food banking product distribution chain, this paper describes primary findings from the FRESH-Foods study, including those operational opportunities and challenges specific to F&V recovery from the US and local food supply.

Methods

Study population and sampling strategy

This qualitative study includes interviews with Executive Directors (EDs) from FBs across the USA. Our sampling frame included all FBs (approximately 200) avbffiliated with the Feeding America network. Feeding America is the largest domestic hunger-relief organization in the USA.[19] Its affiliated local and regional FBs are each independently run organizations that distribute foods to 60,000 partner agencies. In turn, these partner agencies, including food pantries and meal programs, serve 1 in 7 families in the US each year.[5]

FB EDs ($n = 27$) were selected to provide a representative sample of the Feeding America FB network based on three criteria divided into tertiles. These criteria included current FB produce distribution, local produce avail-ability, and FB service area resources (see Table 1). Three FBs were randomly selected within each of the nine resulting cells. Three additional FBs were purposefully chosen to represent states with wide regional variability of produce growers. We also conducted interviews with leadership staff ($n = 3$) from the Feeding America National Organization (FANO). In addi-tion to anti-hunger advocacy, the FANO sources foods that have been donated or purchased (often at discounted rates) for distribution through its member FB network.

From each selected FB, the ED or Chief Executive Officer was recruited via e-mail to participate in this study. Interviews were conducted by MSW or HKS either in-person at conferences ($n = 28$) or over the phone ($n = 5$) between April 2015 and January 2017. Of the 55 EDs and FANO staff initially contacted, 33 (60%) completed the interview. Written informed consent was obtained for all in-person interviews. Verbal consent was obtained for all telephone interviews. Interviews were recorded using an encrypted audio recorder and transcribed verbatim, ranging between 36 and 82 minutes, with most interviews lasting about one hour. Participant compensation was a $100 gift card. The University of Oklahoma Health Sciences Center Institutional Review Board and the University of California San Francisco Committee on Human Research approved this study.

Conceptual framework for interview guide

We used the general food banking product distribution chain (Figure 1) as the conceptual framework for structuring 28 interview questions used in the FRESH-Foods study, with 12 questions specifically exploring barriers and opportunities for F&V distribution across the charitable feeding system as the focus of this paper (Table 2). The interview guide was tested and refined by completing a pilot interview with a single ED. “Sourcing” questions identified how FBs procure food locally or nationally through direct relationships with donors or partners (such as the FANO). “Handling and operations” questions identified capacity issues related to receiving and storing fresh F&Vs. “Outbound and agencies” questions identified factors related to food delivery to partner agency sites where client food distribution occurs, such as transportation from the FB to the charitable feeding program site and cold storage capacity for perishable items once received by agencies from the FB. “Distribution” questions identified strategies for linking more clients with the fresh produce available. Finally, “planning” questions encompassed any strategic initiatives implemented to impact the entire distribution chain. Follow up probes were used to clarify points or to generate more detailed responses.

Data analysis

The same conceptual framework used to develop interview questions informed codebook development to guide transcript-based content analysis. The initial codebook contained a priori themes for perceived barriers, current practices, and future opportunities related to each step of the food banking product distribution chain. Two members of the research team (MSW and KCW) analyzed the transcripts independently using Atlas.ti (Germany) qualitative analysis software.[20] Emerging themes, such as perishable food waste and recovery efforts, were identified using the constant comparative approach.[21] Researchers discussed all emerging themes after independent coding to form a consensus, revising the codebook and re-coding text as necessary.[22] Final inter-coder reliability was assessed using the Coding Analysis Toolkit[23] and an acceptable ≥ 85% agreement threshold for all codes was achieved.[22]

Results

ED participants represented FBs from across the US, including the Northeastern ($n = 3$), Southern ($n = 11$), Midwestern ($n = 10$), and Western regions ($n = 6$).[24] Key themes related

to fresh produce challenges and solutions identified by participating EDs for each domain of the F&V distribution chain are presented in Figure 2 and Table 3.

Sourcing

Challenges—The majority (n = 16) of the 28 EDs who specifically identified key distribution chain bottlenecks cited sourcing as a major issue, regardless of their FB's produce distribution, local availability, or community resources designation. EDs frequently cited the emerging theme of wide regional variation in the F&V locally available for donation as a major barrier to equitable distribution across the FB network (n = 18). Following Feeding America's introduction of a national F&V broker system, which identifies F&V growers willing to sell product to FBs, the emerging theme of competitive bidding for F&V between FBs has led to a perceived reduction in the amount of F&V growers are willing to donate due to the F&V grower expectation for payment (n = 13 EDs; n = 2 FANO staff).

> In essence, there's a lot of excess product that's available in the country that's either grown in this country or comes in through the ports from other countries and then we end up unfortunately bidding against one another to acquire that excess product. I don't know that there's another market that it could go to if it's not going to go to us. We're driving the cost up against ourselves. – ED (Low F&V Availability FB)

For FBs operating in regions with limited local availability, produce donations were often too infrequent or too lacking in variety to meet the F&V preferences of client households. Rescuing excess produce donations from a high availability region was often cost-prohibitive due to transportation costs or high potential for product deterioration during transport time (n = 20 EDs; n = 1 FANO staff).

> I think there is adequate supplies of fruits and vegetables that are out there in the US. It's just getting them from the certain locations, whether it's East Coast, West Coast, South Coast to the Midwest and other areas of the country. – ED (Low F&V Availability FB)

> The transportation costs are killing us. That's killing us. – ED (Medium F&V Availability FB)

> If you're trying to ship it across the country [to another food bank], it's not always a viable option. I think that we probably throw away more than what we actually redistribute to people in need. – ED (High F&V Availability FB)

For FBs operating in high availability areas, pre-harvest barriers to F&V recovery include the "pick and pack" fees to cover the harvesting costs for excess produce that would otherwise be tilled into the ground, along with other budgetary constraints for direct produce purchases from growers (n = 18 EDs; n = 3 FANO staff).

> The limiting factor for many food banks is that they actually can't afford to cover the pick and pack out cost or the value-added processing cost. . . – ED (High F&V Availability FB)

One half of EDs across all interviews described occasional instances regarding the quality of recovered produce that was too ripe for timely redistribution, eliminating the potential of this product to feed the intended recipients (n = 15 EDs), as illustrated by the following quotes:

> We got some broccoli about a month ago, and we ended up having to throw away about a third of it. Same with bananas that came in like late on a Thursday. So, could we move those quickly enough in the next [. . .] day and a half that we had of trucks on the road? We couldn't. We couldn't move it fast enough. – ED (Low F&V Availability FB)

> . . . if it's donated, there is the clock [that] is already ticking because it's probably seen its retail life. . . – ED (Medium F&V Availability FB)

> If it comes to us, it's really ready. We've got to get it out before it goes bad. – ED (High F&V Availability FB)

Reported issues additionally contributing to poor product quality included inadequate climate control during transport as product moves from grower to the FB, which can be exacerbated by lack of refrigerated storage capacity at the FB.

Potential solutions

All but one ED perceived the US fresh produce supply as a food banking distribution opportunity, despite existing sourcing barriers. Potential solutions to overcome these barriers often involved strategic planning to account for accessibility issues related to regional variations across the network. Several EDs described existing ordering systems as prohibitive, especially when they must order each product by the truckload, limiting the types of F&V they can order and distribute in a timely manner. The desire for mixed produce orders was emphasized, especially by FBs with limited distribution capacity. The development of Feeding America-sponsored "mixing centers," now referred to as "Member Led Regional Cooperatives," were cited by multiple EDs (n = 7) and FANO leadership (n = 2) as one high-potential strategy for improving access. These F&V food hubs allow multiple FBs operating in lower access regions to source perishable produce supplied by high-producing or high import regions. This sourcing model also allows individual FBs to place mixed produce orders, which addresses the reported need for building FB access to greater F&V variety to better meet client needs. An interview with FANO staff described the developmental planning process of mixing centers:

> If you think about the Philadelphia area, that port has an overwhelming amount of produce. . .The food bank there. . .[doesn't] have the capacity to take all of that produce and then re-distribute. These mixing centers are really filling a gap in space and capacity and they're doing so in a way that's shared regionally amongst the food banks and the regional office, so that not only are they getting more produce to those areas but it's a better variety, a better mix of produce; and we're saving food from being wasted. – FANO staff

Another similar solution to sourcing barriers is statewide purchasing programs that are locally led by FB consortiums or the state government. These programs have a longer implementation history than do mixing centers, which may explain why they were more

commonly cited (n = 15). Programs operating in states with high regional availability typically focused on sourcing partnerships to solicit donations from growers, with some use of state funds for fresh produce purchasing or transport. Programs operating in low and medium availability areas tended to allocate state funds to include not only fresh produce purchasing, but also produce transportation and processing fees.

In addition to infrastructure changes to support mixing centers and state-wide purchasing programs, several EDs advocated for policy changes at the FANO level to offset the cost of produce transportation (n = 9), either through partnering with national donors to lower acquisition costs or through providing produce transportation subsidies to local FBs.

> I think if they [FANO] went back to look for funding to help us move food across the network, especially to get it to those parts of the country that don't have ready access or it's temporary during the growing season. There's always produce available somewhere, and we just need help moving it. – ED (High F&V Availability FB)

At the local level, FB EDs described opportunities for increasing donations from nearby growers (n = 5 EDs; n = 1 FANO staff) or current grower engagement efforts (n = 19 EDs), including gleaning, networking with growers, or redirecting produce for donation that does not meet grade A standards for retail sale.

> I think the critical component is basically when the farmers go out to pick the crops, what we need them to do is take all the crops out there that are ready to go, even if they're larger than grade A. Because if they can do that, we are only going to be paying for the pack and pick out cost. . .because that way then the farmers win, the food banks win, and our ultimate customers win. – ED (Low F&V Availability FB)

Handling and operations

Challenges—Over one-third (n = 11) of the 28 EDs who specifically identified key distribution chain bottlenecks cited handling and operations as a major barrier, regardless of their FB's produce distribution, local availability, or community resources designation. Many EDs described a current lack of cold storage capacity at their FBs (n = 17 EDs; n = 1 FANO staff) due to a food banking infrastructure that is not equipped for moving high volumes of perishable foods, which was most commonly cited by EDs from FBs with medium F&V distribution. Outdated infrastructure was an issue affecting distribution capacity of fresh produce throughout the FB network, as described by one FANO staff:

> We've got food banks that are still operating a very traditional model. That very traditional model does not always allow for perishable product to be distributed in a timely manner. – FANO staff

Additional capacity needs for efficient handling and operations included the staffing or volunteer needs and related supplies to repackage bulk produce donations into smaller sizes for distribution to partner programs (n = 10 EDs; n = 1 FANO staff).

> We need a lot more food processing capacity to be able to take that product that usually comes in thousand-pound totes and to box it so that it can be easily distributed to our agencies. We need a lot of volunteers. We need a lot of packaging materials. – ED (High F&V Availability FB)

While the FANO provides recommended "Foods to Encourage" nutrition guidelines to help align food banking inventory with the US Dietary Guidelines for Americans, the lack of an incentive metric to reward or require fresh F&V distribution was mentioned as a handling barrier (n = 10 EDs; n = 1 FANO staff). These EDs often stated their FB did not have the internal capacity to measure the nutrition quality of foods using the Foods to Encourage framework, felt that Foods to Encourage failed to give "credit" for distribution of some nutritious foods, or felt that the lack of an official nutrition metric of success at the national level was a disincentive for nutrition-focused food banking.

Potential solutions—Active solutions to handling and operations barriers often centered around strategic planning to prioritize expanding cold storage facilities or constructing new modernized warehouses through current (n = 13) or potential capital campaigns (n = 7).

> . . .Two years ago [we] raised about $2.3 million to double our cold storage space and our cold temperature dock. That's been a huge help. – ED (Low F&V Availability FB)

Enhanced partner agency notification efforts offer one immediate solution for maximizing produce distribution (n = 10), especially when FBs receive products with short shelf-lives that must be distributed quickly. To gain recognition for their F&V distribution efforts, many EDs were currently using (n = 15) or suggested (n = 1) FB-instituted metrics to measure F&V distribution efforts. These metrics often included internal goals adapted from the Foods to Encourage guidelines, as well as other published metrics, such as CHOP (Choosing Healthy Options Program).[25]

For produce that cannot be distributed to partner programs before deterioration, suggested solutions for further increasing food recovery included the emerging theme of preservation and processing efforts (n = 9 EDs; n = 1 FANO staff):

> It's a reoccurring thing that keeps popping up this week is utilizing the kitchen to reduce the produce waste. We just haven't thought about it because we've been so focused on controlling what we're ordering and making sure we're not over ordering. Now I'm thinking maybe we should be over-ordering and then processing it in the kitchen. – ED (Low F&V Availability FB)

Few EDs described efforts to recycle product unfit for human consumption through composting (n = 3) or creative donation relationships with animal agriculture (n = 1) as a way to support future protein donations:

> We also have hog farmers and cattle farmers that we support with some of our surplus produce, so if it's not too bad, we can get it to them, and then they donate meat to us, so we're helping the food chain. – ED (High F&V Availability FB)

Outbound to agencies

Challenges—One half (*n* = 14) of the 28 EDs who specifically identified key distribution chain bottlenecks cited agency infrastructure as a major barrier, with EDs of FBs operating in high (*n* = 6) and medium (*n* = 6) regional availability service areas more often citing this barrier than FBs operating in areas with low F&V availability (*n* = 2). Issues perceived to negatively influence agency demand include lack of partner agency refrigeration, inadequate local transportation resources to support timely delivery to agencies, per-sonal food preferences of food pantry managers that influence ordering practices, and agency operation schedules not aligning with availability of produce donations. Inadequate cold storage capacity was the most com-monly cited agency-level distribution barrier (*n* = 25 EDs; n = 1 FANO staff):

> The bottleneck exists in the infrastructure of the member agency [. . .]. Some of them don't have the capacity to warehouse or store fresh produce, they don't have refrigerators or freezers. They may be open two afternoons a week. – ED (Medium F&V Availability FB)

The attitudes of food pantry personnel and staffing capacity were also suggested as possible barriers to distribution of F&V by partner programs (*n* = 9 EDs; *n* = 1 FANO staff):

> If we run into a problem with produce, typically, it's going to be from the agencies that are acting as gatekeepers. The people involved here at the agencies are no different than you and I. If you don't like spinach, chances are you think nobody likes spinach and so you're not going to go in. Even if we have spinach you'll say, 'Nobody likes spinach,' and so you don't order up the spinach. – ED (Low F&V Availability FB)

> If it's an agency which they've been around forever and they have older volunteers it's just a little bit difficult to bend in the direction we want them to go. – ED (High F&V Availability FB)

Another commonly cited barrier to distribution was a misalignment between partner agency operation schedules and availability of produce donations (*n* = 12 EDs; *n* = 2 FANO staff), with three EDs naming this as the key bottleneck for their entire distribution chain.

> They [food pantries] may not be open frequently throughout a month so, again, if we get all of those fruits and vegetables at the beginning of the month and their distribution is not 'til the third or fourth week, that's long gone. – ED (Low F&V Availability FB)

Finally, a lack of transportation or high costs of transportation to agencies were mentioned frequently as a barrier to F&V distribution (*n* = 11 EDs).

Potential solutions—Potential strategies for increasing systems efficiency at the agency level included capitalizing on agencies with strong interest in distributing more F&V (*n* = 11).

> Our agencies certainly every day are clamoring for more fresh produce, especially those that have the capacity to handle fresh produce. – ED (Medium F&V Availability FB)

Allocation of FB resources to build agency capacity for cold storage was another popular strategy, either through on-site food pantry cold storage or an FB-supplied refrigerated produce trailer to the agency on distribution days as a current (n = 11 EDs; n = 1 FANO staff) or future (n = 4 EDs) practice. These alternative strategies are illustrated by the following quotes:

> Our intent is that we will buy each of those 10 community food resource centers a walk-in cooler to help them distribute more fresh produce on a regular basis as well as provide support in other ways. – ED (Low F&V Availability FB)

> A lot of it just has to depend on their refrigeration. [. . .] We're going to use our beverage trailer. We're going to go out to the ones we know that have limited storage space, cooler space, and we're just going to show up and just help them. – ED (Medium F&V Availability FB)

Distribution to clients

Challenges—While some specific barriers in the distribution domain were mentioned, none of the 28 EDs who identified key distribution bottlenecks cited final distribution to clients as their key bottleneck. While not key bottlenecks for their distribution chain, EDs described some contributing factors that related to final distribution inefficiencies or client demand for fresh F&V. One perceived source of inefficiency was the time gap between partner agency receipt of the product and agency distribution of the product to the client (n = 7 EDs; n = 1 FANO staff). Few EDs perceived demand for F&V to be low among specific client subpopulations, such as middle-aged adults and those clients that are accustomed to eating convenience foods (n = 4). More often, EDs cited a lack of client knowledge about F&V preparation and health benefits as two factors that should be addressed to improve demand (n = 10).

> Sometimes when we send out these fruits and vegetables we have to do a lot of education about this is how you cook it or this is what it tastes like. That's exciting and it's fun to introduce people to new foods but I also worry that if we're not there doing that education do they just take it home and throw it away and not eat it – ED (Low F&V Availability FB)

Potential solutions—All participants unanimously described a high client demand for fresh produce as an opportunity for quickly moving perishable F&V. To bypass agency-level challenges to F&V distribution, over two-thirds of participants (n = 25 EDs; n = 1 FANO staff) described the emerging theme of current initiatives to provide direct distribution through FB "produce drops" or "mobile markets" in collaboration with an agency during its hours of opera-tion, or at an FB service area location without an intermediary partner agency. These initiatives were described as high-efficiency strategies for maximizing timely F&V distributions to a large volume of clients.

> There's an appetite for it and there's a desire for the produce. . .It really is a privilege to be able to get people good food. – ED (Medium F&V Availability FB)

EDs also described complementary education and cooking demonstrations during F&V distribution as a current (n = 21) or future (n = 3) practice, often with a central need to include child-friendly initiatives (n = 11 current; n = 4 future).

> You can't just give them [clients] fruits and vegetables and expect any outcomes. We think you have to at least pair those foods with nutrition education which might include recipes, that might include examples of why it's just as easy to do a chicken taco at home as it is to buy a frozen burrito at the gas station. You have to address all of those aspects of their life in order to have any outcomes. – ED (High F&V Availability FB)

Finally, many EDs and FANO staff mentioned the opportunity to partner with other community agencies, particularly healthcare organizations, to secure sites for direct distributions or funding support currently (n = 21 EDs; n = 2 FANO staff) or in the future (n = 7 EDs).

> The goal is you [client] walk into your county health clinic or this federally qualified health center, you get flagged as being food insecure, "Oh, by the way, you have diabetes. The physician or the medical provider that you meet with gives you a prescription for fresh produce. You walk out of the building and there's the produce mobile right there. And you also have a list of partner organizations where you can get this fresh produce every week. And so, you're really armed. – ED (Low F&V Availability FB)

Discussion

Findings from the present study suggest enthusiasm among food banking leadership participants toward opportunities to enhance the distribution of F&V to food insecure populations accessing food from FBs. Both pre- and post-harvest opportunities exist to source higher quality foods and improve access to healthier foods for food pantry clients while preventing waste of nutritious and edible F&V. However, multiple systems inefficiencies were identified that will require infrastructure capacity changes to the current food banking distribution model, which previously operated to receive, ware-house, and distribute nonperishable food donations. Past research has found barriers such as feared liability for donated foods by growers and retailers,[16,26] although US laws protect and reward donors through tax incentives and reduced disposal (tipping) fees.[11,14] In addition, while some FBs in past research have successfully developed partnerships to glean donated produce from growers, farmers markets,[27] and other retailers, many FBs' and partner agencies' lack of refrigeration[26,28] and inadequate cold transportation capacity have been barriers to handling and re-distribution of perishable produce. These findings are confirmed in the current study, where cold storage and transportation capacity were major barriers to effective recovery of otherwise edible produce. The inequitable distribution of perishable F&V across the network begins at the regional (sourcing) level, with access further being influenced by capacity issues at the FB and agency levels.

At the level of the individual and the household, state and federal efforts to specifically address F&V nutrition disparities primarily include voucher and benefit programs for the direct purchase of fresh produce from retailers and farmers markets or funding for the inclusion of fresh produce in school meals.[29] Enhancing food banking capacity for F&V recovery offers another potential solution to reduce nutrition disparities among food insecure popu-lations. However, enhanced cross-sector collaboration and planning efforts are needed to ensure FBs receive donations that can be redistributed in a timely manner. Identifying cost-effective strategies to encourage food recovery while simultaneously improving healthy food access for at-risk house-holds represents a mutually beneficial opportunity for the agricultural, health, and charitable feeding sectors.

Limitations

This study had limitations, though efforts were made to account for these limitations. First, we sampled participants from within a single food banking network, albeit the largest food banking network (by far) in the USA. Second, the sampling strategy provided variety in the types of FBs, but by choosing only three participants from each category, it is not possible to assess thematic saturation within a particular substratum. Since local F&V availability was measured as a state-level variable, FBs operating in large states with wide regional availability could have been misclassified in the sampling scheme. This limitation was partly alleviated through the selection of three additional interviews from those regions operating in states with wide regional availabil-ity. Finally, this study was designed to explore food banking opportunities and challenges for fresh produce distribution beyond those specific to recovery efforts. Food waste and recovery efforts were identified as emerging themes during our analyses, which resulted in multiple codebook iterations to allow for further exploration of these topic areas. Thus, we were unable to fully explore all aspects of food waste or recovery within the context of the food banking system because the interview questions were not specific to this topic. In addition, the food banking system is evolving quickly, especially with a growing focus on nutrition and health initiatives. As a living system that intersects with the larger, ever-changing US food system, the charitable feeding system likely faces new opportunities and challenges for F&V distribution that were not identified at the time interviews were conducted. In particular, there has been recent momentum at the local, regional, and national levels to address the barriers identified in these interviews, and thus new solutions are already being implemented and evaluated.

Conclusion

While there are several key bottlenecks that hamper optimal distribution of recovered produce through the food banking system, this study identified several opportunities for local and national policies to help address these challenges. These study findings can support FBs, and the agricultural, retail, and public health organizations that partner with them, in creating effective strategies to maximize produce recovery programs. Individual FBs can use this information to develop internal policies and potential partnerships with fresh produce growers, retailers, and the healthcare community as major donors and supporters of healthful food distribution. Finally, future research should inves-tigate potential strategies identified here, such as member-led regional coop-eratives, to establish their effectiveness in

promoting F&V intake among FB clients and more equitably distributing F&V across the system.

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Figure 1.
Steps for fruit and vegetable recovery and redistribution through the general food banking product distribution chain.

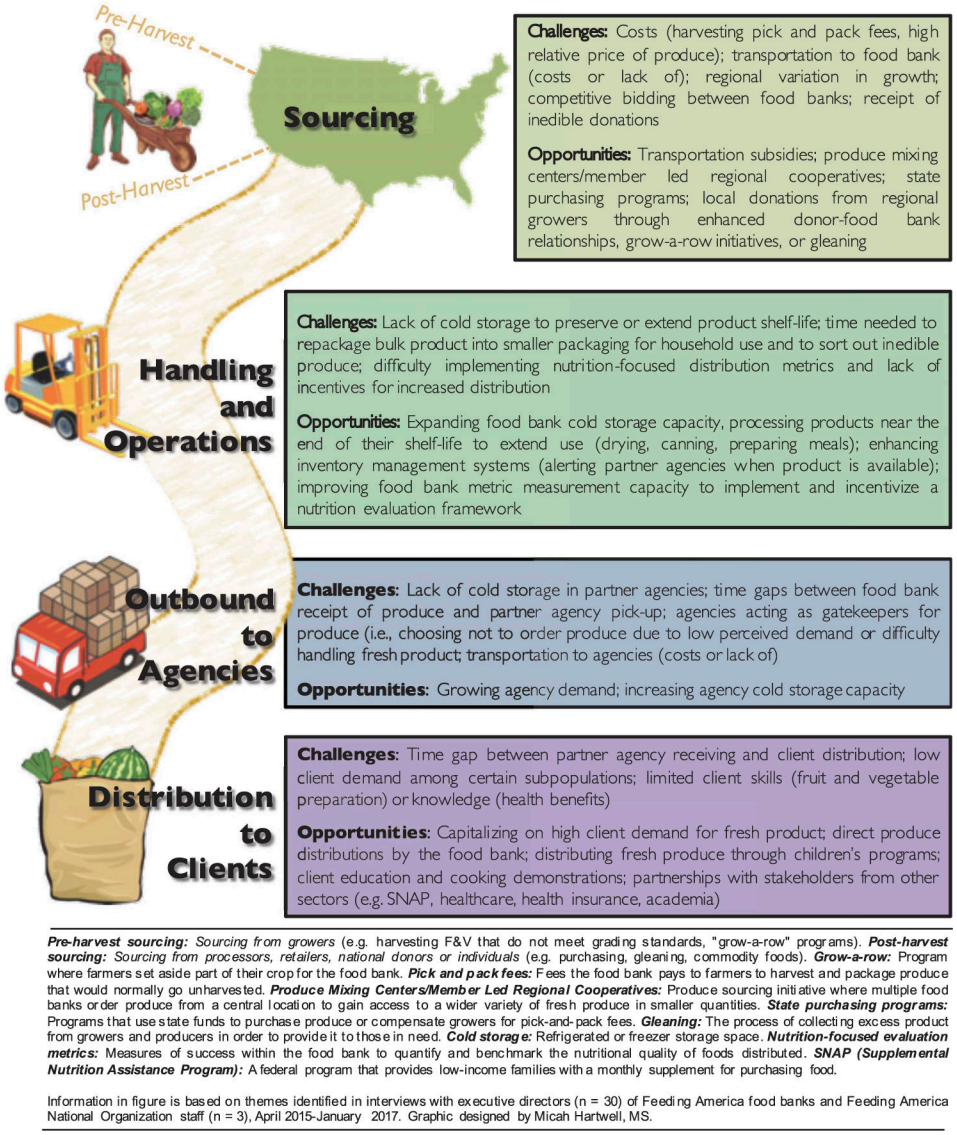

Figure 2.

Challenges and opportunities related to recovery and redistribution of edible fresh produce within the US charitable food system

Table 1.

Sampling criteria for 27 randomly selected food banks represented in the FRESH-foods study.

	Produce distribution[a]	Local produce availability[b]	Food bank service area resources[c]
High	28–66%	1–16	>$77 million
Medium	17–27%	17–34	$25–77 million
Low	2–16%	35+	<$25 million

[a] % of total food distribution in pounds.

[b] State ranking based on acres of produce grown/person.

[c] In dollars of combined community resources. Community resources were defined as an aggregate of both food and funds resources available within a service area, including the available dollars for charity organizations in the service area combined with local retail store, produce grower, and food producer donation opportunities.

Table 2.

Interview Questions Related to Flow of Fresh Fruit and Vegetables (F&V) along the Food Banking Distribution Chain, asked of Food Bank (FB) Executive Leadership.

Sourcing
● What role do you think Feeding America National Organization (FANO) should have in produce distribution?
● Do you feel as if FANO offers you enough opportunity to source F&Vs? What are they doing well at in terms of produce distribution? What could they do better at?
● Is there anything FANO is doing or thinking of doing that would prevent you from distributing more F&Vs?
● Does your FB service area include F&V growers, producers, or processors?
● Do you feel as if the net cost of purchasing fresh produce is relatively high or relatively low for your FB? What increases or decreases costs?
● In your opinion, does the U.S. have enough F&Vs available to meet the needs of every FB in the U.S., or do you feel as if FBs must compete for a scarce resource? To what extent do you feel your FB has access to all the F&Vs it can use? Why or why not?
Handling and Operations
● What does the handling of fresh foods look like at your organization?
● *Outbound and agencies*
● Can you describe the capacity of the agencies you serve for distributing fresh F&Vs?
● What is your perception of F&V demand at the level of the agency?
Distribution to Clients
● In your perception, what is client demand for F&Vs at the pantries your FB distributes to?
Strategic Planning
● What are key opportunities that you see at your FB for increasing F&V distribution, the “low hanging fruit”?
● If you had to point to the key bottleneck for your FB in distribution of fresh F&V’s, which would it be: sourcing, handling/operations, delivery to agencies, distribution to clients, or planning?

Table 3.

Sources of fresh fruit and vegetable (F&V) waste, challenges related to F&V recovery and redistribution, and potential solutions to enhance F&V recovery and redistribution identified by food bank executive leadership (*n* = 33).

Step within the Food Banking Distribution Chain	Sources of Perishable F&V Waste	Challenges to Recovery and Redistribution (number of interviews citing this theme[a])	Potential Solutions to Enhance F&V Recovery and Redistribution (number of interviews citing this theme[a,b])
Sourcing	● Non-recovered surplus of edible F&V from growers, producers, processors, retailers ● Recovery of F&V that is inedible due to product deterioration	● **Acquisition costs (pick and pack fees, high relative price) (21)** ● **Transportation (costs or lack of) (21)** ● **Regional variation (18), leading to inequitable supply across network** ● Competitive bidding between food banks (15) ● Receipt of inedible donations (damaged or expired shelf-life) (15) ● *Problems creating or receiving grants for sourcing or distribution (4)*	● Transportation subsidies funded by food bank network national office or other grants (9 opportunities) ● Produce mixing centers (9 opportunities ● State purchasing programs funded through the state government or associations of food banks (15 current) ● **Local donations from regional growers (enhanced donor relationships/communication, gleaning) (19 current, 6 opportunities)**
Handling & Operations	● Limited shelf-life of F&V upon receipt by food bank	●**Lack of cold storage to preserve or extend product shelf-life (18)** ● Time needed to repackage bulk product into smaller packaging for household use or to sort out rotten products (11) ● Difficulty creating or implementing nutrition-focused metrics and problems with current metrics (e.g., rewarding higher weight items) (11)	● **Expanding cold storage (13 current, 7 opportunities)** ● Processing products near the end of their shelf-life to extend use, such as drying, canning, or preparing meals (10 current) ● Enhanced inventory management systems, such as alerting partner agencies when product is available (10 current) ● **Improving food bank metrics to be more nutritionfocused, including using Foods to Encourage framework (16 current, 3 opportunities**
Outbound & Agencies	● Spoilage at food banks or partner agencies	● **Lack of agency cold storage (26)** ● Time gaps between food bank receipt and partner agency pick-up (14) ● Lack of transportation to agencies or high cost of transport (11) ● Agencies acting as gatekeepers for F&V and choosing not to distribute because of lack of perceived demand or difficulty handling F&V (10)	● **High agency demand (21 current, 3 opportunities)** ● **Increasing agency cold storage capacity (12 current, 4 opportunities)**
Distribution to Clients	● Spoilage at partner agencies	● Lack of client knowledge for F&V preparation or health benefits (10) ●Time gap between partner agency receiving and client distribution (8) ● *Low client demand in certain subpopulations (4)*	● **Capitalizing on high client demand for fresh product (33 current)** ● **Direct F&V distributions by the food bank "produce drops" or "mobile markets" (26 current)** ● **Distributing fresh F&V to children either directly at schools or through child education programs (11 current, 4 opportunities)** ● **Client education and cooking demonstrations on how to prepare F&V (21 current, 3 opportunities)** ● **Partnerships with other programs (Supplemental**

Step within the Food Banking Distribution Chain	Sources of Perishable F&V Waste	Challenges to Recovery and Redistribution (number of interviews citing this theme[a])	Potential Solutions to Enhance F&V Recovery and Redistribution (number of interviews citing this theme[a,b])
			Nutrition Assistance Program, healthcare, health insurance, government, college research and nutrition departments, other non-profits) (23 current, 7 opportunities

[a] Bolded themes were heavily cited (>15 interviews); italicized themes were infrequently cited (<5 interviews).

[b] Participants often provided both current and future FB practices as potential solutions for maximizing F&V distribution.

* Denotes emerging themes. Frequency counts are separated to describe the number of EDs who cited a particular solution as a current or future opportunity practice.