Evaluating Factors Influencing Tennessee and Kentucky Farmers' Willingness to Sell Produce Through Fresh Stop Markets

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Abstract

The food justice movement focuses on resolving inequalities in the food justice system, including but not limited to inequalities related to race, limited resource household access to food, limited resources and minority farmer access to markets, and fair treatment of farmworkers. Previous studies have focused on inequalities of the food system from the demand side, but only a few studies have focused on the role farmers play in food systems that are more equitable.

An example of a market model aiming to fulfill various missions of food justice is Fresh Stop Markets. Fresh Stop Markets aggregate food from local farmers and sell shares on a sliding scale based on income. Households with lower income pay less than higher income households for the same food. A vital component of this market model is farmers' willingness to sell produce through FSM. Using data from a survey of Tennessee and Kentucky fruit and vegetable farmers conducted in 2020 and a bivariate probit regression, this study investigated the factors correlated with Tennessee and Kentucky fruit and vegetable farmers' willingness to sell produce through Fresh Stop Markets. Results suggest farm income dependence and variables capturing farmer engagement with various food justice activities (e.g., offering price discounts to low-income families) are correlated with farmers' willingness to sell produce through FSM. This information might help communities interested in replicating the FSM model to identify and engage farmers willing to sell produce through FSM.

Keywords: Farmers' willingness to sell, Fresh Stop Markets, Food justice, Bivariate Probit Regression

1. Introduction

Previous studies have described the mission of the food justice movement as one that aims to restructure food systems to address societal inequality and disparity issues (Gottlieb and Joshi, 2010). Some studies have connected the definition of the food justice movement with the combination of ecological and economic sustainability and social justice when addressing food systems (Alkon and Agyeman, 2011). Others have emphasized the existence of racial and economic inequalities through the food systems from production to consumption and ways to address those inequalities within the food system (Alkon and Mares, 2012). In general, the food justice movement addresses various elements of the food system, including unequal access to fresh, nutritious, affordable, and culturally appropriate food among households, the wellness of farmworkers, and social, economic, and environmental sustainability of family farms, among other related elements (Alkon and Agyeman, 2011; Allen, 2016; Gottlieb and Joshi, 2010). In this study, we will focus on three major aspects of food justice, which involve low-income, food-insecure[1] households' access to farm-fresh products, connecting small- and medium-sized, limited-resource farms to markets, and community engagement that promotes and supports sustainable agriculture, sustainable food systems, and healthy eating (Velandia et al., 2021).

While the number of studies related to initiatives connected to the food justice movement in the context of local food systems has increased in the past two decades, the vast majority of these studies focus on strategies to increase consumer access to fresh fruits and vegetables at market outlets such as farmers markets, Community Supported Agriculture markets (CSA), and food hubs

[1] The USDA defines food insecurity as having unreliable or restricted access to adequate food due to individuals' household-economic status or other social factors (USDA-ERS, 2021).

(Bradford et al., 2019; Cotter et al., 2017; Hanson et al., 2019; Kaiser et al., 2020; Kasprzak et al., 2021; McGuirt et al., 2020; Pershing and Hendrickson, 2017; Quandt et al., 2013). There are very few studies evaluating farmers' experiences and involvement with initiatives connected to the food justice movement. The majority of these studies focus on farmers selling or willingness to sell produce to low-income consumers and the impact of these activities on the economic viability of their businesses (Hodgins and Fraser, 2018; Kaiser et al., 2020; Montri, Chung, and Behe, 2021; Pershing and Hendrickson, 2017; Pilgerman, 2011; Sitaker et al., 2020). These studies use farmer interviews to assess motivations and barriers to selling products through market outlets located in low-income areas or serving low-income communities. Factors influencing farmers participating in market outlets serving low-income communities include opportunities to sell their products to these communities, alignment of their farm business goals and motivations for farming with these market outlets' mission, opportunities to expand their business into new locations and market segments, and increased community engagement. Findings related to farmers' barriers to selling products through market outlets serving low income communities suggest expansion costs to serve demand and the inability to obtain price premiums when selling products to these households might prevent farmers from selling products through these market outlets. Limitations of these studies include the inability to generalize results from a small sample of farmer interviews (i.e., 12 to 27 farmers). Additionally, these studies focus on farmers' willingness to sell products through market outlets aiming to fulfill only one goal of the food justice mission (i.e., increase low-income households' access to farm-fresh products) but not multiple goals of the food justice mission (e.g., connecting small- and medium-sized, limited-resource farms to markets, and community engagement). Farmers' willingness to participate in initiatives connected to the food justice

movement, specifically selling their products through market outlets with a food justice mission, is critical for the success and long-term sustainability of these initiatives (Velandia et al., 2021).

Understanding the profile of farmers and farm businesses that are more likely to be interested in participating in initiatives with a food justice mission is essential when evaluating the ability to engage farmers in food justice initiatives and replicate successful food justice initiatives. An example of a successful initiative supported by a non-profit organization (New Roots, Inc.) covering various aspects of the food justice mission that depend heavily on farmer engagement is Fresh Stop Markets (FSM) (Velandia et al., 2021). A FSM is a cooperative market set up every two weeks, for 20 weeks, during the growing season at a specific location that provides local produce to customers on a sliding scale. This means that households receive access to the same amount of food at different costs based on their income. Therefore, higher-income households will pay a higher amount for a share (i.e., a box of fresh produce) than lower-income families so that these families can have access to fresh food at an affordable cost. On the production side, New Roots, Inc. tries to guarantee that fresh produce available for a FSM originates from small, limited-resource, minority farmers. Throughout the life of this food justice initiative, which has excited since 2010, communication and engagement with farmers have been critical to the sustainability of this market model. For example, in the organization structure, a position (e.g., farmer liaison, farmer anchor) that ensures communication with farmers and farmer engagement in deciding product offers for each season has always excited, and it has been critical to the financial viability and long-term sustainability of this initiative (Velandia et al., 2021). Currently, it is a farmer (i.e., farm anchor) who communicates with staff members at New Roots Inc. (the executive director) to coordinate the majority of purchase orders and product delivery.

The main objective of this study is to evaluate the factors correlated with farmers' willingness to sell produce through a FSM. This information is useful in helping organizations wanting to replicate this initiative to identify potential farmers interested in supporting this kind of initiative and develop strategies to engage farmers in food justice initiatives in general and FSM specifically.

2. Conceptual Framework

In this study, we assume that farmers' decision to sell produce through market outlet with a food justice mission, in this case, FSM, are not only related to reducing risks associated with the uncertainty of fruit and vegetable farms' income, and maintaining or improving these farm businesses economic viability, but also farmers' values, goals, and motivations for farming (Kaiser et al., 2020; Montri, Chung, Behe, 2021; Sitaker et al., 2020). For example, previous studies suggest that farmers' interest in serving low-income communities and the ability to promote sustainable agriculture, sustainable food systems, and healthy eating through community engagement could be related to farmers' participation in market outlets aiming to fulfill at least one of the food justice missions (Kaiser et al., 2020; Sitaker et al., 2020).

Similar to previous studies evaluating farmers' adoption of marketing and production strategies (Dong, Campbell, and Rabinowitz, 2019; Edge et al., 2018; Walton et al., 2008; Wolf and Widmar, 2014), we used the utility model framework to explore farmers willingness to sell produce trough FSM. The expected utility model framework associated with a farmer's decision to market products through FSM can be represented as:

$$E_{FSM}[U(nfi, \pi_{FSM}, z)] \geq E_{No\ FSM}[U(nfi, \pi_{No\ FSM}, z)], \quad (1)$$

where *No FSM* represents the decision to not sell produce through FSM; nfi represents non-farm income such as wages from non-farm occupations, income earned by a spouse, income from non-farm investments, and pensions; π_{FSM} and $\pi_{No\ FSM}$ represent total net profits associated with

selling produce through FSM and other market outlets, and net profits associated with selling produce through market outlets excluding FSM, respectively; and z represents all other factors, that could be non-monetary, contributing to a farmer's willingness to sell produce through FSM, such as farm business values (e.g., serving low-income communities and promoting community engagement), farm size, farmer's age, gender, and education (Kaiser et al., 2020; Montri, Chung, and Behe, 2021; Newsome, 2020; Sitaker et al., 2020; Trauger et al., 2010).

The net profits of selling produce through FSM, as presented in equation (1), are defined as revenue minus costs (i.e., variable and fixed costs). Following previous studies' definition of net farm profits (Chase, 2020; Conner and Rangarajan, 2009: Dong, Campbell, and Rabinowitz, 2019; Hardesty and Leff, 2010; Kay, Edwards, and Duffy, 2008), total net profits associated with products' sales that include FSM sales and sales through other market outlets are defined as:

$$\pi_{FSM} = p * (Q(l,e)w_{RT1}) + p(1-d) * (Q(l,e)w_{FSM}) + p_{other}(Q(l,e)w_{other}) - C_{FSM} \quad (2)$$

$$\pi_{No\ FSM} = p * (Q(l,e)w_{RT2}) + p_{other}(Q(l,e)w_{other2}) - C, \quad (3)$$

where p and p_{other} represent the price received by farmers at retail market outlets[2] (e.g., farmers markets) and other market outlets, respectively; d represents the price discount received when selling products through FSM; w_{RTj}, w_{FSM}, and w_{ot} represent the percentage of produce quantity sold through the retail market, FSM, and other market outlets, respectively (the sum of weights on equations (2) and (3) should equal 1); $Q(l,e)$ represents total quantity produced, which is a function of l (e.g., seed, fertilizer, and labor) and random variables e (e.g., weather events); C_{FSM} and C represent variable and fixed costs associated with the marketing strategy that includes FSM and the marketing strategy that excludes FSM, respectively. When combining equations 1,

[2] We assume that farmers most likely receive the highest price for their produce when selling through retail market outlets.

2, and 3, we can infer that prices received and volume sold through FSM will impact farm profits and, therefore, the expected utility of selling produce through FSM, ultimately influencing farmers' willingness to sell produce through FSM.

Farmer *i* will sell produce through FSM when the expected utility of selling produce through FSM is greater than or equal to the expected utility from not selling produce through FSM. This difference can be represented by y_i^*:

$$y_i^* = E_{FSMi}[U(nfi, \pi_{FSM}, z)] - E_{No\ FSMi}[U(nfi, \pi_{No\ FSM}, z)], \quad (4)$$

where y_i^* is a latent variable representing the difference between the expected utilities of selling and not selling produce through FSM.

Although, y_i^* is an unobservable latent variable, farmer *i* willingness to sell produce through FSM is observable and can be represented by y_i:

$$y_i = \begin{cases} 1 & if\ y_i^* \geq 0 \\ 0 & if\ y_i^* < 0 \end{cases}, \quad (5)$$

where y_i equals one if farmer *i* is willing to sell produce through FSM and zero otherwise.

3. Data and Methods

3.1. Survey Data

The data used in this study is from a 2020 survey of Tennessee and Kentucky fruit and vegetable farmers conducted between February and May. The contact list of 961 farmers representing fruit and vegetable farms located in 32 counties across East Tennessee and 14 counties near the Lexington and Louisville, Kentucky areas used for this survey was obtained from the Tennessee and Kentucky Departments of Agriculture. There were various factors preventing us from conducting statewide surveys. First, we had budgetary restrictions that did not allow us to conduct a survey covering all counties in Tennessee and Kentucky. Additionally, for Tennessee, we restricted the contact list to farms located in the selected 32 counties because we were conducting

an alternative survey related to a different project at the same time in the other 63 Tennessee counties (there are 95 counties in Tennessee) and wanted to minimize the impact on response rates due to farmer survey fatigue. The 14 Kentucky counties included in the survey were counties where FSM are or were located, or counties that share boundaries with counties where FSM are or were located. Our hypothesis is that farms located in these Kentucky counties might have a better understanding of how FSM work and, therefore, be more likely to provide useful information about their willingness or not to sell products through FSM. We acknowledge that the selection of counties to be included in the survey will impact the representativeness of the sample and our ability to generalize results from our analysis. Below we discuss the representativeness of the sample used in this study.

The survey was a mixed-mode survey consisting of mail [paper] and web versions. A total of 245 Tennessee farmers for whom we had e-mail addresses received the web version of the survey between February and March 2020. Those Tennessee farmers for whom we only had mailing addresses and not e-mail addresses (i.e., 58) and those who did not complete the web version of the survey by April 2020 (i.e., 222) received a mail version of the survey. A mail version was also sent to all Kentucky farmers (i.e., 658) in the contact list since we only had mailing address information for these farms. A total of 161 farmers from the 961 farmers included in the contact list completed the survey. This represents a 17% response rate. There were 112 observations for analysis after eliminating respondents who indicated not producing fruits and vegetables for sale in 2019 and those who sell or have sold products through FSM (i.e., 49). Only 70 observations were used for the regression analysis after eliminating 42 observations due to missing values. The survey included questions related to farmer engagement with food justice activities (i.e., farmers' SNAP or WIC acceptance, participation as leaders or volunteers in food justice initiatives, running

educational programs, food product donation, providing low-income family discounts, and selling produce at farmers markets in low-income neighborhoods), willingness to sell produce through FSM, market outlets they used, and farmer and farm business characteristics (e.g., household income, acres in fruit and vegetable production, farmer age).[3]

3.2. Survey Sample Representativeness

Similar to Velandia et al. (2020a, 2020b), we assessed the representativeness of the Tennessee fruit and vegetable farms included in the survey and regression sample by comparing the distribution of these samples based on acres in fruit and vegetable production to the same distribution according to the 2017 Census of agriculture (USDA, 2022). As stated in Velandia et al. (2020a, 2020b), the 2017 United States Census of Agriculture does not contain information about combined acres in fruit and vegetable production but about acres in vegetable, fruit and nuts, and berry production separately. Given that we used the same contact list in Velandia et al. (2020a, 2020b) to conduct the surveys (at least for the Tennessee farms), we can assume that, just as in these previous studies, the majority of Tennessee respondents in our survey either grow only vegetables or vegetables and fruits and berries. Figure 1 shows the distribution of Tennessee farms based on acres in fruit and vegetable production for the survey and regression samples and the distribution of Tennessee farms based on acres in vegetable production according to the 2017 Census of Agriculture (USDA, 2022). The distribution of farms for the survey and regression samples followed closely the distribution of vegetable farms according to the 2017 Census of Agriculture. Similar to the distribution of farms based on the Census of Agriculture information, more than half of the farms in the survey and regression samples have less than 5 acres in vegetable production. About 61%

[3] A copy of the survey instrument is available from authors upon request.

and 68% of the farms in the regression and survey samples, respectively, reported less than 5 acres in fruit and vegetable production. It is important to note that, similar to Velandia et al. (2020a, 2020b), the survey and regression samples tend to underrepresent farms with less than 1 acre in vegetable production and overrepresent farms reporting between 5 and 50 acres in vegetable production. The overrepresentation of medium-sized farms (i.e., 5 to 50 acres) could be explained by the fact that those farms might be in a better position to expand their market outlets based on the volume of fruits and vegetables they produce compared to those farms with less than 1 acre in vegetable production. They, therefore, might be more likely to be interested in responding to a survey assessing their willingness to participate in a new market outlet.

Since the survey only collected acres of fruits and vegetables combined, we validated the assumption that the Kentucky farms included in our survey sample are more likely to grow vegetables only or vegetables and fruits than fruits only, like the Tennessee survey and regression samples, by assessing the percentage of Kentucky farms in our contact list that produce vegetables only, vegetables and fruits, and fruits only. We took a random sample of 150 farms from the Kentucky farm contact list, which represents 23% of the farms included in the contact list, and determined the percentage of Kentucky farms producing vegetables only (41%), fruits and vegetables (53%), and only fruits (5%). We took a random sample of farms listed in the contact list because IRB protocols do not allow us to connect survey responses with names and addresses, and therefore, we cannot identify the farms included in the survey sample. Furthermore, we only took a random sample of the Kentucky farms included in the contact list because the process of identifying which farms produce vegetables only, vegetables and fruits, and fruits only is labor-intensive because it requires going to the Kentucky Department of Agriculture website[4] and

[4] http://www.kyproud.com/

searching for information on each individual farm. We evaluated the representativeness of the Kentucky farms included in the survey and regression samples by comparing the average fruit and vegetable acres reported by the Kentucky farms included in these samples with the average acres in vegetable production for Kentucky farms according to the 2017 Census of Agriculture (USDA, 2022). We could not compare the representativeness of survey and regression samples by comparing the distribution of farms based on farm size categories as we did for the Tennessee farms because this information is not available from the Census of Agriculture for Kentucky farms. On average, the Kentucky farms included in the survey and regression samples are larger in size, based on acres in fruit and vegetable production, 7.62 and 6.59, respectively, compared to the Kentucky vegetable farms according to the 2017 Census of Agriculture (3.63 acres). Similar to the sample of Tennesse farms included in the survey and regression samples, operators of larger Kentucky farms might be more likely to respond to a survey exploring their participation in a new market outlet because they might be in a better position to expand their market outlets compared to operators of smaller farms.

3.3. Contingent Valuation Approach

Farmers' willingness to sell products through FSM was evaluated using elements of the contingent valuation approach. This method has been used in previous studies to assess consumer and producer willingness to adopt various products and production practices (e.g., DeLong et al., 2020; Dobbs et al., 2016; McKay et al., 2019a; McKay et al., 2019b; Velandia et al., 2020a). The elicitation method used in this study is similar to the contingent valuation iterative bidding approach (FAO, 2000). Still, it differs from this method in that all respondents were presented with the same market scenarios as opposed to being randomly assigned among respondents, which in turn allowed for willingness to accept estimates (Aydogdu, 2016). We have a limited number of

market scenarios that could be logically justified and that represent the reality of selling produce through FSM, and therefore we present the same market scenarios to all respondents.

Only farmers who have never sold produce through FSM were asked about their willingness to sell produce through FSM. Before eliciting respondents' willingness to sell produce through FSM, we provided the following information about FSM:

"Imagine that you had the choice to sell produce through Fresh Stop Markets. This market outlet has the following characteristics:

1. Fresh Stop Markets representatives communicate with the farmers about items needed for the market. They are responsible for aggregating the food and delivering it to the markets to decrease the logistics burden for farmers.
2. A non-profit organization is responsible for all marketing efforts. Therefore, farmers have no costs associated with recruiting and maintaining shareholders.
3. The mission of this market is to give low-income, food-insecure families access to fresh, healthy foods.
4. There is **no binding** contract between the farmer and the non-profit organization coordinating this market opportunity, but this organization provides information about the potential produce volume and kinds of produce a farmer could sell through the Fresh Stop Markets. "

Next, farmers are asked about their willingness to sell produce through FSM if prices paid are 25% below retail prices (e.g., CSA), and they can sell up to 30% of their produce through FSM. Respondents are presented with either a lower (20%) or a higher (30%) price discount over retail prices, depending on their answer to this first market scenario. If they responded yes to the first

market scenario, they would be presented with a higher price discount (30%). If they responded no, they would be presented with a lower price discount market scenario (20%). The volume respondents can sell through FSM doe not vary across market scenarios.

Market scenarios presented to respondents were created using information from interviews[5] we conducted with the executive director of New Roots Inc. (organization coordinating FSM) and three farmers who were selling produce through FSM and who were providing more than 50% of the produce sold by FSM to customers. The executive director of New Roots Inc. provided information about the value of the FSM share based on prices paid to farmers. All farmers selling produce through FSM were using community supported agriculture (CSA) as a marketing strategy, and therefore we asked them to indicate the value of their CSA shares. We estimated the difference between the value of the FSM shares and the value of the farmers' CSAs shares. This information was used to determine the percent price discount scenarios presented to survey respondents (i.e., 20%, 25%, and 30% price discounts over retail prices). We also asked farmers to estimate the percentage of the total production they sold through FSM. This information was used to incorporate volume information in the market scenarios. All market scenarios presented to respondents guarantee that farmers will be able to sell up to 30% of their produce through FSM.

Market scenarios presented to survey respondents included price and volume information, as we hypothesized that farmers' willingness to sell produce through FSM would be influenced by the profits associated with incorporating FSM in their marketing strategies as presented in equations (1) to (3).

[5] We conducted interviews with farmers from Kentucky who have experience selling produce through FSM. Farmers that currently sell produce through FSM and run their own CSA were specifically asked about the prices they receive from FSM and the value of their CSA share.

3.4. Bivariate Probit Regression

Survey respondents' willingness to participate in FSM, given the various market scenarios presented to them (i.e., 25% and 20% or 25% or 30%) is hypothesized to be a function of farmer's values, motivation for farming and farmer and farm business characteristics as described below,

$$y_{i1} = x_i\beta_1 + \varepsilon_{i1} \quad (6)$$

$$y_{i2} = x_i\beta_2 + \varepsilon_{i2}, \quad (7)$$

where x_i captures all variables potentially correlated with y_{im}; m takes the value of 1 for the first market scenario respondents are presented with and 2 for the second market scenario respondents are presented with given their responses to the first market scenario.

A bivariate probit regression was used to jointly estimate y_{i1} and y_{i2} because there is no simultaneity in the market scenarios presented to respondents. Market scenario two is presented to respondents after market scenario one. Additionally, we assumed the error terms of the two outcomes (e.g., ε_{i1} and ε_{i2}) might be correlated (Cameron and Trivedi, 2010), and therefore, a bivariate regression is appropriate to estimate the parameters (i.e., β_1 and β_2) in equations (6) and (7). The likely correlation between the two binary outcomes via the error term might be due to unobserved explanatory variables (e.g., unobserved farmers' values and motivations) that could have similar effects on farmers' willingness to sell produce through FSM for the two market scenarios presented to survey respondents. It is assumed that the error terms $(\varepsilon_{i1}, \varepsilon_{i2})$ for y_{i1} and y_{i2} are normally distributed and correlated $(Cov(\varepsilon_{i1}, \varepsilon_{i2}) = \rho)$.

The marginal effects are computed given the bivariate structure of the model (Greene, 2012; Edge et al., 2018). The joint probability that a farmer is willing to sell produce through FSM given the two market scenarios presented to them $(y_{i1} = 1, y_{i2} = 1)$ is defined as:

$$\Phi_{y_{i1}=1;\, y_{i2}=1} = \text{Prob}\,[y_{i1} = 1, y_{i2} = 1|x_i] = \Phi_2(x_i\beta_1, x_i\beta_2, \rho). \quad (8)$$

The joint outcome is that a farmer is willing to sell produce through FSM in both market scenarios one and two ($y_{i1} = 1, y_{i2} = 1$) is equivalent to the farmer's maximum price discount over retail prices they are willing to accept (WTA) being above 30%,

$$\Phi_{y_{i1}=1;\, y_{i2}=1} = \text{Prob}\{25\% \leq \max \text{WTA} \;\&\; 30\% \leq \max \text{WTA}\} \quad (9)$$

The continuous marginal effect of the bivariate probit outcome for the *k* variable is calculated by taking the derivative of equation (8) with respect to x_{ik}:

$$\frac{\delta\Phi_{y_{i1}=1;\, y_{i2}=1}}{\delta x_{ik}} = \frac{\delta\Phi_2(x_i\beta_1, x_i\beta_2, \rho)}{\delta x_{ik}} = \Phi_{y_{i1}=1|\, y_{i2}=1}\phi_{y_{i2}=1}\beta_{2k} + \Phi_{y_{i2}=1|\, y_{i1}=1}\phi_{y_{i1}=1}\beta_{1k}, \quad (10)$$

where ϕ and Φ denote the standard normal distribution density function and cumulative distribution function, respectively.

Marginal effects were also estimated for the following joint probability scenarios:

$$\Phi_{y_{i1}=0;\, y_{i2}=1} = \text{Prob}\{25\% > \max \text{WTA} \geq\ 20\%\} \quad (11)$$

$$\Phi_{y_{i1}=0;\, y_{i2}=0} = \text{Prob}\{25\% > \max \text{WTA} \;\&\; 20\% > \max \text{WTA}\} \quad (12)$$

$$\Phi_{y_{i1}=1;\, y_{i2}=0} = \text{Prob}\{25\% \leq \max \text{WTA} < 30\%\} \quad (13)$$

3.4. Diagnostic Tests

We used the Wald test to test the correlation between the error terms in equations (6) and (7) (Greene, 2012). This Wald test tests the null hypothesis that $H_0: \rho = 0$. The rejection of the null hypothesis implies that $\rho \neq 0$, and therefore the bivariate probit regression is appropriate to estimate the parameters in equations (6) and (7). We also used a Wald test to evaluate the overall significance of the bivariate probit regression. This Wald test tests the null hypothesis that all

parameters in equations (6) and (7) are equal to zero. Rejecting the null hypothesis for this Wald test implies that at least one of the parameters associated with the independent variables included in the regression is different than zero.

Multicollineairty was tested using the condition Index (Belsley, Kuh, and Welsch, 1980). Condition Index was used to detect multicollinearity problems. A condition index between 30 and 100 suggests that there is a moderate to a strong association between independent variables (x_i) in equations (6) and (7). If multicollinearity is detected, inferences obtained from the estimated parameters in equations (6) and (7) might be compromised due to inflated variance estimates.

4. Hypothesis of Regression Explanatory Variables

A list of the explanatory variables included in the bivariate regression, as well as their definitions, hypothesized signs, and descriptive statistics, are included in Table 1.

We hypothesized that explanatory variables correlated with farmers' willingness to participate in FSM included, but are not limited, to farmer values, goals, and motivations for farming (Kaiser et al., 2020; Montri, Chung, and Behe, 2021). We captured farmer values, goals, and motivations for farming through variables indicating farmer participation in activities related to food justice. All these variables are considered non-monetary motivations for their willingness to participate in FSM. Explanatory variables associated with food justice activities that we expect to be correlated with willingness to sell produce through FSM include offering price discounts to low-income households ($low\_income\_household\_price$), donating produce to a food bank ($donate$), serving as a volunteer or leader in an organization with a food justice mission ($leader$), and offering on-farm, agricultural education programs to communities ($edu\_programs$). We hypothesized that the values and motivations captured by explanatory variables that indicate farming participation in food justice related activities ($low\_income\_household\_price$, $donate$,

$leader$, and $edu\_programs$) are positively correlated with farmers' willingness to sell produce through FSM.

We also hypothesized that non-farming income, captured by a variable showing farmer dependence on farming income ($farm\_income\_dependence$) is correlated with farmers' willingness to sell produce through FSM. As suggested by Montri, Chung and Behe (2021) farmers' income dependence ($farm\_income\_dependence$) could influence farmers' participation in market outlets related to the food justice mission. They suggest that full-time or part-time farmers exploring the opportunity to become full-time farmers are driven by financial goals. Therfeore, we could infer that a price discount related to including FSM in a farm business marketing strategy might deter these types of farmers from participating in FSM. We hypothesized that farmers' income dependence is negatively correlated with farmers' willingness to sell produce through FSM.

We assumed that farmer and farm business characteristics are correlated with farmers' willingness to sell produce through FSM, we specifically hypothesized that farmer age (age), farmer education ($education$), farm size ($farm\_size$), farmer gender ($female$), and farmers market participation ($farmers\_market$) are correlated with y_{i1} and y_{i2}.

We hypothesized that the farmers' age (age) is negatively correlated with farmers' willingness to sell produce through FSM. As suggested by previous studies, older farmers have shorter planning horizons and, thus, might be less likely to change or modify their production and marketing strategies (Davis, 2012; Dong, Campbell, and Robinowitz, 2019; Edge et al., 2018; Walton et al., 2008; Zhong, Qing, and Hu, 2016). On the other hand, we hypothesized that education ($education$) could be positively but also negatively correlated with farmers' willingness to sell produce through FSM. We expect knowledge and information affect farmer marketing or market

outlet choice decisions (Pilgerman, 2011; Edge et al., 2018; Zhong, Qing, and Hu, 2016). Those decisions could be to sell but also to not sell produce through FSM.

We assumed that the size of the operation in terms of annual gross farm revenue ($farm\_size$)[6] could be positively but also negatively correlated with farmers' willingness to sell produce through FSM. As suggested by Peterson et al. (2021), small farms are both more likely to (1) depend on value-based supply chains, such as FSM, as a source of revenue and (2) have value-based supply chains as one of their top three marketing channels. However, farm size could limit the ability of a farmer to sell products through FSM. For example, small farms could be limited due to their inability to provide enough produce volume to satisfy FSM needs (Peterson et al., 2021).

We hypothesized that women (($female$) might be more likely to sell produce through FSM. Newsome (2020) and Trauger et al. (2010) suggest female farmers manage narrow profit margins and maintain the economic viability of their farm business by using production and marketing strategies that differ from conventional strategies (e.g., conventional farming, wholesale).

Finally, we expect farmers' experience selling produce through farmers markets ($farmers\_market$) could be negatively or positively correlated with farmer willingness to sell produce through FSM. On the one hand, price discounts over retail prices (e.g., farmers markets prices) might deter farmers from selling produce through FSM. On the other hand, the potential reduced labor and costs associated with marketing produce through FSM compared to farmers markets might motivate farmers to sell produce through FSM.

[6] We also measured farm size in terms of acres and obtained a similar interpretation to farm size in terms of annual gross farm revenue from the regression results. Nonetheless, the model with farm size measured in terms of annual gross farm revenue had a better fit to the data (i.e., lower Akaike Information Criterion).

5. Results

5.1.Sample Overview and Descriptive Statistics

The means and standard deviations of all explanatory variables included in the regression analysis are presented in Table 1. About 41% of the respondents included in the bivariate regression were females, 70% indicated having a bachelor's degree or higher, and they were on average 58 years old. About 30% of the respondents reported annual gross sales of $25,000 or more, and more than 25% of their income from farming. About three-fourths (73%) of the respondents reported selling produce through farmers markets in 2019.

More than half of the respondents (63%) included in the regression sample reported donating produce through food banks. About a third of the respondents (31%) indicated they had been involved with an organization with a food justice mission as a leader or volunteer, and also about a third of respondents (29%) indicated they run educational programs to educate the community about sustainable agriculture and food systems. Finally, 19% of the respondents indicated they offer price discounts to low-income households.

Figure 2 shows the percentage of respondents willing and unwilling to sell produce through FSM given the price discount presented in market scenario one (25%), and the percentage of respondents willing and unwilling to sell produce through FSM given their response to their first market scenario and the price discounts presented in market scenario two (i.e., 30% and 20%).

More than half of the respondents included in the regression analysis, approximately 61%, were willing to sell produce through FSM at market scenario one when prices paid were 25% below retail price. Of the 61% who were willing to sell produce through FSM at market scenario one, 60% were still willing to sell produce through FSM at market scenario two when prices paid were

30% below retail prices. On the other hand, nearly 19% of respondents who were not willing to sell produce through FSM at market scenario one changed their decision and were willing to sell produce through FSM at market scenario two when prices paid were 20% below retail prices.

5.2. Bivariate Probit Regression Results and Joint Probability Marginal Effects

Parameter estimates from the bivariate probit are presented in Table 2. The Wald test evaluating the correlation (ρ) between $\varepsilon_{i1}$and ε_{i2} in equations (6) and (7), suggest ρ is statistically significant at the one percent significance level. Results from this Wald test suggest the bivariate probit regression is appropriate for estimating the parameters in equations (6) and (7). The Wald test statistic evaluating the overall significance of the bivariate probit regression suggests at least one of the independent variables included in the regression is different than zero. The condition index (18.67) indicates there are no collinearity issues that could affect inferences from the estimated parameters.

Since each respondent was presented with different price discounts on market scenario two (20% or 30%) depending on their responses to the first market scenario (25%), we focus on the results related to marginal effects associated with the various joint probability scenarios presented in equations 9, 11, 12, and 13. We present the marginal effects for the joint probabilities scenarios in Table 3.

There were three variables negatively correlated with the joint probability of a respondent's willing to sell produce through FSM, given price discounts over retail prices of 25% and 30% (i.e., $y_1 = 1, y_2 = 1$). These three variables were farm operator age (age), farm operator gender ($female$), and dependence on farm income ($farm\_income\_depedence$). These results suggested that older

and female operators, reporting more than 25% of their income from farming, were less likely to be willing to sell produce through FSM regardless of the price discount scenario presented to them.

Consistent with our hypotheses about the correlation between age and willingness to sell produce through FSM, these results suggest that older individuals are less likely to be willing to change their marketing strategies by adding FSM to the mix because they have a shorter planning horizon (Davis, 2012; Dong, Campbell, and Robinowitz, 2019). Our results are also consistent with our hypothesis about farm income dependence, where we assumed that full-time farmers or part-time farmers who have a higher dependence on farm income are driven by financial goals and therefore are less likely to consider selling produce through a market outlet that pays them prices below their highest-paid market (Montri, Chung and Behe, 2021). In contrast, our results contradict our hypothesis that female respondents are more likely to sell produce through FSM. Female farm operators could be responsible for additional household tasks (e.g., childcare) on top of being responsible for the farm business, and that might deter them from adding a new market outlet to their marketing strategy (Inwood and Stengel, 2020).

In contrast to the joint probability scenario where $y_1 = 1$ and $y_2 = 1$, dependence on farm income ($farm\_income\_depedence$) was positively correlated with the joint probability that a respondent would be willing to sell produce through FSM at market scenario one and would not be willing to sell produce at market scenario two (i.e., $y_1 = 1, y_2 = 0$). This result suggests that respondents with more than 25% of their income from farming might be more sensitive to price discounts when evaluating their interest in selling produce through FSM. These respondents might be more likely to be willing to sell produce through FSM when price discounts are 25% below retail prices and not be willing to sell produce through FSM when price discounts increase to 30%. Additionally, farmer engagement with specific food justice related activities, specifically

providing price discounts to low-income households ($low\_income\_household\_price$) and being engaged with organizations with a food justice mission as leaders or volunteers ($leader$), were negatively correlated with the joint probability of being willing to sell produce through FSM at a 25% price discount and not be willing to sell produce through FSM at a 30% price discount.

These results suggest that respondents who are already investing time or money in food-justice related activities might be less likely to be willing to sell produce through FSM when the price discount is at the 25% level.

The variables negatively correlated with the joint probability of not being willing to sell produce through FSM at a 25% price discount level and being willing to sell produce at a 20% price discount level (i.e., $y_1 = 0, y_2 = 1$) are the dependence on farm income ($farm\_income\_depedence$) and farmers running education programs to educate the community about sustainable agriculture and food systems (*edu. programs)*.

These results suggest that respondents with more than 25% of their household income coming from farming ($farm\_income\_depedence$) and running education programs to educate the community about sustainable agriculture and food systems (*edu. programs*) might be less likely to change their minds regarding their interest in selling produce through FSM, if they already expressed they are not willing to sell produce through FSM at a 25% price discount level, even when the price discount decreases to 20%. In contrast, farmers who have been engaged as leaders or volunteers in organizations with a food justice mission ($leader$) are more likely to change their minds about their willingness to sell produce through FSM, if they have already indicated they are not willing to sell produce through FSM at a 25% price discount level if this discount decreases to a 20% level. Survey respondents who have experience as leaders or volunteers in food justice-

related organizations could have particular insights about the challenges related to running and sustaining organizations or market outlets with a food-justice related mission (Velandia et al., 2021), and therefore, might better understand that at 25% price discount participation in FSM might not be a viable option for them but it may be at a 20% price discount level (Velandia et al., 2021).

Finally, marginal effects for the joint probability scenario where the respondent is not willing to sell produce through FSM at a 25% and a 20% price discount market scenarios (i.e., $y_1 = 0, y_2 = 0$) suggest female operators (*female*) with gross annual sales greater than $25,000 (*farm size*) are more likely to not be willing to sell produce through FSM at any price discount market scenario. In contrast, results suggest respondents running education programs (*edu. programs)* are less likely to not be willing to sell produce through FSM at any price discount market scenario. We could infer that as small farms are more likely to depend on value-based supply chains, such as FSM, as a source of revenue (Peterson et al., 2021), larger farmers are less likely to depend on these types of market outlets, which is consistent with our findings. Also, the findings related to the *edu. programs* variables are consistent with our hypothesis that farmers who are already engaged with food justice related activities are less likely to not be willing to sell produce through FSM.

6. Discussion

The food justice movement focuses on resolving inequalities in the food justice system, including but not limited to inequalities related to race, limited resource household access to food, limited resources and minority farmer access to markets, and fair treatment of farmworkers. Previous studies have focused on inequalities of the food system from the demand side, but only a few studies have focused on the role farmers play in the food systems that are more equitable.

An example of a market model aiming to fulfill various missions of food justice is Fresh Stop Markets. Fresh Stop Markets aggregate food from local farmers, and sell shares on a sliding scale basis based on income. Households with lower income pay less than higher income households for the same food. A vital component of this market model is farmers' willingness to sell produce to FSM. This market model has been successfully supported by New Roots Inc. for more than ten years with a great impact on the community they serve, providing access to fresh, healthy organic produce to 715 families - a large percentage of these families are categorized as limited resources households-, and generating a revenue of $160,000 for local farmers in 2021 (New Roots Inc., 2022). The longevity of this market model and the great impact this market has had on Kentucky communities makes this market model an attractive model to be replicated.

A key component associated with the replicability of the model is farmers' willingness to sell produce through this market outlet. Using data from a survey of Tennessee and Kentucky fruit and vegetable farmers conducted in 2020 and a bivariate probit regression, this study investigated the factors correlated with Tennessee and Kentucky fruit and vegetable farmers' willingness to sell produce through Fresh Stop Markets.

Results associated with the marginal effects of all the possible joint probability scenarios (i.e., $y_1 = 1$ and $y_2 = 1$, $y_1 = 1$ and $y_2 = 0$, $y_1 = 0$ and $y_2 = 1$, $y_1 = 0$ and $y_2 = 0$) suggest that although there is variation in the variables correlated with the joint probability outcomes, farm income dependence seems to be a variable that is statistically significantly correlated with almost all joint probability outcomes. We could infer from these results that respondents' willingness to sell produce through FSM is highly sensitive to their household dependence on farm income, with respondents who are more dependent on farming income being less likely to take the risk of participating in market outlets that could result in a decreased farm revenue due to lower prices

when compared to other market outlets. Furthermore, results suggest that respondents' with higher dependence on farming income could be more sensitive to price discounts faced when selling produce through FSM.

It is important to note that variables capturing farmer engagement with various food justice activities (i.e., offering price discounts to low-income families, running education programs to educate the community about sustainable agriculture and food systems, and being engaged as a leader or volunteer in an organization with a food justice mission) are correlated with the various joint probability outcomes. This information might help communities interested in replicating the FSM model assess the number of farmers likely to sell produce through FSM in their communities. Furthermore, this information could help organizations interested in replicating the FSM model to design strategies aiming to engage farmers with business values and farming motivations that align with the FSM food justice mission. Finally, this information could help managers of existing FSM identify areas of improvement in their FSM structure to better accommodate or support farmers willing to participate in FSM who are currently not selling produce through FSM. For example, there might be time constraints for farmers running education programs on their farms or participating as leaders or volunteers in the food justice-related organizations that prevent them from selling produce through FSM. Facilitating the logistics associated with delivering produce to FSM could increase the participation of these types of farmers in FSM.

There are several limitations of this study that need to be acknowledged. The sample size available for the bivariate probit regression used in this study was relatively small and was limited to specific regions in Tennessee and Kentucky. Therefore, we cannot confidently generalize the results and conclusions for this study and apply them to farmers located outside the geographic regions included in the regression sample. As a result, future research should focus on expanding its

population to account for more farmers located in a much larger geographic area. Furthermore, future research should also determine the specific price discounts farmers are willing to accept for their produce when selling produce through FSM. The survey design used for this study did not allow us to assess willingness to accept estimates. Future studies could improve the survey design to allow for these estimates. These estimates will provide organizations interested in replicating the FSM model with valuable information regarding the specific price discounts farmers are willing to accept when looking to attract suppliers for the market. This information will help prevent these organizations from setting price discounts that could negatively impact farm net profits, and, therefore, farmer participation in FSM.

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Table 1. Regression sample dependent and explanatory variables' description and summary statistics (n=70).

Variable	Description	Hypothesis Sign	Mean	Standard Deviation
y_{i1}	=1 if the respondent is willing to sell produce to FSM, given a 25% price discount		0.614	0.490
y_{i2}	=1 if the respondent is willing to sell produce to FSM, given a 20% or 30% price discount		0.443	0.500
Age	Respondent's age in years.	-	57.943	13.616
Education	= 1 ≥ bachelor/graduate degree; 0 otherwise	+/-	0.700	0.462
Female	=1 if respondent is a female; 0 otherwise	+	0.414	0.496
Farm Size	= 1 if revenue ≥ $25,000; 0 if revenue < $25,000	-	0.300	0.462
Farmers market	=1 farmer sold produce through farmers markets in 2019, 0 otherwise	+/-	0.729	0.448
Farm Income Dependence	=1 if % of taxable income ≥ 25%; 0 if % of taxable income < 25% in 2019	-	0.300	0.462
Low-Income Household Price	= 1 if farmer offers a price discount to low-income households; 0 otherwise	+	0.186	0.392
Donate	= 1 if farmer donates produce; 0 otherwise	+	0.629	0.487
Edu. Programs	= 1 if farmer runs education programs to educate the community about sustainable agriculture and food systems; 0 otherwise	+	0.286	0.455
Leader	= 1 if a farmer has been involved as a leader or volunteer in an organization with a food justice mission; 0 otherwise	+	0.314	0.468

Table 2. Parameter estimates from the bivariate probit regression.

Independent Variables	Parameter Estimates for the Bivariate Probit Regression	
	Market Scenario 1	Market Scenario 2
Constant	1.003	1.616*
	(1.072)	(0.976)
Age	-0.013	-0.029**
	(0.014)	(0.014)
Education	0.152	0.037
	(0.373)	(0.357)
Female	-0.878**	-0.582
	(0.381)	(0.375)
Farm Size	-0.702*	-0.615
	(0.420)	(0.565)
Farmers market	0.461	0.099
	(0.403)	(0.391)
Farm Income Dependence	0.478	-0.981 **
	(0.349)	(0.501)
Low-Income Household Price	-0.027	0.101**
	(0.049)	(0.047)
Donate	0.063	0.310
	(0.401)	(0.360)
Edu. Programs	0.154***	0.044
	(0.053)	(0.042)
Leader	-0.841**	-0.042
	(0.404)	(0.377)
n	70	
Log pseudo-likelihood value	-68.674	
Wald $\chi 2$	39.27***	
Rho	0.740	
Wald Test Statistic	10.125***	

Note. Values in parenthesis are robust standard errors. Statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

Table 3. Marginal effects on FSM participation joint probabilities from bivariate probit regression.

	$y_1 = 1$ $y_2 = 1$	$y_1 = 1$ $y_2 = 0$	$y_1 = 0$ $y_2 = 1$	$y_1 = 0$ $y_2 = 0$
Age[a]	-0.010**	0.005	-0.001	0.006
	(0.005)	(0.004)	(0.001)	(0.005)
Education	0.025	0.031	-0.010	-0.046
	(0.121)	(0.126)	(0.042)	(0.119)
Female	-0.249**	-0.074	0.026	0.297**
	(0.121)	(0.100)	(0.037)	(0.125)
Farm Size	-0.237	-0.029	0.007	0.259*
	(0.158)	(0.160)	(0.053)	(0.147)
Farmers market	0.075	0.100	-0.036	-0.138
	(0.136)	(0.104)	(0.046)	(0.141)
Farm Income Dependence	-0.264**	0.432***	-0.087*	-0.081
	(0.132)	(0.150)	(0.051)	(0.107)
Low-Income Household Price	0.194	-0.295***	0.190	-0.090
	(0.174)	(0.087)	(0.123)	(0.130)
Donate	0.101	-0.078	0.019	-0.043
	(0.125)	(0.126)	(0.033)	(0.132)
Edu. Programs	0.241	0.209	-0.067**	-0.382***
	(0.159)	(0.143)	(0.032)	(0.106)
Leader	-0.106	-0.211***	0.090*	0.227
	(0.139)	(0.081)	(0.047)	(0.145)

[a] Statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

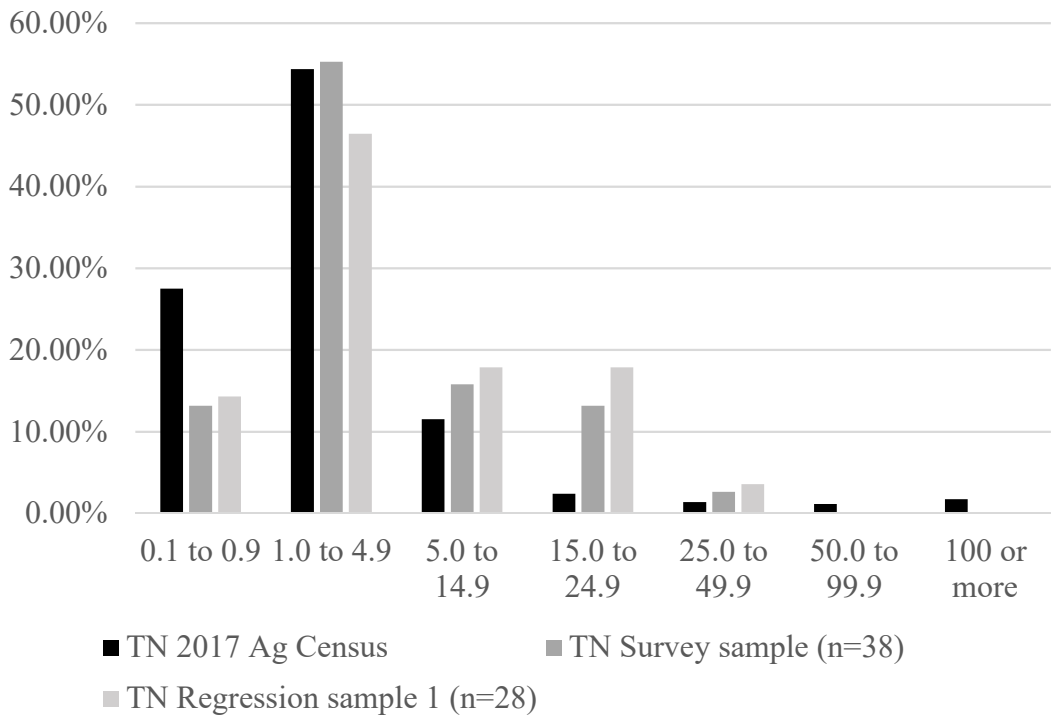

Figure 1. Percentage of Tennessee Farms in Each Farm Size Category Based on Acres in Vegetable Production According to the 2017 U.S. Census of Agriculture, the Survey Sample and the Bivariate Probit Regression.

Figure 2. Respondents' willingness to sell produce through FSM at market scenario two given their willingness to sell produce through FSM at market scenario one (n=70).

Note. Respondents willing to sell produce through FSM in market scenario one were presented with a 30% price discount in market scenario two, and respondents unwilling to sell produce through FSM in market scenario one were presented with a 20% price discount in market scenario two.