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## A Novel to Method to Measure Food Waste: The Mobile Food Record

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# A Novel Tool for Measuring Food Waste: The Mobile Food Record

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**Abstract.** The mobile food record™ (mFR™) is a novel app that allows for the tracking of individual food waste and addresses the limitations of current methods to accurately quantify food waste. Extension educators may use data from the mFR™ to create educational initiatives for food waste prevention and education that may be implemented in settings such as schools and universities. The mFR is an innovative application that simplifies the process of collecting food-based data and accurately quantifying food waste for use in Extension.

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## INTRODUCTION

Food waste is a significant problem, impacting global food security, the environment, and the economy. The Food and Agriculture Organization of the United Nations (FAO) estimates that one-third of food produced worldwide is wasted, which contributes to the more than 820 million people who go hungry annually (Food and Agriculture Organization of the United Nations, n.d.-b). In addition to contributing to hunger, wasted food accounts for 25% of the annual U.S. freshwater supply and approximately 300 million barrels of oil annually (Richards & Hamilton, 2018). Greenhouse gas emissions from the production of food that is ultimately wasted account for 8% of total anthropogenic emissions and are nearly equivalent to global transport emissions (Food and Agriculture Organization of the United Nations, n.d.-b). In the United States, food waste accounts for 124.1 billion dollars, or approximately 63% of the total retail value of wasted food using 2011 retail prices. Avoidable U.S. consumer food waste is equivalent to \$1,600 per family of four annually (Venkat, 2012).

Extension educators face challenges regarding food waste reduction. One of these challenges is the public's lack of knowledge regarding food waste prevention (Tedrow, 2018). Extension educators are actively involved in reducing total food waste by understanding the causes for it and devising potential remedies (Campbell & Munden-Dixon, 2018).

In order to reduce food waste, accurately quantifying waste is important. The use of many current self-report tools (e.g., dietary records, surveys, questionnaires) may result in measurement errors (Elimelech et al., 2019). Objective measurements involving physical waste measurements are expensive, time and labor intensive, and sometimes unpleasant (Elimelech et al., 2019). Rigorous objective methods that address these limitations are needed. Using technology to quantify waste at the individual level may provide a solution.

## QUANTIFYING FOOD WASTE USING NOVEL TECHNOLOGY

The mobile food record™ (mFR) is a mobile app that can be used to track individual food waste and that addresses the limitations of current methods to quantify food waste (Ahmad et al., 2016). The mFR™ is part of an image-based dietary assessment system (Daugherty et al., 2012; Fang et al., 2019; Zhu et al., 2010; Zhu et al., 2015). Coauthor C. J. Boushey developed the concept in a joint effort with researchers, including coauthors F. Zhu and D. A. Kerr. Coauthors C. E. Panizza and J. C. Banna have collaborated with these developers on mFR™-based research. Individuals can use the mFR™ on iOS or Android platforms to take before and after photographs of their plate (or the like) during eating occasions (Six et al., 2010). A fiducial marker, a small colored checkerboard marker of



**Figure 1.** Before and after eating buttons on the mFR™.



**Figure 1.** Before eating image captured using the mFR™.

known dimensions and color, is placed in each image to assist in portion size estimation and color calibration. The mFR™ performs automatic uploading of images to a secure cloud-based server when in 3G/4G/Wi-Fi range, with all images available to researchers for viewing and analysis. The software is designed to be user-friendly. A study conducted in 2010 demonstrated that 9% of 70 adolescents surveyed about their use of the app disagreed with a statement that the software was easy to use (Six et al., 2010). Figure 1 displays the before and after eating buttons that appear in the app. Figure 2 shows a before eating image.

These images can be used to indicate the quantity of uneaten foods or beverages. As part of the Australian Connecting Health and Technology study, for example, Kerr et al. asked participants (n=244) to capture before and after images of eating occasions over the course of 4 days. A total of 4,885 before eating images and 4,655 after eating images were captured. Participants submitted 5.7% fewer after eating than before eating images. Thus, a drawback of the app in logging food waste is that in some cases users may neglect to post after images (Bathgate et al., 2017; Kerr et al., 2016).

### MOBILE FOOD RECORD™: USES IN EXTENSION

Extension educators can use the mFR™ to address food waste in school lunchrooms and university dining halls and across their campuses through education on healthy eating and sustainability (Harray et al., 2015). Researchers in European studies have demonstrated positive effects of education on food waste reduction in such settings (Derqui et al., 2018; Pinto et al., 2018). A study describing such efforts was conducted in Spain with elementary to secondary school students. Elementary school students that did not receive education on food waste wasted 15 g more food per student per day than their counterparts at elementary schools that did provide this education. At secondary schools, each student wasted an average of 36 g more food per day at schools without lessons on food waste (Derqui et al., 2018). In another study at the University of Lisbon, Portugal, a campaign was implemented to raise awareness about plate waste, or uneaten portions of food selected. After informative posters were placed in the dining hall, plate waste was reduced by 15% (Pinto et al., 2018).

While these studies did not involve use of the mFR™, they are relevant given the mFR™ could be used to quantify food waste in similar educational campaigns in the United States aimed at reducing food waste. For

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example, Panizza et al. (2017) used mFRs™ and participant interviews to ascertain whether unconsumed food in O'ahu, Hawai'i, was thrown in the trash or instead eaten later, fed to a pet, or composted. The food selected, food left over, and food wasted was examined with regard to energy, nutrients, and food groups. Extension educators could use data like this drawn from the mFR™ to create educational material about the magnitude of waste to be used in programs in schools and universities nationwide (Jacko et al., 2007). The Extension material could be used in health classes to educate about nutrition and food waste prevention or in math classes as part of lessons on calculating (plate waste) percentages. Teach the Teacher programs could educate participants on the research findings on food waste and the value of educating students on prevention. Extension professionals could also educate university students on using the mFR™ for research.

The mFR™ app is a versatile application designed to be used as a collaborative tool for researchers. The cost of using the app depends on study goals, sample size, the length of time of use, and the complexity of the research project. The app can be used as a research tool to quantify food waste in various settings. The image data collected could be used to create educational campaigns through Extension aimed at reducing food waste at schools and universities, among other uses.

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