



Castor Market, Dakar Senegal. Photo courtesy of Premise Data Contributor.

FEED THE FUTURE BUSINESS DRIVERS FOR FOOD SAFETY

Cooperative Agreement No. 720BFS19CA00001

FOOD SAFETY ASSESSMENT OF SENEGALESE MARKETS THROUGH MOBILE APP TECHNOLOGY

Technical Brief

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INTRODUCTION

Inadequate food handling practices and poor infrastructure across supply chains increase health risks to consumers, in addition to being root causes of pre-consumer loss and waste in the overall food system. Feed the Future Business Drivers for Food Safety (BD4FS), implemented by Food Enterprise Solutions (FES) and funded by USAID, is a multi-country effort that works alongside agrifood actors to codesign and implement incentive-based strategies to accelerate the adoption of food safety practices in local food systems.

BD4FS focuses on food safety practices among growing food businesses (GFBs). GFBs are small- and medium-sized food businesses that connect producers with consumers at the retail level. In the spring of 2020, BD4FS completed a Food Safety Situational Analysis (FSSA) in Senegal targeting the artisanal seafood sector (FES, 2020a; Vilata, 2021). Interviews and field observations revealed significant food safety challenges associated with lack of cleanliness, improper handling, and inadequate cooling in this sector. These challenges put artisanal seafood products at risk of contamination from bacterial pathogens, viruses, parasites, heavy metals, histamine poisoning, microplastics, biotoxins, Persistent Organic Pollutants (POPs), and Polycyclic Aromatic Hydrocarbons (PAHs) (FES, 2021; Hatzipetro, 2021; Sene & Hatzipetro, 2021). The absence of a clean water supply emerged as a major barrier to cleanliness of fresh fish handling, processing, and selling; and inconsistent power sources prevent proper cooling.

To expand baseline knowledge of food safety practices in Senegal to other perishable foods, BD4FS initiated a rapid market assessment utilizing a local network of experts and data collectors hired by Premise¹, a company specializing in crowdsourcing data through mobile-app technology. Premise data contributors conducted a visual assessment of market characteristics, vendor food safety practices, and infrastructure conditions in 64 food markets across eight cities which aided BD4FS in understanding the principal issues around food hygiene and temperature control in Senegal.

Objectives

The primary objectives of this study were to identify local food markets in selected regions of Senegal and explore their food safety practices and challenges in three critical areas: 1) market demographics and physical characteristics, 2) food safety conditions and food quality at the individual retail locations, and 3) water and sanitation facilities available at the market.

¹ To learn more about Premise, visit: <https://www.premise.com/>

SURVEY METHODS

This Senegalese local market assessment - conducted in October and November 2020 - identified, mapped, and gathered data on 64 perishable food markets in population centers and along food transport routes.

BD4FS and Premise collaboratively designed the study and developed questionnaires and observational guidelines for data contributors to follow when visiting food markets. BD4FS identified the key food safety information of interest and Premise entered the questionnaires into their mobile app to be used by data contributors for recording observations. The app directed the contributors to observe and record food safety practices by market vendors and the availability of infrastructure needed to maintain proper hygiene and cooling (e.g., running water and electricity). Because the crowdsourcing methodology relies largely on data collectors living in target survey areas, this allowed BD4FS to capture data from areas that would otherwise have been challenging to access during the COVID-19 travel restrictions.

Data Collection

Guided by the smartphone app, data contributors conducted observations on market characteristics and food safety conditions at local perishable food markets in Senegal. They recorded observations, took digital images, and answered simple yes/no questions about what they photographed. Other information for a sub-set of markets included the presence of electrical outlets or proximity to running water. The app automatically time stamped and geo-validated the location of each entry.

The data collection utilized place-based tasks from markets in eight cities: Dakar, St. Louis, Mbour, Joal Fadiouth, Ziguinchor, Touba, Tambacounda, and Kaolack. The study consisted of the following three tasks:

- **Task 1 – *Tell us about a market*** – Characterize markets and vendors by recording the type of structure (closed building and open-air), types of foods being sold, presentation of foods, and demographics of the vendors (age and gender). Data contributors noted and photographed food transport methods where available.
- **Task 2 – *Food safety and quality at a local market*** – Document market infrastructure and vendor practices relevant to food safety by recording presence of electricity, cooling facilities, cooling equipment, and presence of debris, animals, and garbage.
- **Task 3 – *Water and sanitation at a local market*** – Document hygiene and sanitation facilities and practices including observations of running water, use of cleaning agents, surface cleanliness, handwashing facilities and soap available, as well as on-site restrooms, standing water, open sewers, and dumpsites.

Contributor Submissions

Contributors produced a total of 621 verified submissions across the three tasks. Among these, there were 202 submissions and 64 unique markets visited for the first task, 210 submissions and 64 markets visited for the second, and 209 submissions with 61 markets for the third task. The study design was to collect multiple submissions for each market to verify data through multiple observations and to better characterize the larger markets.

Premise Crowdsourcing Technology

Premise relies on networks of local citizens to crowdsource data using a proprietary app with targeted tasks to collect information. This task-oriented data capture generates structured inputs that can be used in conducting field research. Readily available through Google Play and iTunes, the app enables rapid acquisition and activation of on-the-ground data contributors. The app provides guidance, feedback, and rewards for successfully performing tasks and taking photos, and works when connected on- or offline.

Premise employs a micropayment model based on the difficulty of the task that can be used to incentivize contributors to complete tasks quicker and helps ensure higher quality submissions. Contributors can provide precise geographic coordinates of sites visited and can easily take and input high quality photos. Contributor findings are verified through a combination of manual and automatic quality control and fraud detection processes. (Source: [How the Premise app works – Premise](#))

RESULTS

Task 1 - Tell Us About a Local Market

For Task 1, data contributors recorded their observations on the following market characteristics: the type of market structure (open or closed), materials used for flooring, and the kinds of food products for sale. Most submissions reported observing food markets as open air with no roof or walls (almost 50%), followed by open air with a roof (30%), and a smaller portion were indoor markets (18%) (Figure 1). Most markets had concrete and cement flooring (45%), followed by dirt and sand (39%) and tile (10%) (Figure 2).

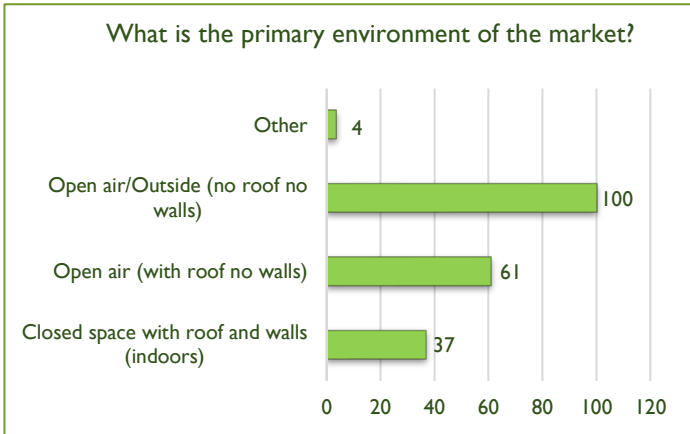


Figure 1. The number of data contributors who reported markets being open air, closed, or a combination of both.

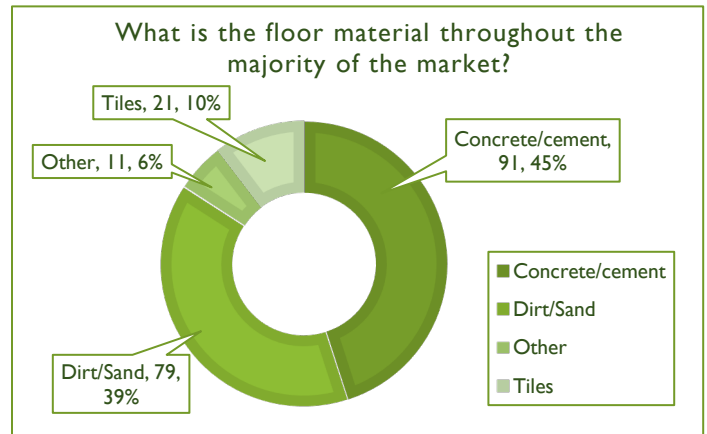


Figure 2. The number (and percent) of data contributors who reported market floors being dirt, concret, tile, or other.

Contributors observed diverse types of food sold at markets that varied according to location. Most commonly observed were markets specializing in fruits and vegetables, comprising 52 out of the 202 observations. In second place, contributors visited mixed markets carrying a diversity of perishable products – seafood and fish, meat and poultry, eggs and dairy, and fruits and vegetables – observed in 33 of the 202 submissions. The final type of markets observed were located near the coast that mostly carried exclusively seafood (observed in 29 of the 202 submissions).

Contributors also recorded the percentages of women and youth vendors in the markets. Women comprised a sizeable portion of market vendors observed: only 17 submissions (8%) reported that women represented less than 25% of vendors at a given market, while 60 submissions observed that between 50-75% of vendors were women (Figure 3). On the other hand, fewer youth work as market vendors, typically comprising less than half of the vendors observed at a given market (Figure 4).

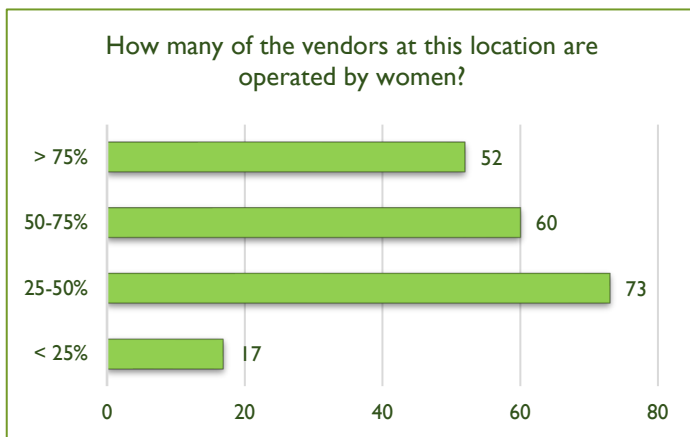


Figure 4. The proportion of vendors reported to be women by the data collectors.

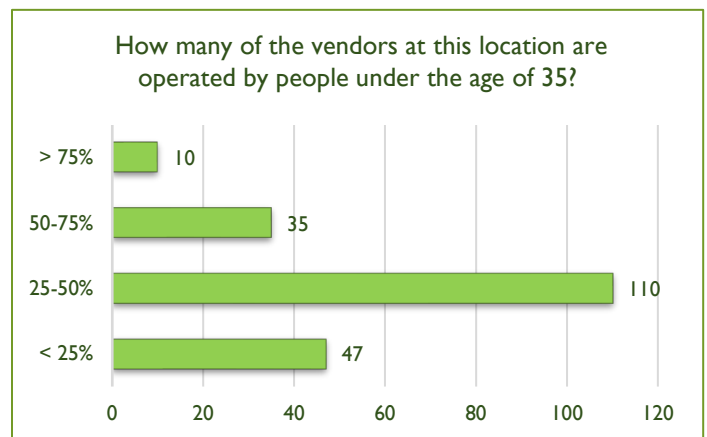


Figure 3. The proportion of vendors reported to be under 35 years of age by the data collectors.

The study also examined the types of transport used to and from the markets. Of the 202 submissions, 89 reported some form of transport (handcarts, donkey carts, three-wheelers and closed trucks were the other), 38 of which were reported to be refrigerated. Contributors reported observing refrigerated trucks in 26 of the 64 markets, and found principally in Dakar, Ziguinchor, Mbour, and St. Louis. However, analysis of the pictures taken by the data contributors as a means of verification of the transport types showed many unrefrigerated trucks, indicating that actual refrigerated transport may be lower than what was reported.



Images: Refrigerated trucks at Marche Yoff in Dakar (left) and at Marché Central au

Poisson in Dakar (right). Source: Premise data contributor.

Task 2 – Food Safety and Quality

Task 2 focused on conditions of perishable foods in the markets. To this end, contributors noted the types of foods in the market and how they were presented for sale, particularly requesting observations on temperature control such as cooling. Of particular concern, were if vendors had access to electricity for refrigeration and lighting.



Image: Plugged in refrigerator at Marché Nar Toute; market in St. Louis. Source: Premise data contributor.

Forty-five (45) contributors reported that vendors used refrigeration (21% of submissions); but only half of those noted that refrigerators were actually plugged into outlets (Figure 5). In Senegal, refrigerators are often used as cool chests (ice-based) without electricity which most likely explains this observation. Contributors also noted which food types were being refrigerated. They observed seafood being kept cold with either ice or refrigeration but rarely fruits and vegetables or eggs and dairy (Figure 6).

Observations of refrigerated temperature control by food type break down as follows:

- Seafood - 39/45 observations of refrigeration (87%)
- Meat / poultry - 25/45 observations of refrigeration (56%)
- Fruits / vegetables - 11/45 observations of refrigeration (24%)
- Eggs / dairy - 6/45 observations of refrigeration (13%)



Image: Vendor Selling Fish with ice at Marché Banneto, market in Ziguinchor. Source: Premise data contributor.

In Senegal, ice is a common alternative to refrigeration for keeping perishable foods fresh. Of the 210 submissions, 39 reported that they saw vendors using ice (19% of submissions), with the following observations for different types of perishable foods (Figure 6):

- Seafood - 32/39 observations of ice (82%)
- Meat / poultry – 8/39 observations of ice (21%)
- Fruits / vegetables - 9/39 observations of ice (23%)
- Eggs / dairy - 2/39 observations of ice (5%)

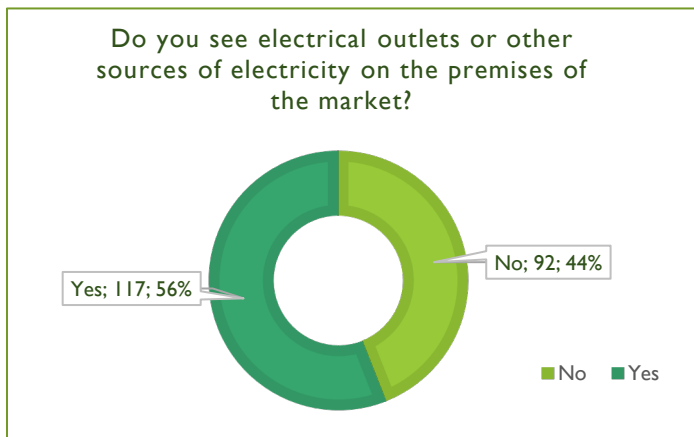


Figure 5. Percent of observations of electrical outlets at markets.

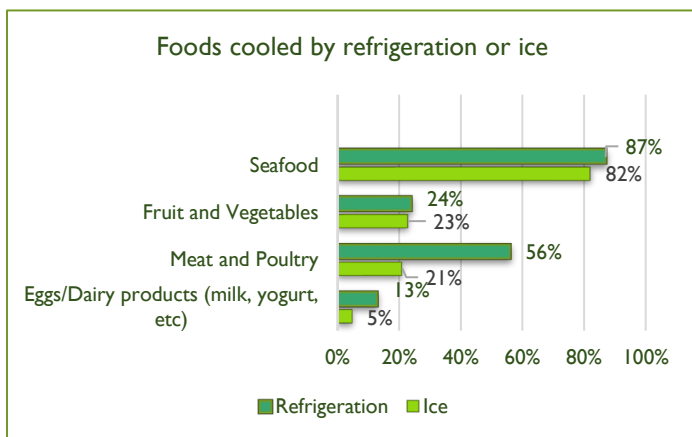


Figure 6. Percent of observations of perishable foods being cooled by refrigeration or ice at markets.

Besides temperature control, the presence of pests can adversely affect the quality and safety of food. To assess this, contributors made observations regarding rodents, insects, and domestic animals such as dogs and cats. Overall, contributor submissions reported that most markets were free of rodents (80% of submissions, Figure 7 and 8), insects on foods and counters (57% of submissions, Figure 9), and dogs and cats (59% of submissions, Figure 10).

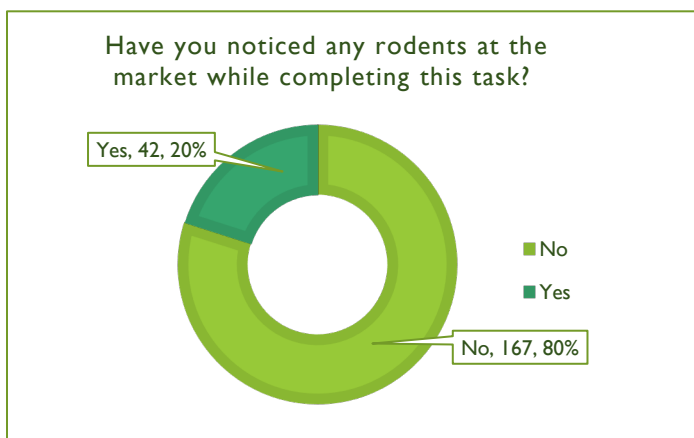


Figure 7. Number and percent of observations of rodents at markets.

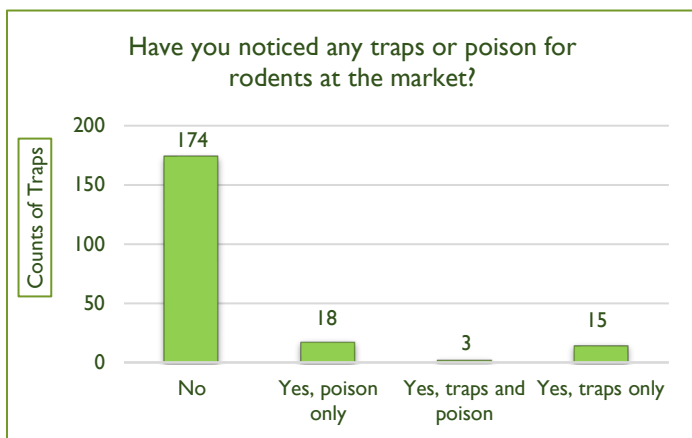


Figure 8. Number of observations of traps or poison for rodents at markets.

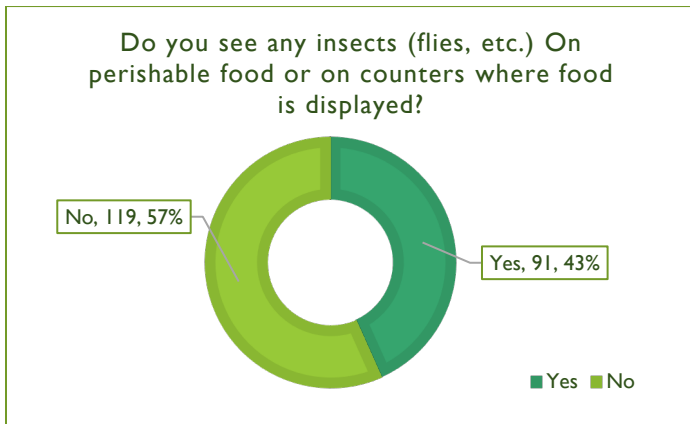


Figure 9. Number and percent of observations of insects on perishable food or on counters at markets.

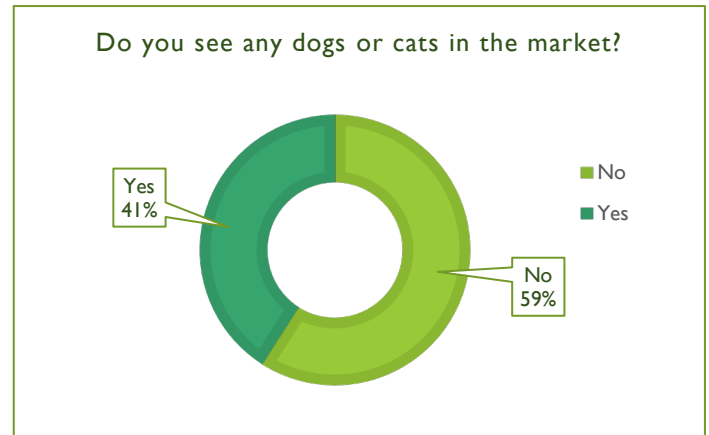


Figure 10. Percent of observations of dogs or cats in the markets.

Task 3 - Water, Sanitation, and Hygiene

For the third task, the app directed contributors to make observations on the existing conditions of infrastructure for water, sanitation, and hygiene (WASH) in the markets. This included running water and hand washing facilities, the presence of soap, and toilets. WASH facilities were found to be absent in most markets, with the following observations reported by the contributors (Figure 11):

- Functional sources of running water: There were a total of 83 observations of faucets among the 209 submissions, but not all were operational. There were only 53 observations of running water among the 209 submissions (24%).
- Facilities available for washing hands (faucet and tippy-tap): 57 out of 209 submissions reported either a faucet or tippy-tap (25%).
- Soap available at hand washing stations: 29 of the 209 submissions reported markets were equipped with soap (13%).
- Presence of restroom facilities: 86 of the 209 submissions observed markets to have restroom facilities (38%).



Figure 11. Number of observations of running water, hand washing facilities, restrooms, and soap at markets.



Image: Restroom/WC with handwashing nearby at Marché Mame Diarra in Dakar. Source: Premise data contributor.

In Dakar, Senegal's capital and the principal zone of investigation in terms of study coverage, principal findings include:

- 74% of submissions reported that there was no facility or water to wash hands, and of those that did have handwashing stations, only 14% had soap.
- 43% of submissions reported that there were no WC/toilets present at the market.

Concerning sanitation, 78% of the 209 submissions reported that they did not see any vendors cleaning their stalls (Figure 12). They also reported that most markets did not have a dedicated dump site for refuse (80% of submissions, Figure 13), and a smaller portion were close to an open sewer (15% of submissions, Figure 14) and had stagnant water present (38% of submissions, Figure 15).

The study also captured the environmental contamination visible in the market through directed observations of animal waste, food waste, large debris, and litter. The most commonly observed contaminant was large debris (reported in 51 of 209 submissions), followed by food waste (reported in 44 submissions), and a combination of all contaminants (reported in 30 submissions).



Figure 12. Number of observations of vendors cleaning their market stalls.

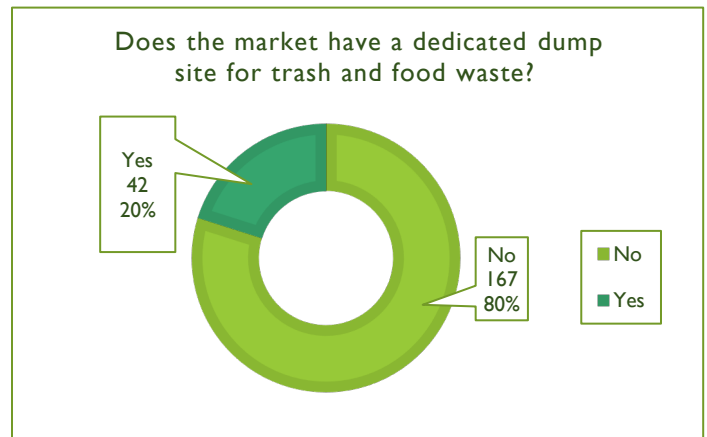


Figure 13. Number and percent of observations of markets with dedicated dump sites.

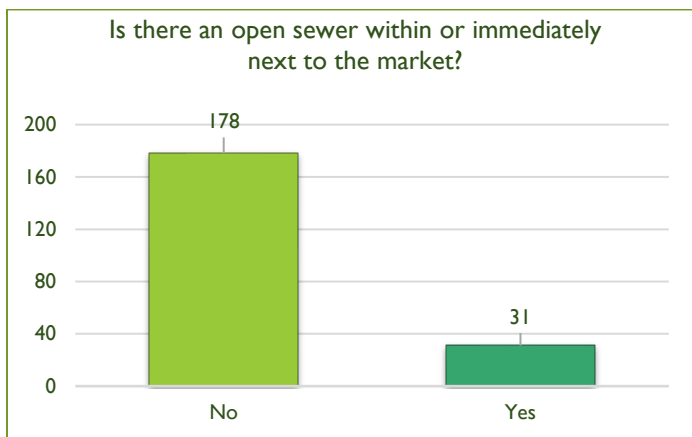


Figure 14. Number of observations of open sewers near markets.

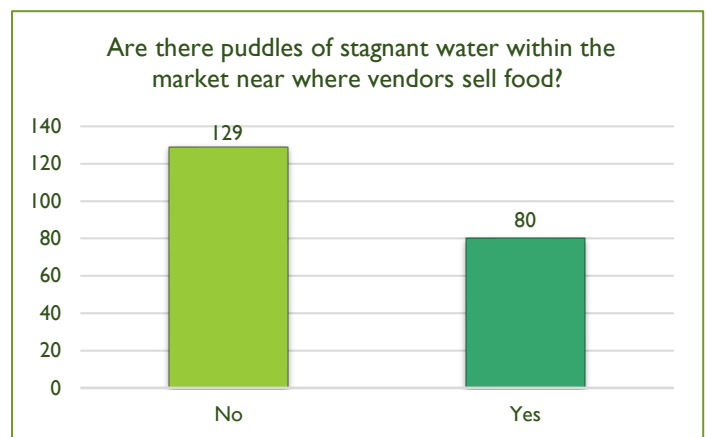


Figure 15. Number of observations of puddles or stagnant water near vendors at markets.

CONCLUSIONS AND DISCUSSION

The Premise app and approach helped BD4FS observe food safety practices and conditions in 64 fresh food markets. BD4FS was able to direct contributors to observe infrastructure conditions and food handling practices of key actors and stakeholders at these markets. An important element of the app was the ability to track and analyze the market observations as they were collected and then adapt the directed observations to explore additional aspects of food safety conditions.

Cooling and cleanliness (personal and business practice related hygiene) pose the greatest challenges to food vendors in the markets observed. Contributors infrequently saw perishable products being chilled appropriately, with refrigeration observed in only 21% of submissions and food kept cool on ice in 19%. Seafood, more often than other products, did receive adequate temperature control, but few contributors observed eggs and dairy being refrigerated or on ice. And while clean water is essential to basic hygiene, only 24% of submissions reported observing running water to be present at markets. Additionally, contributors observed hand washing stations in 25% of the submissions, and only half of those had soap present. Also, sanitation rated low with cleaning of vendor stalls observed in just 22% of submissions and dump sites for refuse were absent at most markets (80%). These findings track closely with those from the Senegal FSSA (FES, 2020a) and from another qualitative assessment of water, sanitation, and hygiene (WASH) conditions conducted earlier by BD4FS at seafood processing sites in Senegal (FES, 2020b).

The findings from this directed observational study confirm the BD4FS approach to collaboratively working with growing food businesses (including kiosk “micro” vendors) to focus on improving food handling practices—especially hygiene, food storage, and temperature control. The study also confirms the critical importance of adequate access to infrastructure, especially energy, transport, water and sanitation, and solid waste management. The directed observations have guided BD4FS on where to focus food safety trainings for businesses. As well, the directed observations have been useful in co-developing feasible food safety protocols and plans with businesses as a first step towards eventual certification. Equally important, this digital methodology contributes to the growing BD4FS portfolio of digital technologies for improving food safety awareness and practices. BD4FS already employs mobile phone technology for training and awareness building through its mSafeFood initiative in Senegal and through a game-based learning app to promote food safety learning – developed by and targeting youth (FES, 2022).

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ANNEX A – LIST OF MARKETS VISITED BY CITY

No.	City	Market
1	Dakar	Grand Marché Oukam
2	Dakar	Marché Arafat
3	Dakar	Marché Asc Eco
4	Dakar	Marché Bou Bess
5	Dakar	Marché Boune
6	Dakar	Marché Camberene
7	Dakar	Marché Castor
8	Dakar	Marché Central au Poisson
9	Dakar	Marché Colobane
10	Dakar	Marché de Poisson de Rufisque
11	Dakar	Marché Dior
12	Dakar	Marché Eglise
13	Dakar	Marché Fass
14	Dakar	Marché Fith Mith
15	Dakar	Marché Golf Sud
16	Dakar	Marché Grand Medine
17	Dakar	Marché Gueule Tapee
18	Dakar	Marché HLM
19	Dakar	Marché Kermel
20	Dakar	Marché Keur Massar
21	Dakar	Marché Mame Diarra
22	Dakar	Marché Ndiareme
23	Dakar	Marché Ndiareme Guediawaye
24	Dakar	Marché Parcelles Assainies Unite 3
25	Dakar	Marché Pikine Ouest
26	Dakar	Marché Pikine Tally Boubess
27	Dakar	Marché Rio
28	Dakar	Marché Sandaga
29	Dakar	Marché Sicap Mbao
30	Dakar	Marché Soumbédioune
31	Dakar	Marché Thiaroye Gare
32	Dakar	Marché Thiaroye Sur Mer

No.	City	Market
33	Dakar	Marché Tilène
34	Dakar	Marché Unité 3
35	Dakar	Marche Unite 11
36	Dakar	Marché Yarakh
37	Dakar	Marché Yoff
38	Dakar	Marché Zinc
39	Dakar	Quai de Rufisque
1	Kaolack	Marché Central
2	Kaolack	Marché Guedj
3	Kaolack	Marché Zinc
1	Mbour	Marché Malou Quaiba
2	Mbour	Marché Saly
3	Mbour	Marché Somone
4	Mbour	Marché Téfesse
5	Mbour	Marché Vélingara
1	Saint-Louis	Marché Nar Toute
2	Saint-Louis	Marche Pikine
3	Saint-Louis	Marché Sor
1	Tambacounda	Marché Central
2	Tambacounda	Marché Marinaires/Médinacoura
3	Tambacounda	Marché Quinzambougou
1	Touba	Marché Central Mbacké
2	Touba	Marché Djanatou Mahwa
3	Touba	Marché Domaine-Ba
4	Touba	Marché Guédé
5	Touba	Marché Madiyana
6	Touba	Marché Ocasse
1	Ziguinchor	Marché Banneto
2	Ziguinchor	Marché Escale
3	Ziguinchor	Marché Gd Dakar
4	Ziguinchor	Marché St Maure
5	Ziguinchor	Marché Tilene