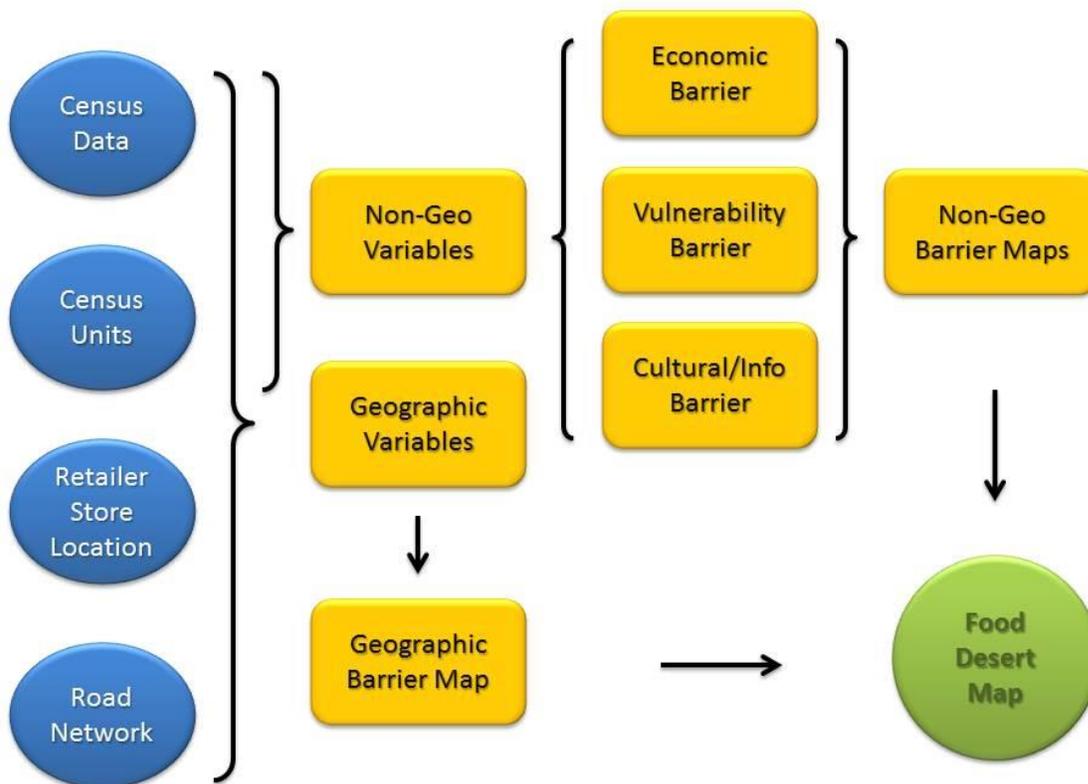


## Appendix -Referenced Tables and Figures

**Table 1: Variables and Input Datasets of Non-Geographic and Geographic Barrier Analyses.** Variables were selected to evaluate barriers from different sources. Each variable has one or two input datasets. Whenever possible, auxiliary data was used in spatial interpolation to provide complementary information to the evaluation of a variable. For details about usage of auxiliary-aided interpolation, please refer to program documentation of ArcGIS 10.2 for Desktop (ESRI 2013). Census data was summarized by census units such as census block group or census tracts.

Barrier Group	Variable Name	Primary Input			Auxiliary Input		
		Input Data	Year	Summary Level	Input Data	Year	Summary Level
Economic	Median Household Income	Median Household Income	1999	Block Group	Median Household Income	2012	Tract
	Poverty Rate	% Pop. below poverty	1999	Block Group	% Household Below Poverty	2012	Tract
	Food Stamp Status	% Household on food stamps	2012	Tract	% Household with Non-White Residents	2012	Tract
Vulnerability	Elderly Population	% Pop. 65 and over	2010	Tract	% Pop. 65 and over	1999	Block Group
	Percent Children	% Pop. under 18	2010	Block Group	N/A		
	Disability Population	% Pop. with disability	2012	Tract	% Pop. with disability	2000	Block Group
Cultural/ Info	Minority Group	% Non-White Householder	2010	Block Group	% Household with Non-White Residents	2012	Tract
	Education Attainment	% Pop. less than high school	2012	Tract	N/A		
Geographic	Limited Vehicle Access	% Household No Vehicle	1999	Tract	% Worker Driving to Work	2012	Tract
	Travel Distance	Geographic coordinates of supermarkets, big grocery stores, and fresh produce markets/stands	2014	Inside and within 7 miles of Beaufort and Washington Co.	N/A		



**Figure 1: General Workflow of Food Desert Analysis.** Non-geographic barriers are summarized by individual barrier maps as well as an integrated “final score” map. Geographic barriers are summarized in a “distance-based food desert” map. Non-geographic and geographic barriers are combined to generate an “ultimate food desert” map.

**Table 2: Identification of Variables Used in the Regression**

<b>Category</b>	<b>Variable</b>	<b>Unit</b>
<i><b>Response Variable of Interest</b></i>		
Access and Proximity to Grocery Store	Population, low access to store (%), 2010	Percent
<i><b>Explanatory Variables of Interest</b></i>		
Demographic Characteristics	% White, 2010	Percent
Demographic Characteristics	% Black, 2010	Percent
Demographic Characteristics	% Hispanic, 2010	Percent
Demographic Characteristics	% Asian, 2010	Percent
Demographic Characteristics	% American Indian or Alaska Native, 2010	Percent
Demographic Characteristics	% Hawaiian or Pacific Islander, 2010	Percent
Demographic Characteristics	% Total Non-White Population (created by adding all other % populations together)	Percent
Demographic Characteristics	Percent of county pop under the age of 18	Percent
Demographic Characteristics	Percent of county pop 65 years old or older	Percent
Socioeconomic Characteristics	Median household income, 2010	Dollars
Socioeconomic Characteristics	Poverty rate, 2010	Percent
<i><b>Control Variables</b></i>		
Socioeconomic Characteristics	Persistent poverty counties=1, 2000	Legend
Socioeconomic Characteristics	Metro counties =1/nonmetro counties =0 as of the year 2000	Legend
Socioeconomic Characteristics	Population loss counties=1, 2000	Legend
Store Availability	Grocery stores/1,000 population (% change), 2007-09	% change
Store Availability	Grocery stores/1,000 population, 2009	# per thousand

\*\* indicates that two variables (%\_NONWHITE and MAJNOWHITE) were created by the researchers.

**Table 3: Counties and Independent Cities included in statistical analysis**

*Coastal Plain Counties in North Carolina and Original Study Area (31)*

Beaufort	Hyde
Bertie	Johnston
Camden	Jones
Carteret	Lenoir
Chowan	Martin
Craven	Nash
Currituck	Northhampton
Dare	Pamlico
Edgecombe	Pasquotank
Franklin	Perquimans
Gates	Pitt
Granville	Vance
Greene – missing data for dependent variable	Warren
Halifax	Washington
Hertford	Wayne
	Wilson

*Coastal Plain Counties and Independent Cities in Virginia (16)*

Accomack	Newport News
Essex	Norfolk
Franklin	Northhampton
Gloucester	Northumberland
Hampton	Portsmouth
Lancaster	Suffolk County
Mathews – missing data for dependent variable	Virginia Beach
Middlesex	Westmoreland

*Additional Coastal Plain counties in North Carolina (8)*

Bladen	New Hanover
Columbus	Onslow
Cumberland	Pender
Duplin	Tyrell

*Coastal Plain Counties in South Carolina (12)*

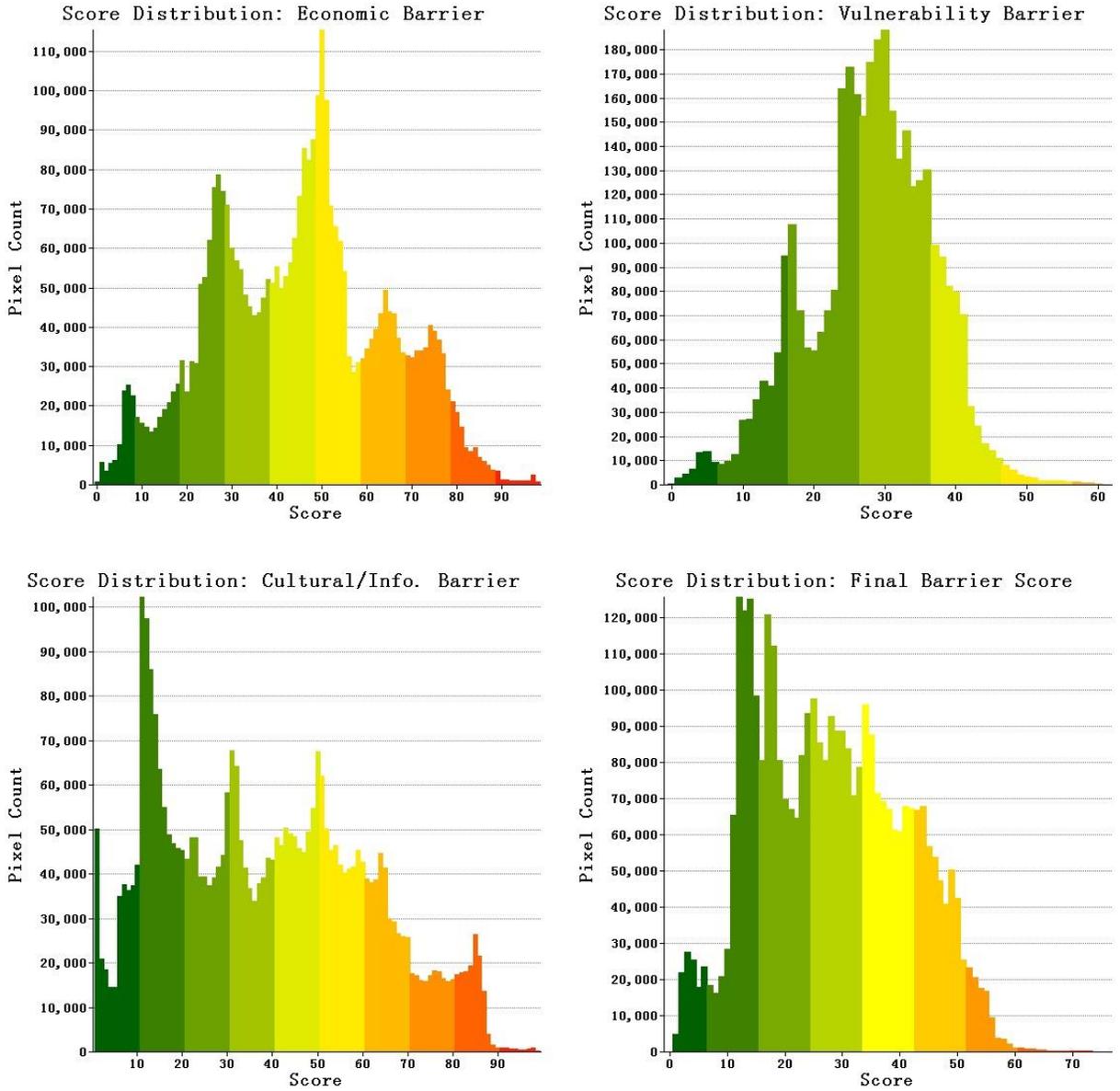
Beaufort	Georgetown
Berkeley	Hampton
Charleston	Horry
Colleton	Jasper
Dorchester	Marion
Florence	Williamsburg

*Coastal Plain Counties in Georgia (19)*

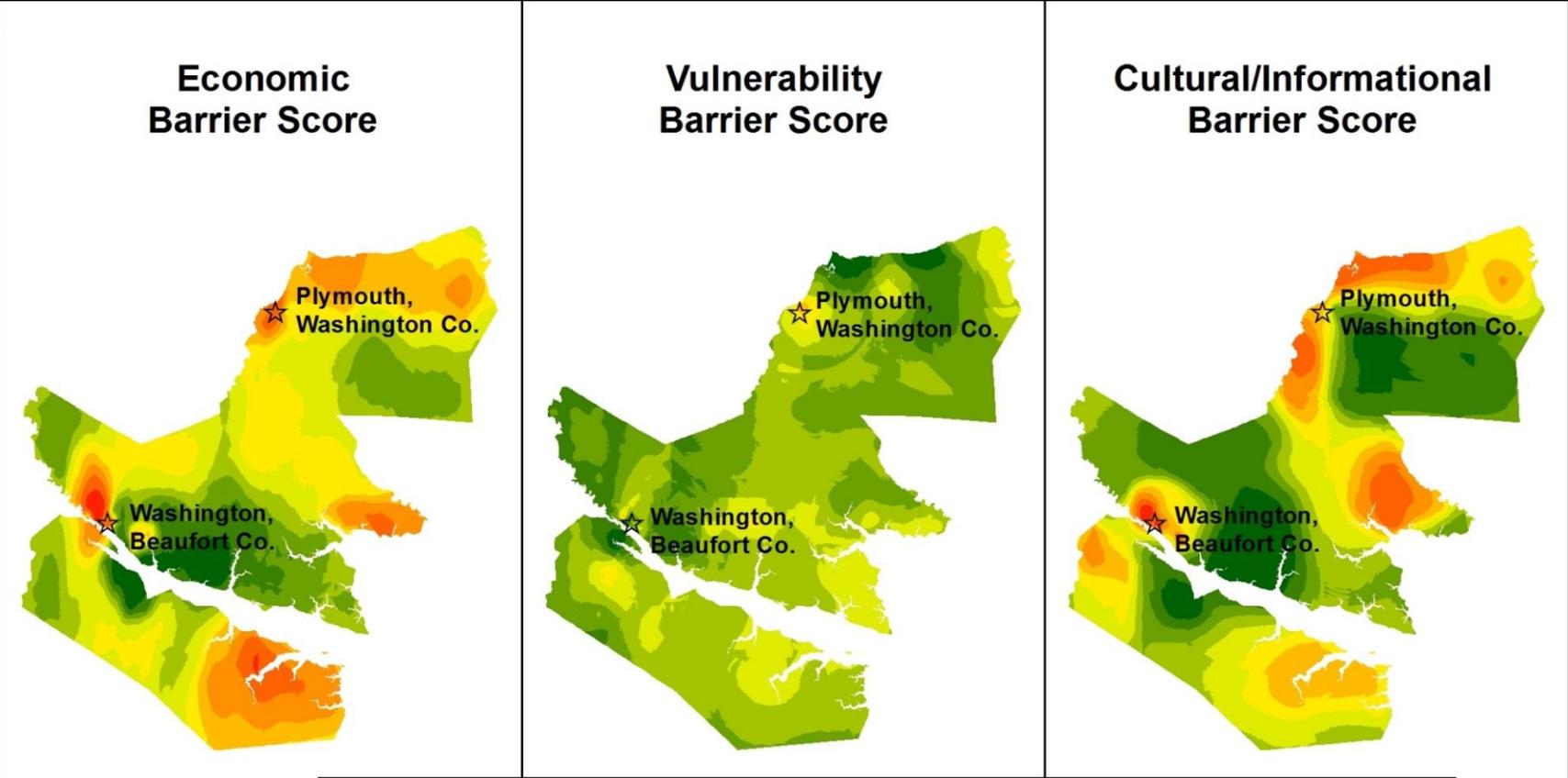
Appling  
Bacon  
Brantley  
Bryan  
Bulloch  
Camden  
Charlton  
Chatham  
Clinch  
Echols  
Effingham  
Evans  
Glenn  
Liberty  
Long  
McIntosh  
Pierce  
Ware  
Wayne

**Table 4: Summary of Consumer Survey Results**

Total N = 687 observations	Number Answered	Number Skipped
Question 1	680	7
Question 2	686	1
Question 3	684	3
Question 4	678	9
Question 5	650	37
Question 6	655	32
Question 7	679	8
Question 8	663	24

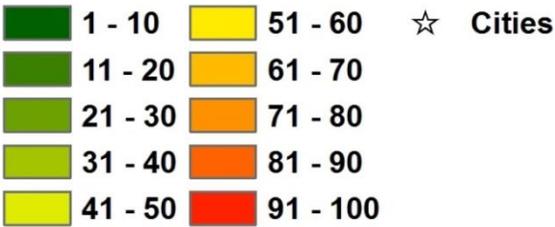


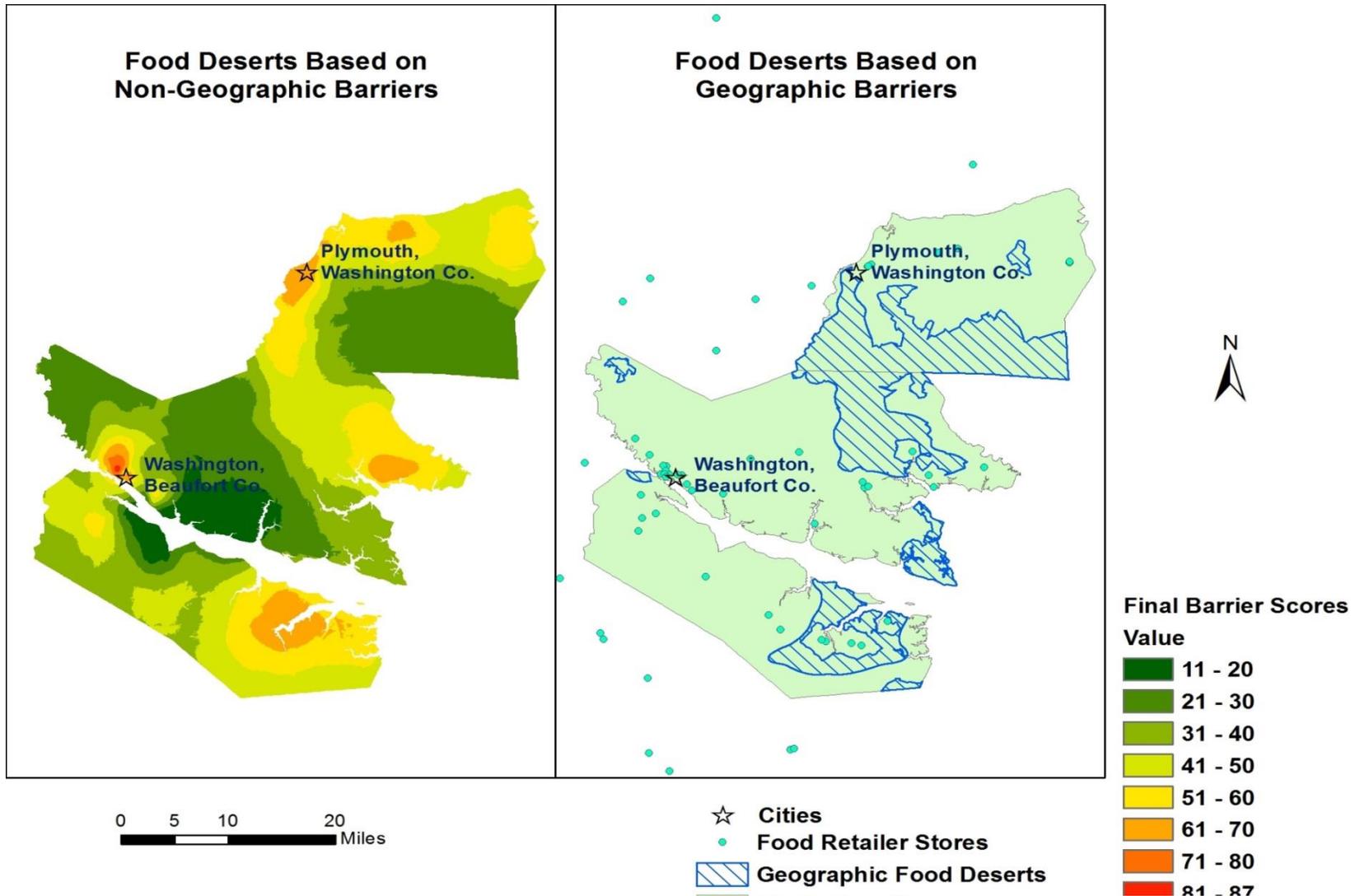
**Figure 2: Frequency distribution of barrier scores and final barrier score.** Note that Economic scores are roughly symmetric while the others are positively skewed.



**Figure 3: Socioeconomically stressed areas experiencing three types of barriers.** Lower scores indicate fewer barriers, based on economic barriers (such as income or poverty rate), vulnerability barriers (populations of disabled, elderly, or young populations), and cultural/informational barriers based on educational attainment and

**Barrier Scores**





**Figure 4: Areas experiencing socio-economic barriers (left) and geographic barriers (right) to healthy food.** The final barrier score was the mean of the three individual barrier scores in Figure 2. Beaufort and Washington Counties are most influenced by economic barriers, then cultural/informational barriers. This supports the survey and interview data.

**Table 5: Pairwise Correlations for Selected Variables**

**a: Model 1 – North Carolina Analysis**

<b>Correlation (Obs.=30)</b>	%White	%Black	Log of median income	Poverty rate	Log of % bachelor's degrees
%WHITE10	1.000				
%BLACK10	-0.9830	1.000			
LOG_INCOME_10	0.8646	-0.8781	1.000		
POVRATE2010	-0.9030	0.8893	-0.9441	1.000	
LOG_BACHELOR	0.6551	-0.7025	0.6226	-0.5595	1.000

**b: Model 2 – Regional Analysis**

<b>Correlation (Obs.=85)</b>	%White	%Black	Poverty rate	%65 and older	%18 and younger	% Groceries
%WHITE10	1.000					
%BLACK10	-0.9463	1.000				
POVERTYRATE	-0.5072	0.4899	1.000			
%65OLDER10	0.0840	0.0676	-0.0695	1.000		
%18YOUNGER10	-0.0568	-0.0896	0.0445	-0.7701	1.000	
%GROC2009	-0.0673	0.1906	0.1432	0.5072	-0.4630	1.000

**Table 6: Model 1 -Final Results of NC Statistical Analysis, R2=0.5272, p<0.05**

<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>p-value</b>	<b>95% Confidence Interval</b>
Log_income (\$)	-87.147	39.049	0.037	-168.602 to -----
%_nonwhite (%)	3.881	7.639	0.617	-12.053 to 19.816
%_65older10 (%)	-3.511	1.087	0.004	-5.778 to -1.244
%_18younger10 (%)	-2.371	1.251	0.073	-4.980 to .2380
<b>Interaction Terms</b>				
Nonwhite_income (%*\$)	-.454	.727	.539	-1.970 to 1.062
grocery_%nonwhite(%*%)	-.00151	.00206	0.473	-.00580 to .002780
<b>Categorical Variables</b>				
Metro00 (0,1)	-2.055	5.695	0.722	-13.935 to 9.826
Poploss00 (0,1)	10.205	9.321	0.284	-9.238 to 29.649
Perpov00 (0,1)	-11.535	6.112	0.074	-24.283 to 1.214
Constant	1081.421	425.834	0.020	193.146 to 1969.696

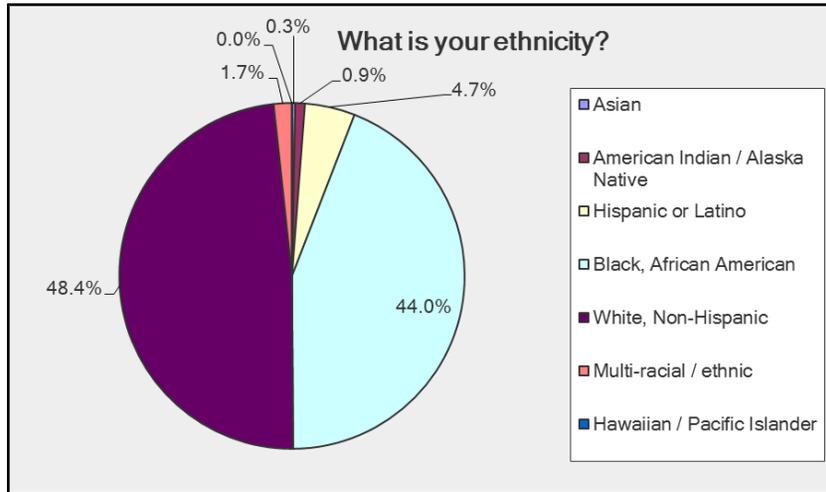
**Table 7: Model 2 - Final Results of Statistical Analysis R2 value = 0.2746, p<0.01**

<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>p-value</b>	<b>95% Confidence Interval</b>
%_White (%)	-5.368	2.133	0.014	-9.621 to -1.115
%_nonwhite (%)	-5.540	2.154	0.012	-9.832 to -1.248
Log_65older10 (%)	-45.320	22.463	0.047	-90.087 to -0.552
%_18younger10 (%)	-4.205	2.648	0.117	-9.482 to 1.072
Poverty Rate (%)	0.252	0.243	0.303	-0.232 to 0.736
Grocery09 (per thousand)	22.308	12.812	0.086	-3.227 to 47.842
<b>Interaction Terms</b>				
White_Nonwhite (%*%)	0.00265	0.00349	0.449	-0.00430 to 0.00961
Log_old_young(log%*%)	1.287	0.991	0.198	-0.687 to 3.262
<b>Categorical Variables</b>				
Metro00 (0,1)	-3.938	3.079	0.205	-10.074 to 2.198
Poploss00 (0,1)	11.076	3.598	0.085	-1.551 to 23.703
Perpov00 (0,1)	-7.674	3.598	0.036	-14.846 to -0.5024
Constant	677.242	202.333	0.001	273.992 to 1080.491

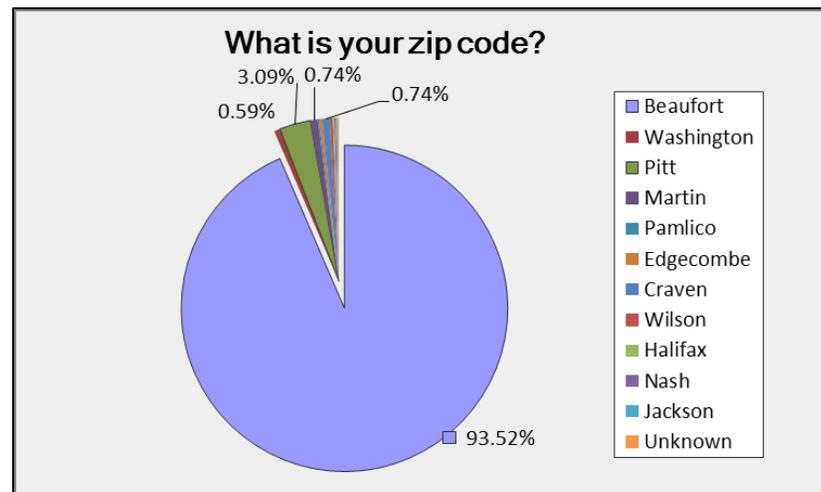
## Consumer Survey Results

### Figure 5a-d: Demographic Variables of Interest

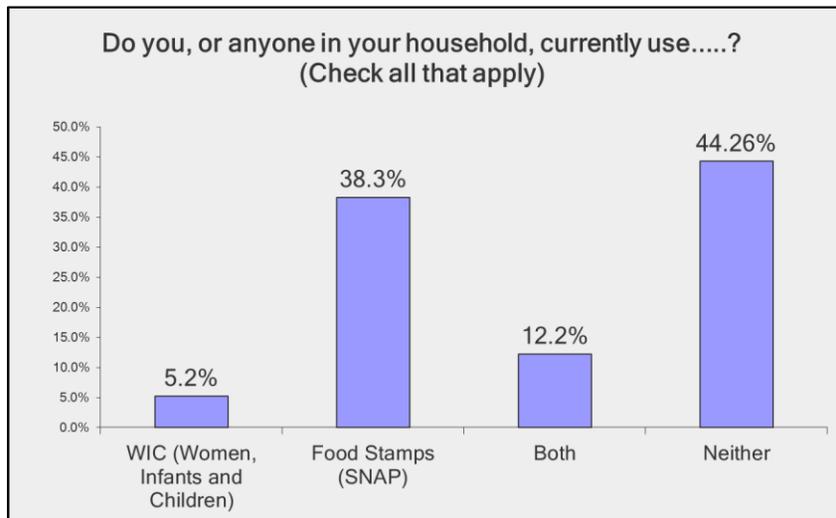
a: Self-Identification of Ethnicity



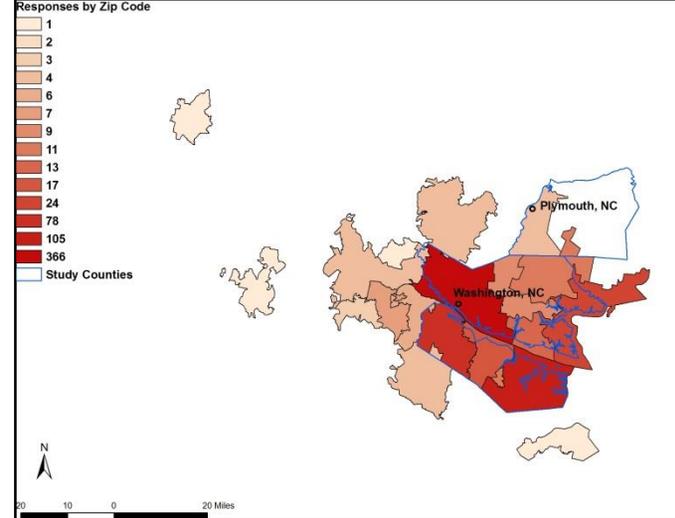
b: Self-Identification of Location by County



c: Use of Government-Provided Benefits

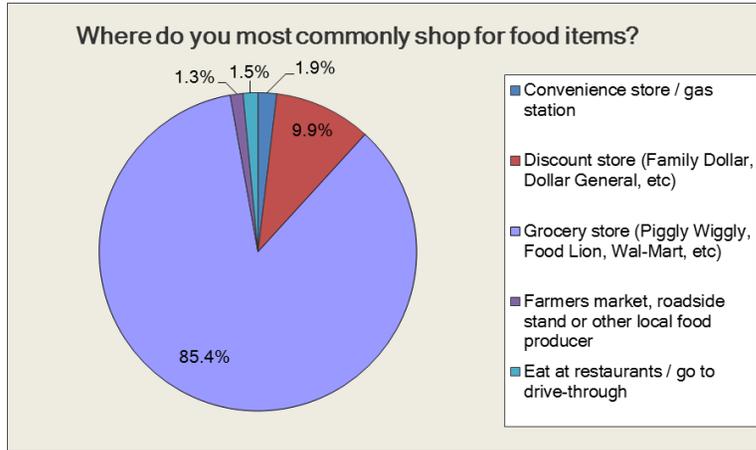


d: Survey responses sorted by County

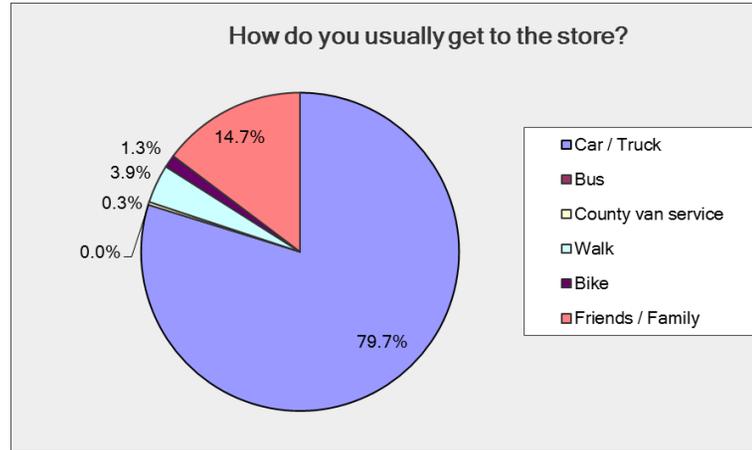


**Figures 6a-b: Food Retailer Use and Transportation Use**

*a: Primary Source of Food*

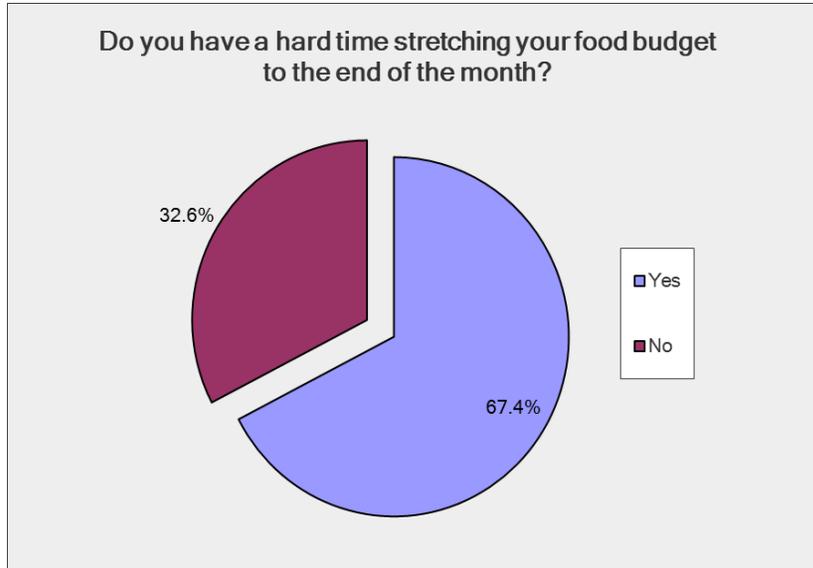


*b: Primary Source of Transportation to Food Retailer*

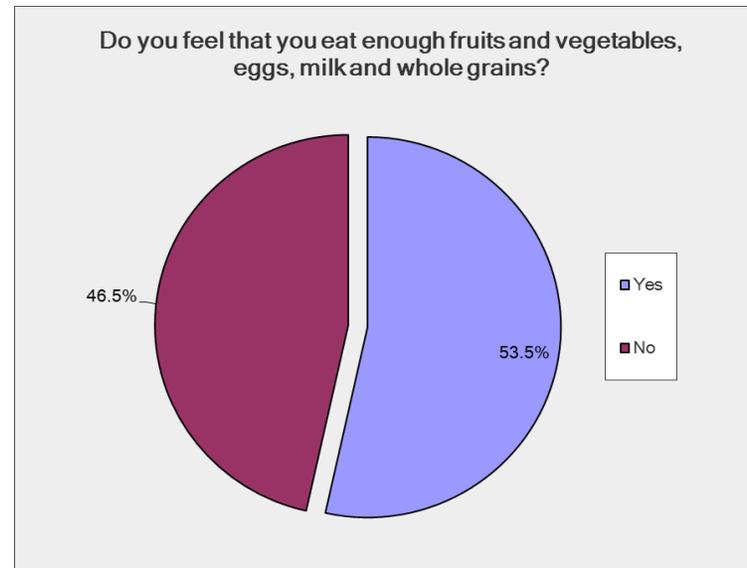


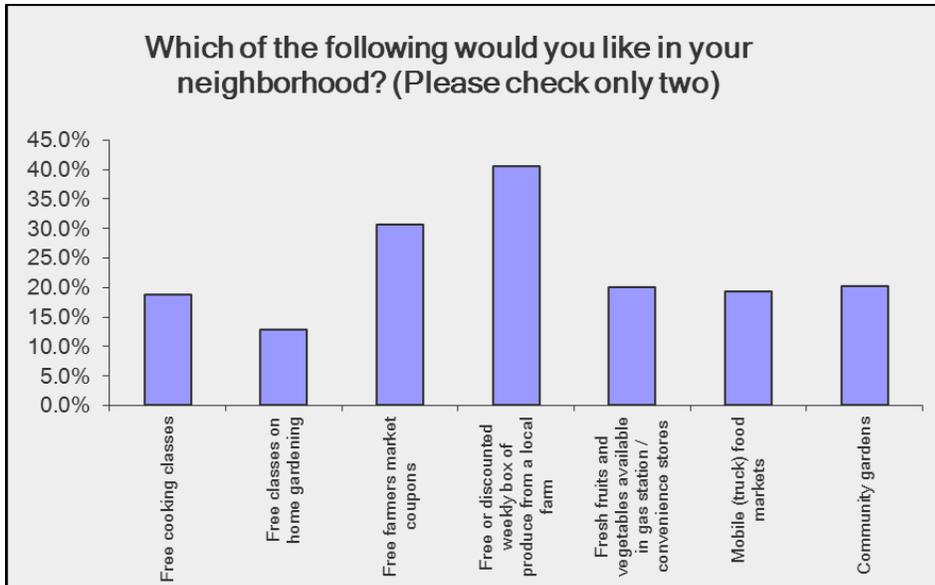
**Figure 7a-b: Food Accessibility and Nutrition Questions**

*a: Measure of Reliable Access to Food*



*b: Measure of Adequate Nutrition*



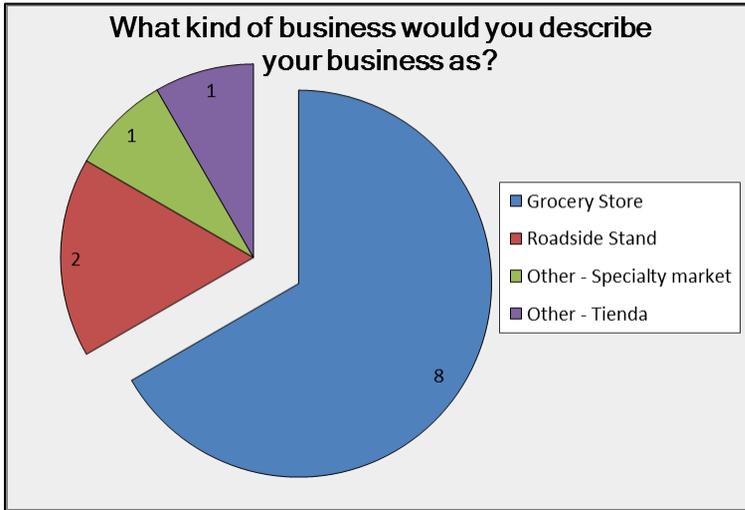


**Figure 8: Preferred Interventions**

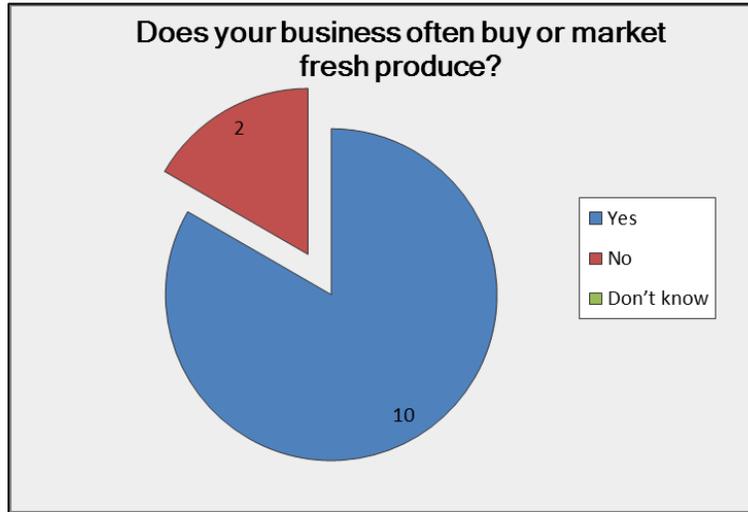
**Survey Results**

**Figure 9a-d: Self Identification of Businesses**

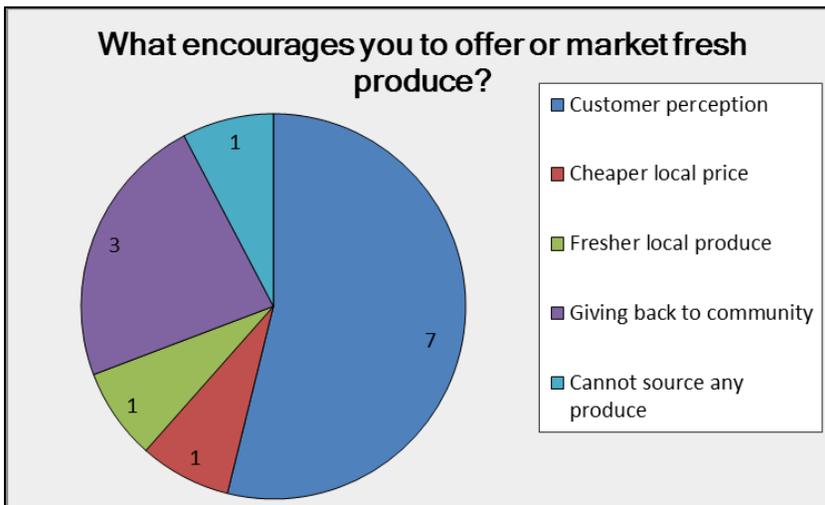
*a: Self-Identification of Food Retailer Type*



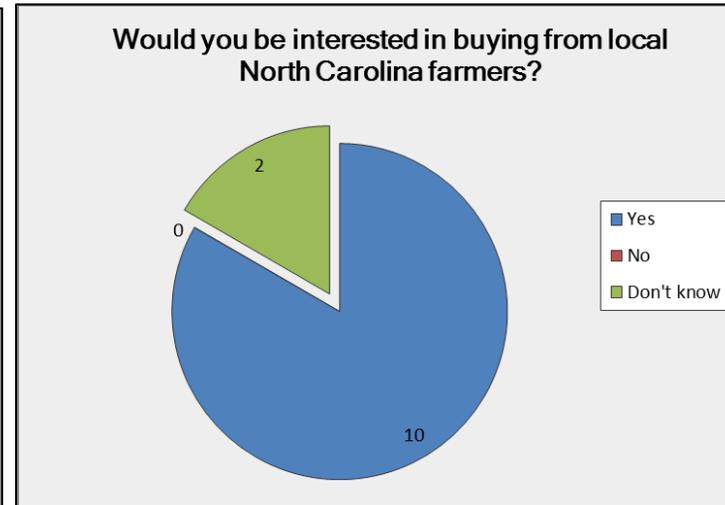
*b: Availability of Fresh Produce*



*c: Reasons for offering fresh food (open-ended question)*

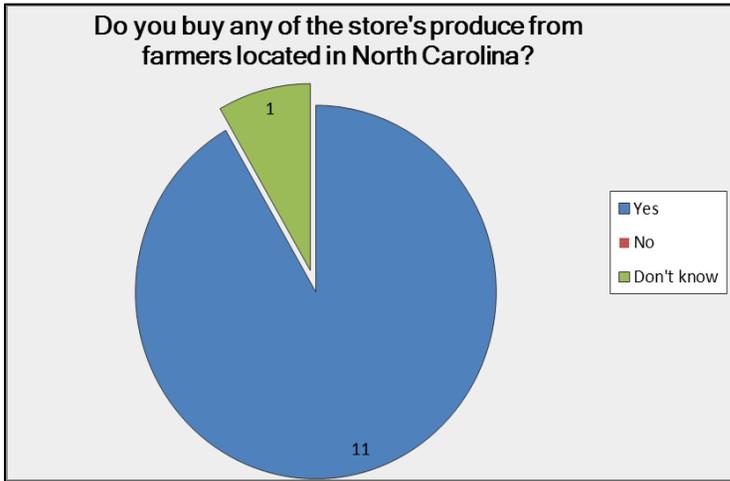


*d: Interest in buying local*

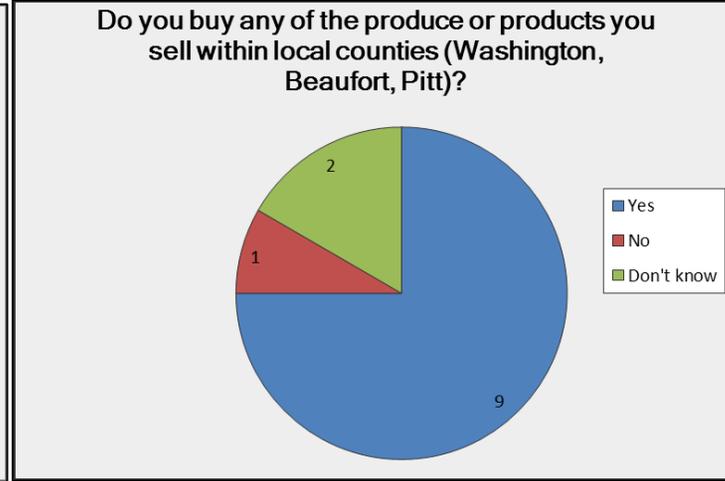


**Figure 10a-d: Local Sourcing Questions**

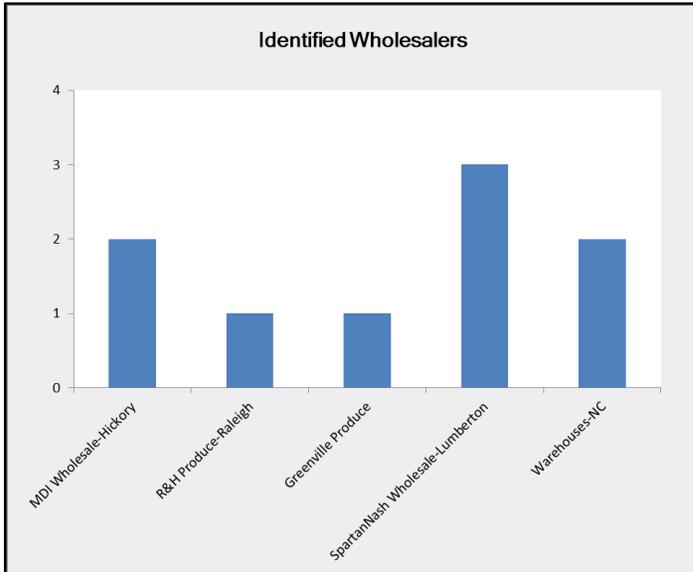
*a: North Carolina Sourcing*



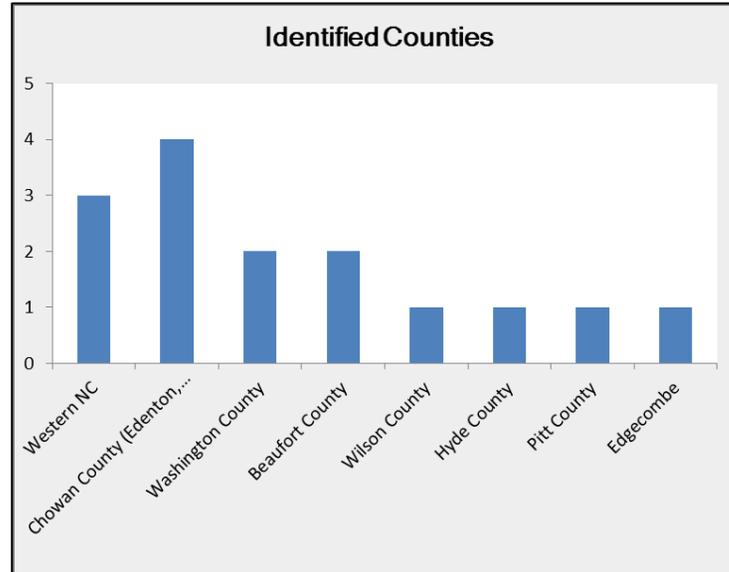
*b: Local Counties Sourcing*

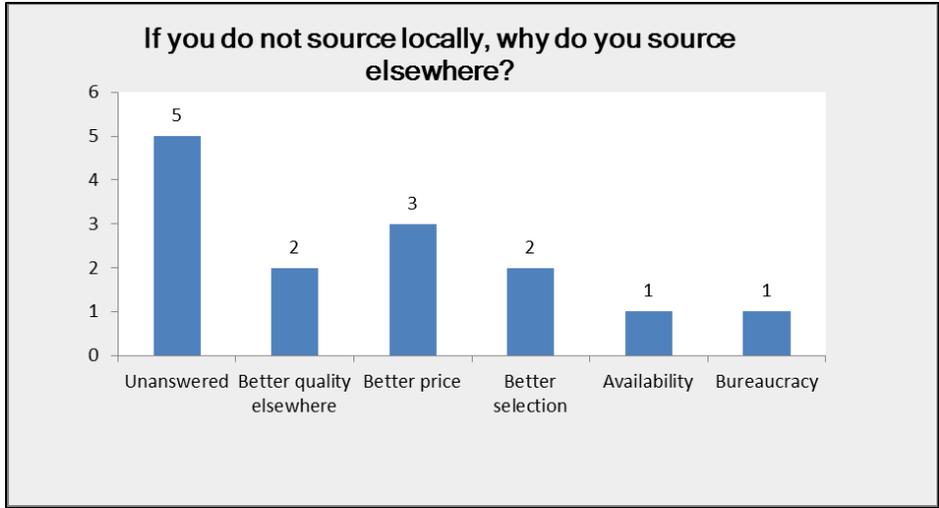


*c: Identified Produce Wholesalers in NC*



*d: Identified NC Counties Stores Buy From*





**Figure 11. Reasons for Sourcing Elsewhere**

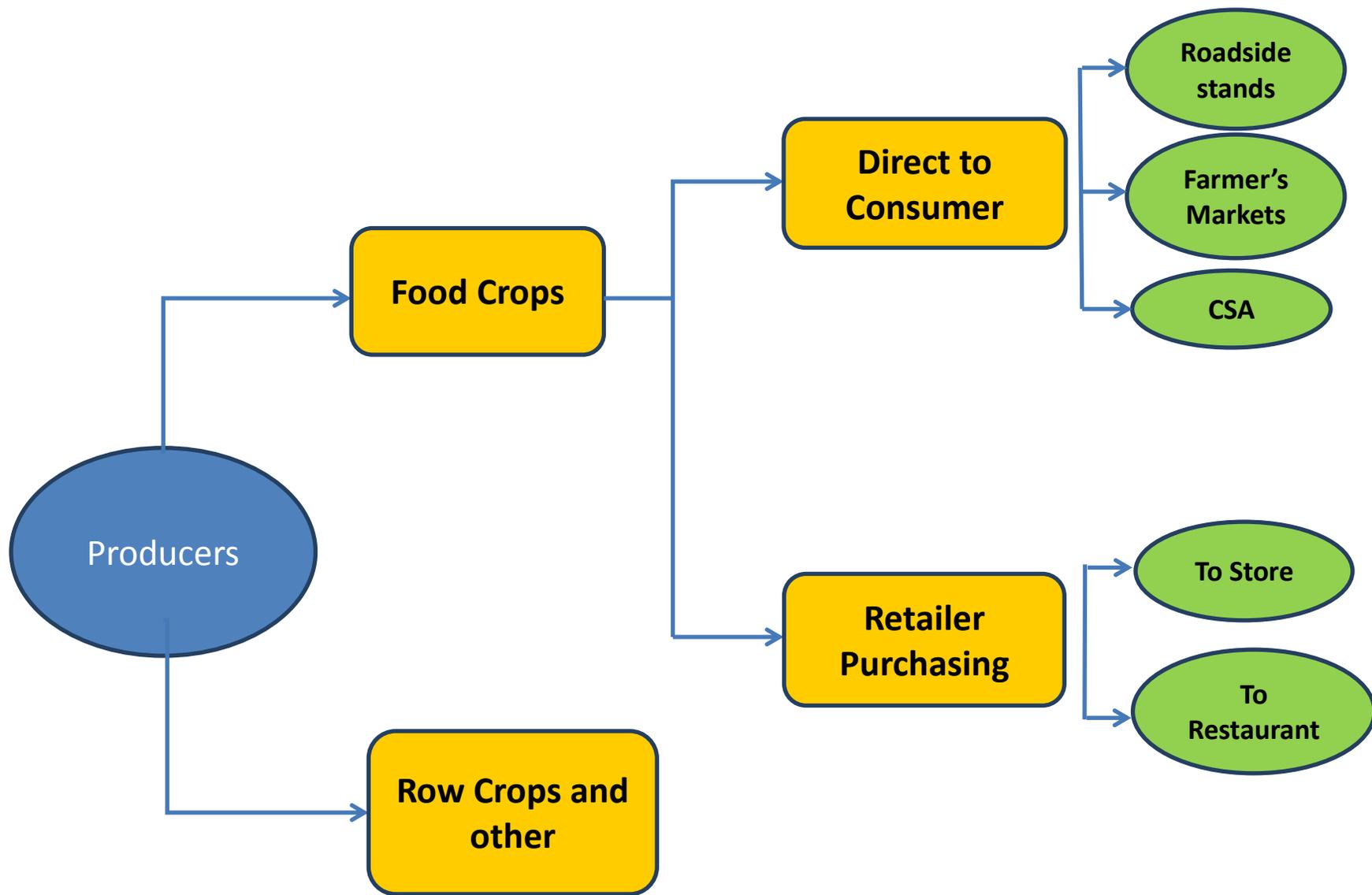
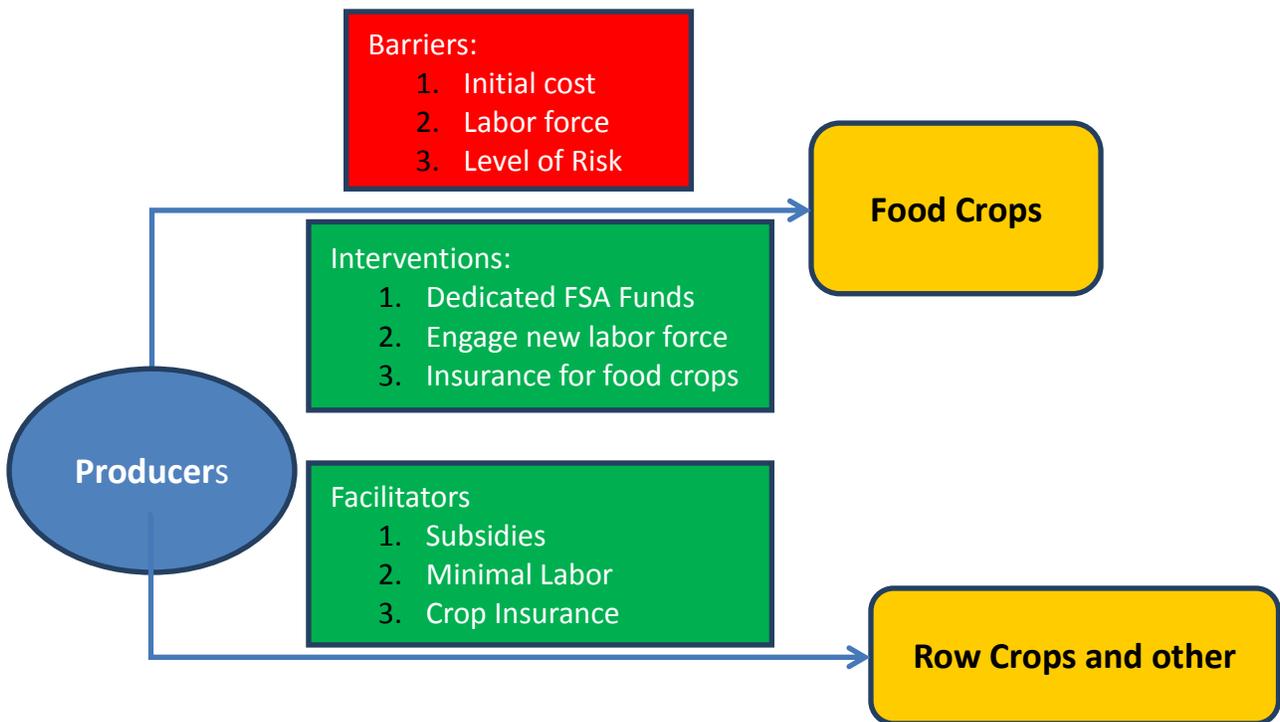


Figure 12: Flowchart of the local food production system



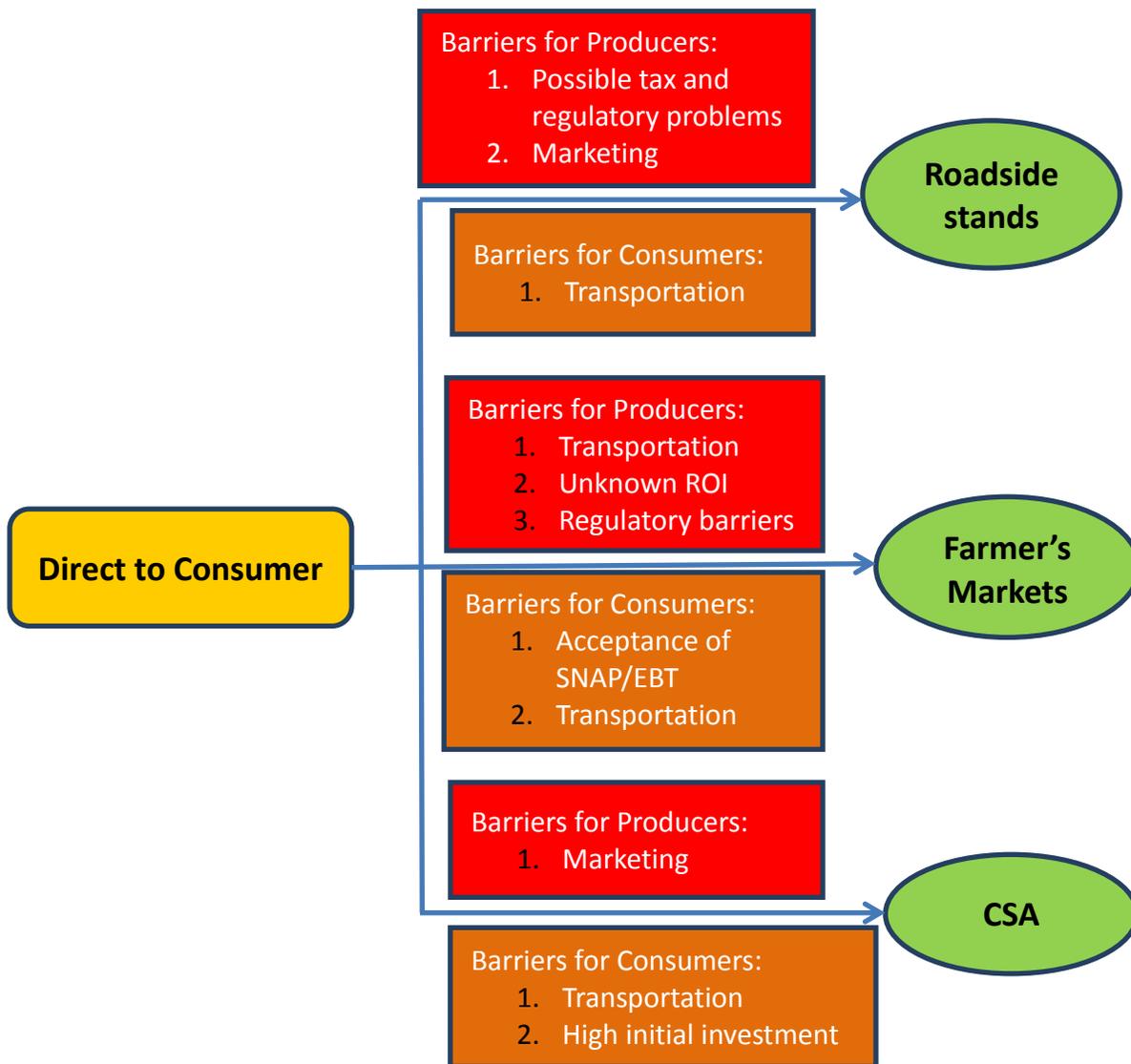
**Figure 13: Barriers producers face when deciding to grow food**

**Producers must consider several factors when they decide to grow food.**

**How much risk are they willing to take on?** The initial cost to sow, maintain, harvest, and sell food crops is very high, and there are no guaranteed buyers. Pests can destroy crops, and consumers and wholesalers can refuse crops based on quality. On the other hand, row crops are generally covered by US government-backed insurance programs and subsidies. Some farmers work under contract – for instance growing tobacco – and have a guaranteed price for their crop, regardless of its appearance (based on a conversation with a Washington County-based interviewee).

**Labor in Eastern North Carolina is limited.** Interviewees in both Washington and Beaufort Counties identified labor shortages as a major issue stopping farmers from growing food crops. One interviewee in Beaufort County noted a past program paid local people to work on farms, but most participants quit after a week or two due to the low pay and physically difficult nature of the work.

**Interventions take time and dedicated effort.** Insurance for food crops is available, but is often not worth the cost and is not covered under the Federal Crop Insurance Corporation (FCIC). State and national Congress-members can advocate for dedicated funds to local Farm Service Agencies (FSA) to encourage growth of the local food movement. However, an advocacy movement is required. Developing a viable workforce requires a well-networked community.



**Figure 14: Flowchart of direct-to-consumer barriers**

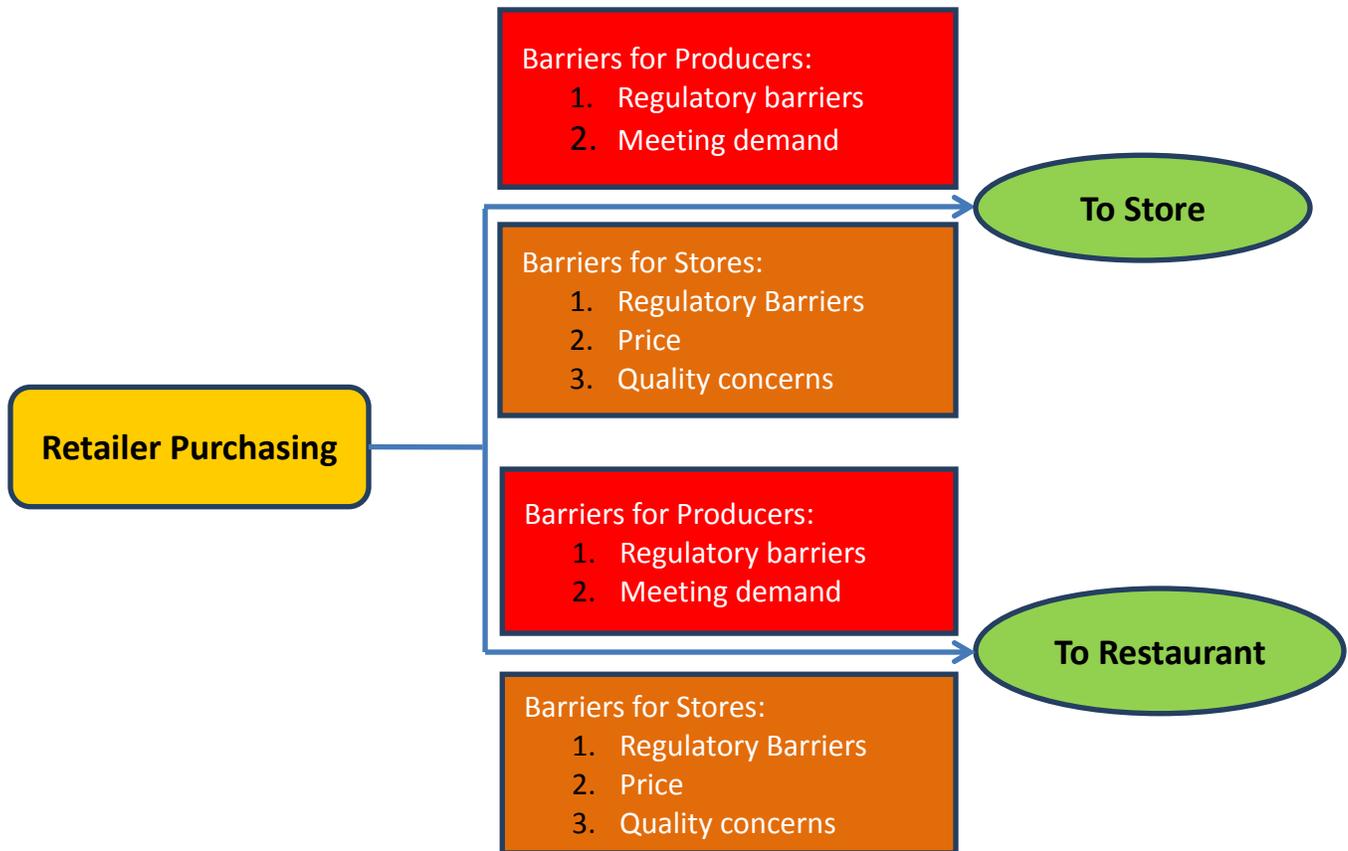
**Direct-to-consumer sales methods offer producers low-cost ways to access markets. However, low-income consumers may not be able to access these markets.**

**Roadside stands are the lowest cost option for producers.** They do not require a vendor fee, they do not require the producer to travel, and they require minimal labor. However, in most states including North Carolina, these stands are required to have a business license, collect sales tax, and have appropriate liability insurance. Due to their remote locations, consumers may not be able to access these stands. Due to the costs associating with WIC and SNAP/EBT, small vendors usually do not accept benefit cards, meaning low-income consumers cannot use their benefits.

**Well-organized farmer's markets are the best option for low-income consumers.** Notably, low-income women in Greenville, NC were willing to travel farther to access the farmer's market. However, that market accepts SNAP/EBT. Neither of the two farmer's markets in the study area accepts SNAP/EBT as of May 2014. Washington County has not had a functional farmer's market since 2009. Limited hours and limited access to transportation affect the ability of consumers to shop at farmer's markets. Producers may have to pay a vendor's fee and must meet food safety standards. Additionally, while one interviewee noted farmer's markets are a great venue for

beginning farmers, the return on investment (ROI) for producers is not guaranteed. One community stakeholder involved in managing a farmer's market noted that some vendors could not afford the transportation costs based on the money they made at the market. However, incentives similar to Michigan's Double UP Food Bucks program (doubling the value of EBT funds used at farmer's markets) provide systemic incentives for low-income consumers to buy directly from low-resource producers. Similar programs have been enacted in 25 states around the country. To address cost differences, some farmer's markets have developed a 50% coupon incentive program. Customers who buy \$20 in SNAP/EBT tokens at certain Western North Carolina farmer's markets receive an extra \$10 matched by FirstHealth, a non-profit healthcare network.

**CSAs (Community Supported Agriculture) programs provide the best mix**, allowing producers to have investors to manage risks and consumers to have a guaranteed source of fresh produce for the growing season. While producers must have a business license and practice basic food safety protocols (all information which can be gained from the local extension office), the cost of a CSA is manageable. However, few if any farms in North Carolina accept WIC and SNAP/EBT benefits, and consumers must arrange to pick up their CSA share once a week or every other week during the growing season. Some farms with CSA programs subsidize the CSA cost for low-income residents by having a larger number of full-cost shares. Other programs, such as the Chapel Hill-based Farmer Foodshare, encourage donations from both producers and consumers at local farmer's markets. They then distribute to food pantries and low-income people.



**Figure 15: Flowchart of retailer purchasing barriers**

**Farmers can and already do sell to local retailers in both Washington and Beaufort County. Local farmers also sell to restaurants in Beaufort County.**

**The biggest issue is meeting demand.** According to survey data, retailers like to buy local, but appear to do so seasonally and haphazardly. As one interviewee noted, “the market is a huge challenge.” If local producers cannot meet the quality and price standards expected by the retailer, they cannot sell their crops. Though only one retailer noted that the North Carolina Department of Agriculture could test their fruit and vegetables at any time due to public health concerns, retailers do not appear to impose many, if any, regulatory requirements on producers.

**Retailer purchasing is an indirect method of reaching low-income consumers, but it may be more effective.** Grocery stores are more centrally located, have longer hours of operation, and usually accept WIC and SNAP/EBT. Purchasing agreements with restaurants may allow producers to supplement their income from farmer’s markets, CSAs, and the like.

**Producers may be able to expand to the “corner store” market.** One interviewee noted the effectiveness of the “Healthy Corner Store Initiative” in Pitt County; the initiative encourages discount stores, convenience stores, and gas stations to carry limited fresh produce.

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