Measuring the Economic Impacts of Increased Fresh Fruit and Vegetable Production in Iowa Considering Metropolitan Demand

A Technical Report Submitted to the
Leopold Center for Sustainable Agriculture

Dave Swenson
Department of Economics
Iowa State University

April 2011

Edited by Mary Adams and Rich Pirog
Design by Tina Davis,
Leopold Center for Sustainable Agriculture
209 Curtiss Hall
Iowa State University
Ames, Iowa 50011-1050
(515) 294-3711
leocenter@iastate.edu

LEOPOLD CENTER

Overview of Findings

On an acres per capita basis, Iowa has 83 percent fewer fresh vegetable acres than the national average and 94 percent fewer non-citrus fruit bearing acres. Furthermore, 88 percent of the state's vegetable acres are devoted to sweet corn and peas. As a consequence, the vast majority of fresh fruits and all other vegetables consumed by Iowans must be imported from other states and countries. Were Iowa able to increase its production of these critical food items thereby reducing imports, it would lead to increased jobs and incomes.

This study supposes that the state's metropolitan areas, those with a central city population of 50,000 or more, will have sufficient regionally concentrated demand to stimulate nearby fresh fruit and vegetable production. The research a priori limits the production to Iowa counties within 100 miles of an in-state or nearby metropolitan area. After considering distance from the metropolitan communities, the study weights a county's propensity and capacity to produce fresh fruits and vegetables based on the number of farms with fewer than 50 acres in the county and on the number of harvested crop acres. The economic estimates were made using a set of 28 fresh fruits and vegetables that could be—but are not—grown in Iowa.

By so doing, the research established that five Iowa counties would not supply fresh fruit and vegetable acres for these metropolitan markets, 31 would supply up to 50 acres, 18 would supply from 50 to 99 acres, 36 counties would supply from 100 to 249 acres, and nine counties would supply 250 or more acres of fresh fruit and vegetable crop production.

The study determined that:

- The metropolitan demand for the 28 fresh fruits and vegetables would require 10,548 crop acres and would generate $39.96 million in farm-level sales.
- The farm-level sales, once analyzed using an input-output model of the state's economy, would result in 428 total jobs in the state. This total includes jobs on the farms, supplying jobs, and jobs that serve the needs of households that are supported by the farm jobs and the jobs in the supplying sectors.
- As the cropland needed to produce fresh fruits and vegetables must come from existing Iowa production, a reduction in corn and soybeans grown on those 10,548 acres would result in 85 fewer total jobs leaving a net job gain of 343 jobs from this scenario.
- Were Iowa farmers also to directly market half of their produce to metropolitan consumers, it would require 87 fruit and vegetable establishments, which would generate $68.3 million in direct sales and would require 595 job holders at those establishments who would receive $15.2 million in labor incomes.
- In terms of total acre production potential, Pottawattamie County ranked highest at 809 acres, followed by 425 acres in Polk County, 365 acres in Linn County, 295 acres in Warren County, and 286 acres in Dallas County.
- Owing to the configuration of the research, the vast majority of the fresh fruit and production acre gains would be in the state's metropolitan counties or in counties adjacent to metropolitan areas.

Photos provided by Des Moines Farmers Market, Northeast Iowa Food and Farm Coalition, USDA and Leopold Center Staff

Introduction

This is a technical report of the methods used to investigate the economic outcomes that might accrue to expanding Iowa's local fresh fruit and vegetable agricultural production, considering the state's potential capacity to supply, within season and within reason, a substantial fraction of Iowa's metropolitan area demand for those foods. This represents a modification of an earlier, more comprehensive report, "Selected Measures of the Economic Impacts of Increased Local Food Production and Consumption in the Upper Midwest," which can be found at http://www.leopold.iastate.edu/pubs-and-papers/2010-03-selected-measures. That study looked at the potential statewide and regional economic values that might accumulate to farmers and regional economies if there was an increase in the production of 28 types of fresh fruits and vegetables for local consumption. Those study states were Illinois, Indiana, Iowa, Michigan, Minnesota and Wisconsin.

Specifically, this report offers a reanalysis of the Iowa fruits and vegetable findings with two significant modifications to the Iowa values in that original report. First, in calculating the probability of a farmer in county X producing for sale in city Y in the original multi-state study, only large metropolitan areas, those with 250,000 persons or more, were included in the analysis. Second, given the size of those metropolitan areas, that research delimited "local" suppliers to those within 150 miles of those metropolitan areas.

This study looks at Iowa fruit and vegetable production potentials for all metropolitan areas in Iowa and surrounding Iowa that are within 100 miles of any of the state's 99 counties. In brief, it adds several metropolitan areas to the Iowa analysis, but it delimits ostensible "local" production to that which occurs within 100 miles of any of those metropolitan regions.

As this is a reanalysis, it relies on nearly all of the same major data sources as the earlier multi-state study including:

- Detailed state- and county-level agricultural production characteristics derived from USDA Agricultural Census data for 2007.
- Information on farm and retail level fruit and vegetable prices obtained from the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA).
- Information about fruit and vegetable market retailers at the national level found in the 2007 Economic Census of Retail. Data on state fruit and vegetable markets were obtained from the 2007 County Business Pattern on-line data set at the Census Bureau.
- Data on expected resident population fruit and vegetable consumption were obtained from the USDA and from data imbedded in the Iowa Produce Market Calculator.
- Economic impact modeling data were purchased from Minnesota Implan for Iowa in order to properly project economic growth.

Vegetable Production

According to the 2007 Census of Agriculture, Iowa was among the lower performing states nationally in terms of fruit or vegetable production acres per capita. While the state has 1 percent of the U.S. population, it only accounts for 0.1 percent of all vegetable and melon sales. Iowa's comparative standing in the Midwest is clearly demonstrated in Figure 1. Where the national average is 9.3 vegetable production acres per 1,000 persons and the overall regional amount is 4.6 acres, Iowa has 1.6 acres. Only Illinois has fewer acres per capita than Iowa in this region.

The primary reasons for the sharp variation in vegetable production acres is overall regional commodity crop specialization, given natural resource and historic production advantages. Iowa is much more suited to growing corn, as Figure 2 clearly indicates, and Figure 3 shows equally clearly the paucity of vegetable acres in the state. (See next page)

Iowa's comparative disadvantage in fruit production is displayed in Figure 4 at .5 acres per 1,000 persons compared to a national average of 6.4 acres. And its standing in berry production is a mere .08 acres per 1,000 persons, compared to a U.S. average of nearly .7 acres.

There is ample evidence of potential to increase Iowa's vegetable, fruit, and berry production to accommodate regional demand. The data suggest that extremely large fractions of Iowa fruit and vegetable demand must be satisfied by out-of-state imports.

CONTINUED ON PAGE 7.

FIGURE 1

Fresh Vegetable Acres Per 1,000 Persons, 2007

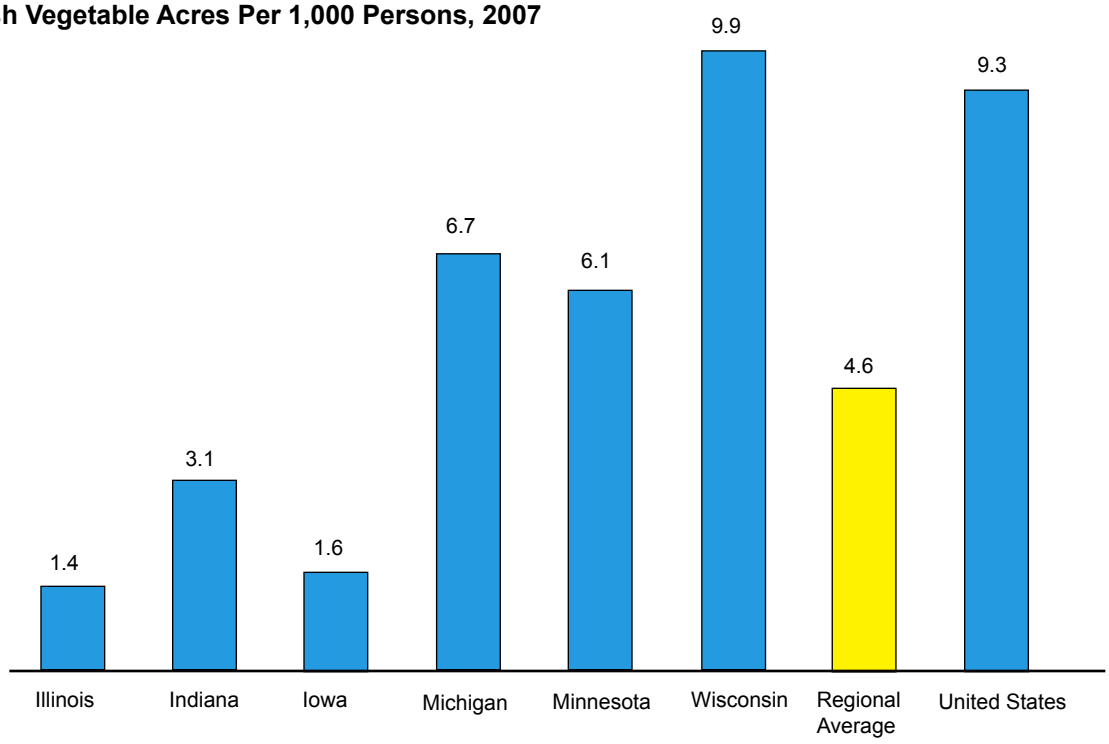


FIGURE 2

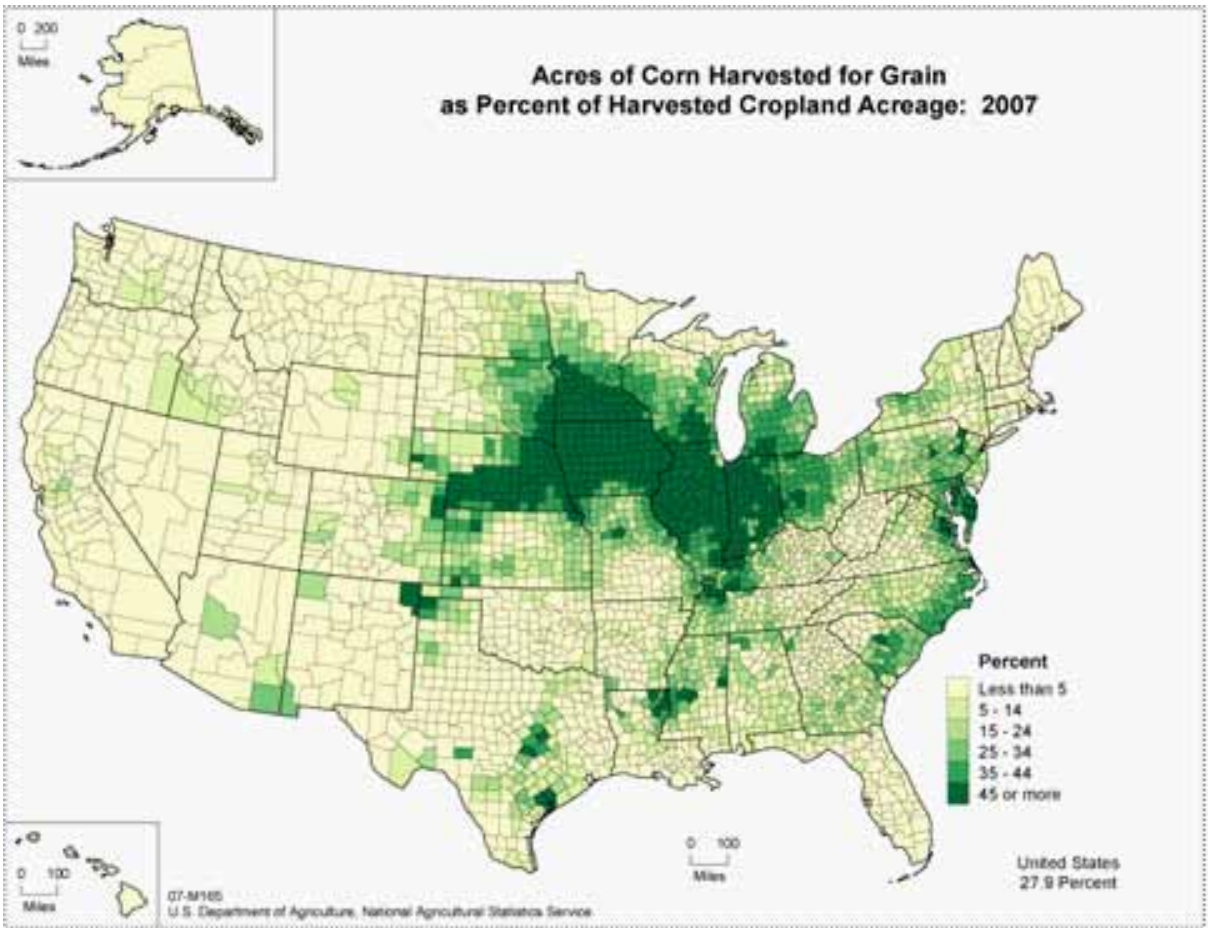


FIGURE 3

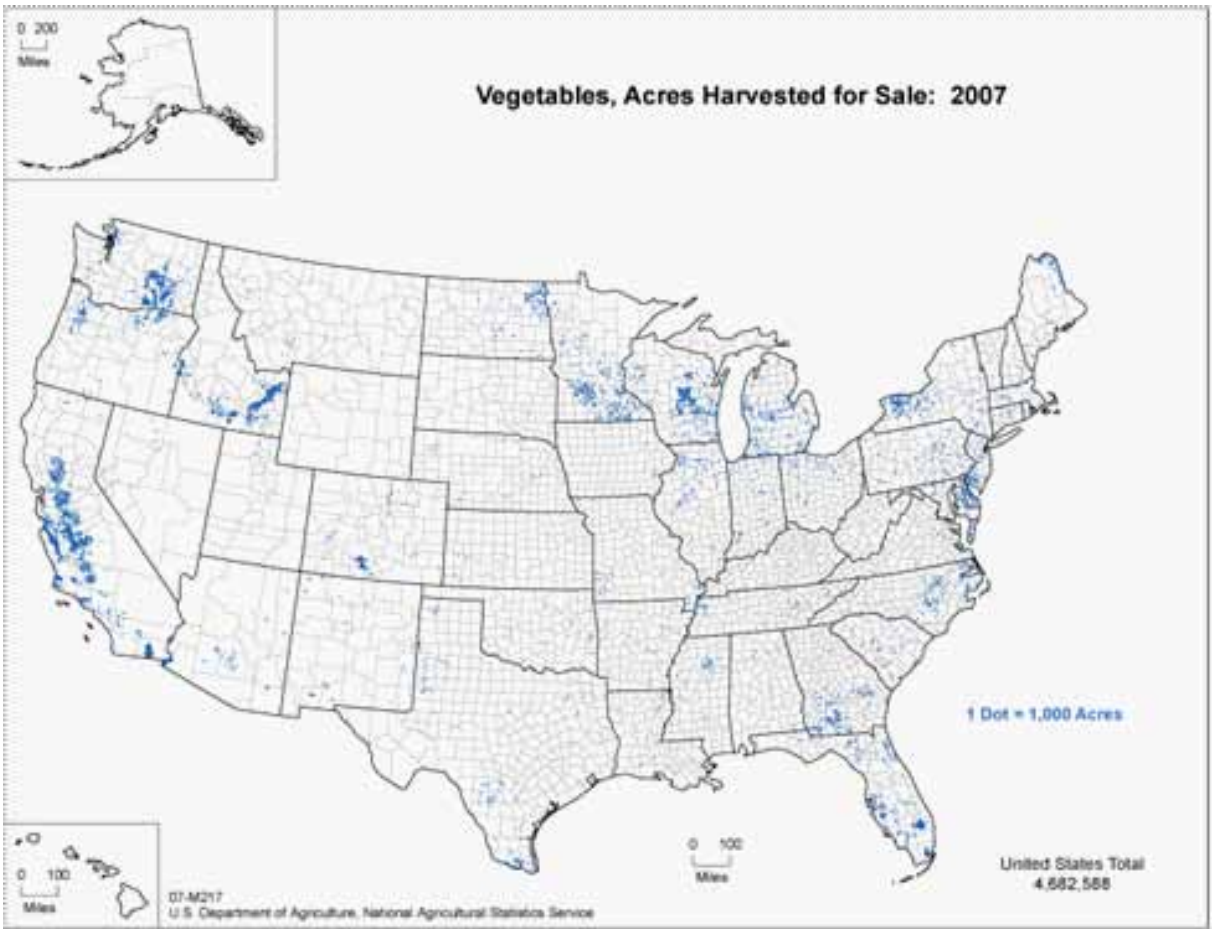


FIGURE 4

Noncitrus Fruit Bearing Acres Per 1,000 Persons, 2007

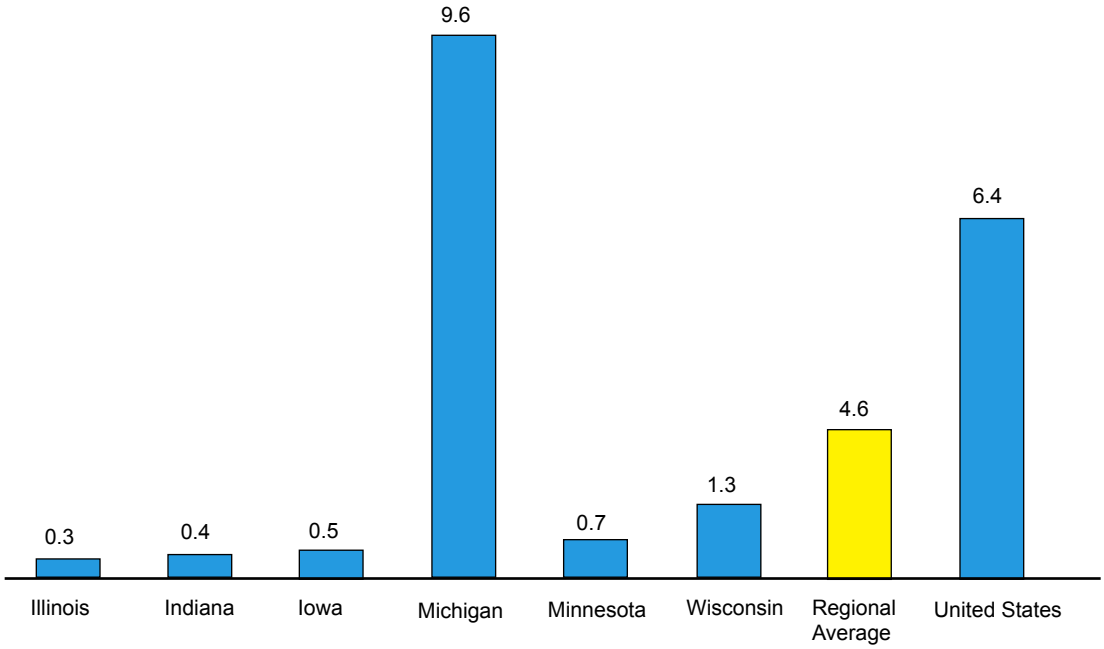
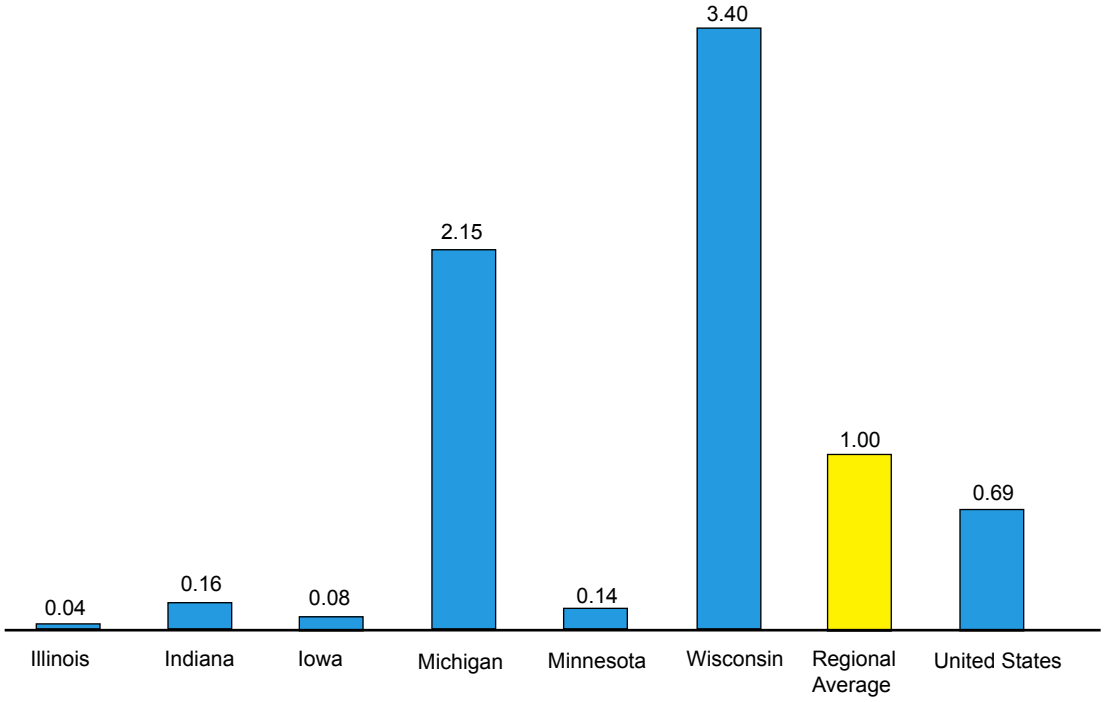


FIGURE 5

Berry Producing Acres Per 1,000 Persons, 2007



Estimating Iowa Demand and Iowa Production Potential

The amounts of vegetables and fruits that possibly can be generated by local producers are constrained significantly by the length of the Iowa growing season. Here are the steps required to estimate Iowa production values for this exercise.

Step 1 – Per capita consumption must be determined

The potential farm weights and the subsequent retail weights per capita were taken from the Fruit and Vegetable Market Planner -- 2010 tables which originally were derived from USDA estimates of U.S. production per capita. Table 1 provides the estimated farm level production required per capita for an abbreviated assortment of fruits and vegetables. This table illustrates both the annual demand for certain products and the amount that would have to be produced in whole or in part to accommodate local food demands.

TABLE 1

Farm and Retail Weight Assumptions, Selected Fruits and Vegetables

Item	Farmed Weight (Pounds/Capital)	Retailed Weight (Pounds/Capital)
Apples	16.4	14.4
Apricots	0.2	0.1
Asparagrus	1.1	0.9
Bell peppers	6.8	5.7
Blueberries	0.6	0.5
Broccoli	6.0	4.9
Cabbage	8.6	6.9
Cantaloupe	9.9	8.0
Carrots	9.0	8.2
Cauliflower	1.7	1.4
Cherries	1.2	1.1
Collard Greens	0.6	0.3

Step 2 – Required Acre Estimates

Once the total commodity demand is known, the next requirement is to determine the acreage requirements which are a function of expected yields. Productivity estimates contained within the commodity listings for the Iowa Produce Market Calculator were used to establish a crop yield baseline. The Iowa Produce Market Calculator features an array of yield values for fruits and vegetables, and it is used to project the production potential in Iowa counties in light of current fruit and vegetable production. These values have been reviewed by Iowa State University horticulturalists to provide "best estimates" of the state's yield potentials for these crops. Because many of the crops contained in this research are not grown commercially in the state, there are no standardized agricultural statistics on average yields over time or for specific regions of the state. In addition, there is little in-state research on production practices, yield variances, or other production outcomes for many fruits and vegetables that might be candidates for growth in Iowa. The yields for Iowa are considered, therefore, reasonable in the eyes of ISU scientists given their knowledge of overall horticultural production in the state.

Table 2 provides examples of Iowa's production estimates for a selection of fruits and vegetables. These values were used to identify the number of acres required to produce the whole range of fresh fruits and vegetables that are ultimately assessed in this study.

TABLE 2

Selected Crop Yields in Iowa

Item	Yield (Pounds Per Acre)
Apples	13,000
Apricots	9,000
Asparagrus	2,500
Bell peppers	8,500
Blueberries	6,000
Broccoli	11,000
Cantaloupe	21,000
Carrots	30,000

Step 3 – Determining the Amount of Local Demand that Can be Supplied

Iowa's growing season is much shorter than those enjoyed by many areas of the United States that have well-demonstrated competitive advantages in fruit and vegetable production. Previous studies by this researcher set a limit of 25 percent of annual demand on fruit and vegetable production for local consumption given that shortened season. That restriction sets unreasonable limits for this research for two important reasons. First, there are fruits and vegetables that store well and therefore are available for an extended period after harvest time. Second, we tend to consume higher quantities of some fruits and vegetables precisely because they are in season, and when they are not in season we do not consume them as much. Fresh tomatoes are a good example, as are sweet corn and cantaloupes. Absent any reliable research that demonstrates the actual amounts of annual fruits and vegetables consumed during particular months,

the entire array of fresh fruits or vegetables that could be produced for our Iowa-served metropolitan populations was limited to either 25 percent of annual consumption or 50 percent of annual consumption.

Table 3 displays the weights that were assigned. More perishable items or those we consume in relatively constant amounts monthly are scored 25 percent. Items that we consume in larger quantities during their peak season or that store well are scored 50 percent. While it may be the case that more than 50 percent of a particular crop can and is produced annually, this analysis set the upper limit at 50 percent. Seasonal consumption studies should be conducted to verify whether these assumptions are valid.

TABLE 3

Local Supply Potential Weights Per Crop

Apples	50%	Lima Beans	25%
Apricots	25%	Mustard Greens	25%
Asparagrus	50%	Okra	25%
Bell peppers	50%	Onions	50%
Blueberries	25%	Peaches	50%
Broccoli	25%	Pears	50%
Cabbage	25%	Plums	50%
Cantaloupe	50%	Potatoes	50%
Carrots	25%	Pumpkin	50%
Cauliflower	25%	Radishes	50%
Cherries	50%	Raspberries	50%
Collard Greens	50%	Snap Beans	50%
Cucumbers	25%	Spinach	25%
Eggplant	50%	Squash	50%
Garlic	50%	Strawberries	50%
Grapes	25%	Sweet Corn	50%
Kale	25%	Sweet Potatoes	25%
Lettuce (Head)	25%	Tomatoes	50%
Lettuce (Leaf)	25%	Watermelon	50%

Step 4 – Determining Realistic Local Production Potential

As the final step to this overall estimation process, the number of fruits and vegetables measured for local production and consumption was limited by three factors that were part of the original multi-state study. The first limiting factor took into account the wider region's existing production of the entire array of fruits and vegetables and excluded those that the region already produced in excess of estimated regional demand. That step excluded potatoes, sweet corn, pumpkin, apples, grapes, cranberries, and cherries, as examples. As this analysis is a refinement of the broader, multi-state study, these exclusions were carried forward.

The second limiting factor was actual evidence of production. For example, no acres of artichokes, celery, or other more tender crops are recorded in the USDA data set for Iowa. Third, there were a few categories for which no prices for 2008, the base year for this analysis, were available from USDA data summaries, so those crops were not analyzed. Fresh radishes, okra, and lima bean prices were examples in this exception.

Table 4 is the final list of fresh vegetables and fruits for which a realistic increase in local production can be made to satisfy significant portions of realistic local demand and for which prices were either obtained or estimated. This list of 28 items, though excluding a few items that could be produced in Iowa, is nonetheless quite representative of a basket of fruits and vegetables that it would be conceivable for Iowa farmers to produce for sale within the state.

TABLE 4

28 Fruit and Fresh Vegetables Analyzed

Apples	Lettuce (Leaf)
Asparagrus	Mustard Greens
Bell peppers	Onions
Broccoli	Peaches
Cabbage	Pears
Cantaloupe	Plums
Carrots	Raspberries
Cauliflower	Snap Beans
Collard Greens	Spinach
Cucumbers	Squash
Eggplant	Strawberries
Garlic	Sweet Potatoes
Kale	Tomatoes
Lettuce (Head)	Watermelon

There is one final critical point to this overall preliminary estimation process. This analysis does not control for the amount of Iowa demand for the selected crops that is already met by Iowa production, although the information in Figures 1 through 5 clearly indicates the amounts are likely to be very low. An additional key point is that in Iowa more than three-quarters of all vegetable and melon production in 2007 was concentrated in just five commodities, with sweet corn accounting for more than 37 percent of the acres (see Table 5 on next page). Obviously, high levels of concentration in a few types of production mean significantly lower production percentages in all other possible fruit and vegetable categories.

The impact summaries that will be produced project either the farming or retail value of these 28 commodities as if the demand values displayed in

TABLE 5

Total Acres, Iowa 2007	Acres	Percent of Total
Sweet Corn	3,548	37.2%
Peas, green	1,342	51.2%
Beans, snap	837	60.0%
Pumpkins	830	68.7%
Watermelons	823	77.3%
All remaining vegegables and melons	2,165	100.0%

Table 3 were met completely by regional farmers, irrespective of whether portions of those demands were met already. No net new economic production increments are calculated. Except for the instances described above where the acres in production are far in excess of the acres required to satisfy the broader region's needs and thus were excluded from this analysis, there are no other estimates of existing local production considered in this report.

Understanding Economic Impact Analysis

The economic impact, or in this research the *projected economic value*, of a specific type of productivity ideally is measured using an input-output (IO) model of the area of scrutiny. For this study, an Iowa- based set of industrial accounts was utilized so that the results represented Iowa's existing economic structure as closely as possible.

The tables that are produced in IO models display the amount and types of economic activities that are generated when fruit and vegetable production increases in Iowa. There are four categories of economic information that will be produced in subsequent tables:

- **Total industrial output**. This is the value of what is produced in the industries that we are evaluating.
- **Total value added.** Value added is composed of wages and salaries to workers, returns to management to sole proprietors, incomes from properties and other investments and indirect tax payments that are part of the industrial production processes. Value added is the same thing as Gross Regional Product, and it is the standard measure used to gauge the size of an economic activity, especially on a comparative basis.
- **Labor income.** Labor income is a subset of value added. It is composed of the payments to workers and the proprietors' incomes. Labor incomes are useful for regional analysis because very large fractions of them accumulate to resident workers, whereas incomes from investments, for example, may accumulate out of the region of scrutiny.
- **Jobs**. Jobs are not the same as employed persons because many people have more than one job. An economy, therefore, has more jobs than employed persons. In addition, jobs are not created equal. Some are seasonal, others are part-time. The modeling system provides an annualized value of the jobs associated with some level of industrial output even if the jobs only occur during a short period of time, which would be the case for fruit and vegetable production jobs or many other crop production jobs.

Three levels of economic activity are summarized.

- **Direct activity.** This refers to all of the economic values listed earlier for the industry that we are assessing. In subsequent analyses, for example, all fresh fruit and vegetable production is the direct activity.
- **Indirect activity.** All firms require inputs into production such as raw commodities, chemicals, services, wholesale goods, transportation, banking services, and utilities. When levels increase or decrease in the direct sector, that influences the demand for inputs.
- **Induced activity.** This occurs when workers in the direct firm and workers in the indirect (or supplying) sectors convert their labor incomes to household consumption. This sparks another round of regional economic activity that, in turn, stimulates jobs and pays incomes.

We can sum these values to arrive at an estimate of the total economic value of a particular kind of industrial production.

The phrase *economic value* is used instead of economic impact. In this kind of analysis, we reserve the term economic impact for situations in which we can document net increases in state productivity. Those increases would happen if a region were expanding export sales or, as is the case here, reducing imports by substituting locally grown foods for imported foods. The degree to which an economic activity is indeed producing incremental export or import substituting gains constitutes the regional economic impact. This study, however, identifies the full value of the economic

activity, here fruit and vegetable farming, but it does not estimate how much of that production would be considered new production in Iowa.

However, this exercise can be considered representative of any reasonable bundle of fresh fruits and vegetables, and the values can be used to infer net gains to a state's economy from incremental improvements in the ability of Iowa producers to satisfy regional demands. In addition, on a technical basis, all Iowa production that satisfies metropolitan demand that is outside of Iowa is generating an economic impact in that the foods are exported to those other states.

Input Output Model Modifications and Other Considerations

Data were purchased to build the input-output (IO) model for Iowa. Knowing that Iowa has significant deficits in its overall production of vegetables and fruits, those two separate sectors in the original Iowa model were modified significantly so that they much more closely approximated national averages, as the local production scenario for Iowa logically presupposes the attainment of production efficiencies and labor to output ratios that would be competitive with national producers. If those types of production efficiencies are not assumed, it would be very hard to make the case that local production in and of itself is competitive with the alternative. This process involved restating the employment in each state so that it made payments to workers and fruit and vegetable producers similar to national averages, with payments to labor adjusted for the state's average per job relative to the national average. This allows the modeling system to suppose efficient and to-scale production of fruits and vegetables on a statewide basis, and eliminates the distortions that occur because of a predominance of one type or another of production in states such as Iowa where vegetable production is overwhelmingly concentrated in just a few crops that are not labor intensive.

Cropland is treated as fixed in the subsequent analyses. Accordingly, if there is an increase in production of fruits and vegetables in Iowa, that land must come from existing crop production. As corn and soybean are the dominant Iowa cropping choices, comparisons are made to an equivalent amount of corn and soybean farming on the same acres to demonstrate the potential net changes in regional jobs, incomes, etc., when shifting from one form of crop production to another. The amount of land needed to satisfy regional fruit and vegetable demand is relatively small, and the overall production consequences to the total corn and soybean industry are nominal, but still must be acknowledged.

Marketing to All Regional Metropolitan Markets

This scenario assumes that dense metropolitan population demand creates opportunities for production efficiencies in Iowa. Large population centers send a powerful and consistent demand signal to producers interested in developing their locally grown enterprises. That signal is strongest and most consistent for growers nearest the metropolitan areas as proximity lowers their average costs of production.

It assumes that the draw of nearby metropolitan areas also must be included in any calculation of regional production potential. Accordingly, adjacent and relatively close metropolitan areas are included in the subsequent measures. Finally, a particular county can be expected to produce primarily for one or more metropolitan areas, provided transportation distances are feasible. Other counties, owing to much greater transport distances, will be assumed to not produce for any metropolitan market. Given these assumptions, some counties will not be candidates for enhanced fruit and vegetable production in this scenario.

Step 1 – The Candidate Metropolitan Areas

When considering a significant boost to regional fruit and vegetable production, the most consistent regional demand will be generated from metropolitan areas. Those larger areas would require a concentrated level of regional production – production levels that could stimulate beneficial economies of scale internal to the producers as well as economies external to the producers, such as shared marketing, warehousing, transportation, coordination, and other production-benefitting activities economically downstream from the farm.

In this assessment, all in-state and nearby metropolitan markets are considered. There always have been and always will be elements of local fruit and vegetable production for all metropolitan areas. If the emphasis here is on boosting production to serve the most concentrated demand, focusing on the region's largest population areas offers the greatest production volume relative to the average distance a producer might be from any given major market. Smaller regional markets are important, but this analysis considered Iowa's metropolitan areas as the primary drivers of local foods production potential in the near term.

The metropolitan areas are measured in terms of all the counties that comprise the metropolitan or the combined metropolitan areas. Table 6 lists the nine Iowa metropolitan or combined metropolitan markets, and the nine that are within at least 100 miles of an Iowa county. They range from a low of 86,219 persons in the Ames, Iowa, metro to a high of 839,265 in the Omaha, Nebraska- Council Bluffs, Iowa region.

TABLE 6

Iowa Metropolitan Areas	2008 Popolation	Nerby Metropolitan Areas	2008 Population
Ames, IA	86,219	Janesville, WI	160,186
Cedar Rapids, IA	254,911	La Crosse, WI-MN	131,728
Davenport-Moline-Rock Island, IA-IL	376,980	Lincoln, NE	294,665
Des Moines-W. Des Moines, IA	554,101	Mankato-N. Mankato, MN	92,576
Dubuque, IA	92,589	Peoria, IL	372,638
Iowa City, IA	149,359	Rochester, MN	183,394
Omaha-Council Bluffs, NE-IA	839,265	Rockford, IL	353,381
Sioux City, IA-NE-SD	142,764	St. Joseph, MO-KS	126,051
Waterloo-Cedar Falls, IA	163,659	Sioux Falls, SD	233,503
Total Population	*2,659,847*	*Total Population*	*1,948,122*

Step 2 – Determining the Propensity and the Capacity to Produce Regionally

Research recently completed at Iowa State University provided a procedural template for the next step in the estimation process. In that research, a 12-county area (primarily rural and sparsely populated) wanted an assessment of the farmer income potential for expanding production for metropolitan markets in Omaha on its western edge and Des Moines on the eastern edge.

Three factors mathematically determined the propensity to produce for those markets:

- **Factor 1. The number of farms sized smaller than 50 acres.** Small farms in the upper Midwest are more likely to produce fruits and vegetables than standard-sized farms. The presence of small farms also is greater in more urban counties.
- **Factor 2. The amount of harvested cropland in 2007.** This refers to the supply of land that can be farmed for any purpose.
- **Factor 3. Distance.** The probability of either Factor 1 or Factor 2 playing a role in local food demand for any of the several metropolitan areas is delimited by the number of miles that produce must be transported. In the subsequent analysis, a threshold distance of 150 miles was established. Distance to a market need not be limited, but for the purposes of identifying primary potential production areas, the 150-mile limit seemed reasonable.*

*ISU research on a 12-county region of southwestern Iowa looked at the probability of selling to metropolitan markets on their eastern and western borders. That research used methods similar to those employed here to demonstrate that the probability of producing for a metropolitan area was relatively low given a 100-mile distance from that metro area. That assumption is replicated here, but the research also can be conducted using a greater or a lesser distance threshold. It is important, too, to note that regional economists frequently assume an exponent in the distance decay function that is greater than 1.0. There are many factors that can be used to adjust the disincentives of distance, but without detailed evaluations informed with actual supply-demand-distance values, something that is not available in Iowa, one can only model the supposed relationships.
The ISU report can be found at: http://www.leopold.iastate.edu/pubs-and-papers/2010-01-fruit-and-vegetable-production-metro-markets

Factor 1 is considered as the propensity to produce, Factor 2 is the ability to produce, and Factor 3 is a countervailing limit on production for a particular market due to the impacts of distance and transportation costs on farmer returns. These factors are applied in this study.

Step 3 – Calculating Distances

A matrix of distances was calculated for each of the 99 Iowa counties to each of the 18 metropolitan markets within 100 miles. This 99 X 18 matrix of values represented the right-angled distance between all points considering the population weighted midpoint of the county, and the population weighted midpoint of the entire metropolitan area that was to be served. Each metropolitan area's population-weighted midpoint represented the point on a plane that considered the densely populated central cities and the less dense suburban county place compositions. Each county's midpoint is the weighted value of all places within the county.

This simple process provided all of the potential for metropolitan supply opportunities and provided very reasonable measures of the distances required to adjust the production propensity and production capacity factors cited earlier.

Step 4 – Calculating Weights

All counties under Factor 1 and Factor 2 above generated a score representing the propensity or the capacity of the county to produce for the metropolitan regions given their sums of distances from all of them. By dividing those factors by the sum of all scores for all counties, we get the share of that factor's contribution to the total value for each metropolitan candidate, again as weighted by either the propensity to produce (the small farms factor) or the capacity to produce (the cropland factor).

Step 5 – Calculating Regional and Extra-Regional Demand

Table 7 shows that Iowa metropolitan or combined metropolitan areas could have from 100 percent of their fresh fruits and vegetable consumption produced by Iowa farmers, as in the case of Ames, to a low of 40 percent in the case of the Omaha-Council Bluffs area, given the production assumption limits in Table 3 (either 25 percent or 50 percent of the demand, depending on the fruit or vegetable type). The percentages are less than 100 percent for eight of the nine metropolitan areas because there are non-Iowa counties within 100 miles

TABLE 7

Iowa Metropolitan Areas	Percentage of Demand Met by Iowa Farmers	Nerby Metropolitan Areas	Percentage of Demand Met by Iowa Farmers
Ames, IA	100%	Janesville, WI	5%
Cedar Rapids, IA	90%	La Crosse, WI-MN	20%
Davenport-Moline-Rock Island, IA-IL	50%	Lincoln, NE	10%
Des Moines-W. Des Moines, IA	95%	Mankato-N. Mankato, MN	10%
Dubuque, IA	60%	Peoria, IL	3%
Iowa City, IA	85%	Rochester, MN	10%
Omaha-Council Bluffs, NE-IA	40%	Rockford, IL	5%
Sioux City, IA-NE-SD	60%	Sioux Falls, SD	20%
Waterloo-Cedar Falls, IA	90%	St. Joseph, MO-KS	5%

of those metropolitan areas. To maintain consistency in this analysis, those out-of-Iowa counties are allowed to produce for our metropolitan markets as well, subject of course to the distance calculations listed above.

For the out-of-state metropolitan areas, Iowa's ability to produce for their demand ranged from 20 percent in Sioux Falls, South Dakota, and La Crosse, Wisconsin, to a mere 3 percent for Peoria, Illinois. In these cases, Iowa farmers are competing with significantly more out-of-state farmers who are located closer to those metro areas.

Step 6 – Applying the Weights to Metropolitan Demands

The Step 4 allocation values in each county for Factors 1 and 2 were applied to the estimated demand for each metropolitan area, if the Iowa county was within the 100-mile limit. This produces two values for each county. The first would be the sum of all metropolitan demands weighted by the number of small farms, as delimited by distance. The second would be the sum of all metropolitan demands weighted by the amount of harvested cropland, as delimited by distance. Those two factors were averaged to estimate the average amount of demand for each metropolitan area that would be met by each county in the region. That value was then divided by Iowa's productivity value to estimate the number of acres that would be producing for the metropolitan areas.

Table 8 provides the aggregate outcomes. Iowa would need just 10,548 acres of total production to satisfy the metropolitan demands. In marketing those fruits and vegetables, Iowa farmers would receive $39.96 million in sales. The total retail value of the produce would be $149.7 million.

The visual outcomes are more dramatic and reflect the much higher concentrations of production in metro counties, those close to metropolitan areas, or those serving more than one major market.

TABLE 8

Production Outcomes for the Metropolitan Markets Served by Iowa Producers

Acres Required	10,548
Farm Value	$39,960,374
Potential Retail Value	$149,682,202

Figure 6 shows the estimated allocation of acres for Iowa. It is evident that, given the 100-mile production threshold, Appanoose, Clay, Davis, Palo Alto, and Pocahontas County would not be expected to competitively produce for the in-state and out-of-state metropolitan areas. The density of dots increases markedly within and around metropolitan areas and for those areas that are spatially fortunate to fall between more than one metro.

Figure 7 (next page) provides the same type of information translated into estimated farm sales value gradients. The darkest county values represent farm sales opportunities in excess of $1 million. Pottawattamie County would be expected to require 809 acres to meet the needs of its metropolitan region and neighbors, followed by Polk County at 425 acres. In contrast, Emmett and Humboldt County would be expected to devote only 6 acres each. The expected sales values per Iowa county are contained in Appendix A of this report.

FIGURE 6

Distribution of Probable Vegetable and Fruit Production Acres (1 Dot=1Acre)

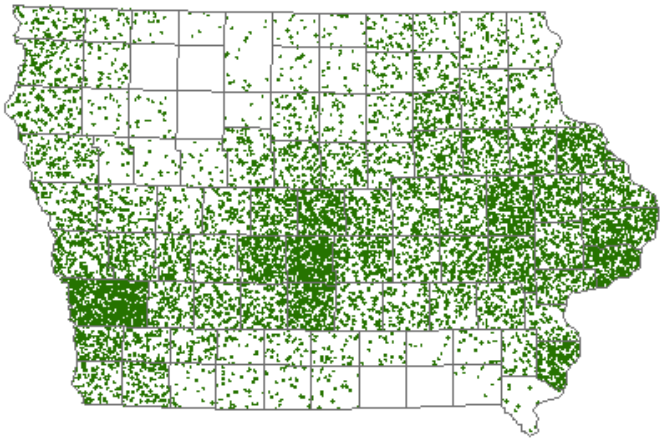
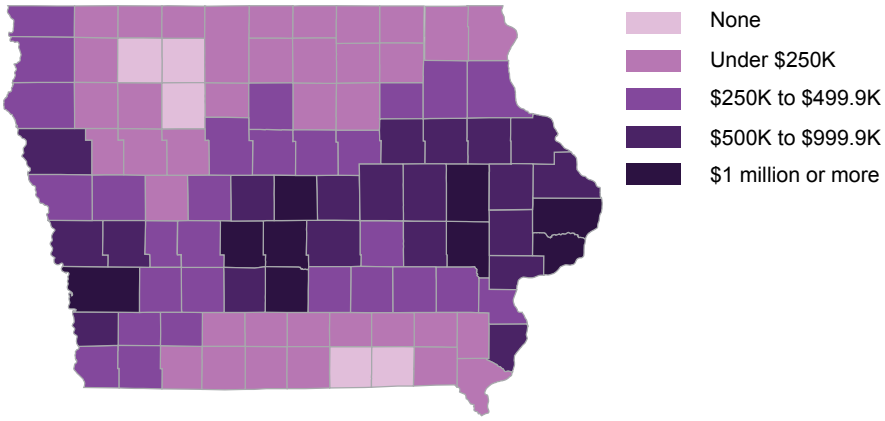


FIGURE 7

Potential Farm Level Vegetable and Fruit Sales



Economic Outcomes

Table 9 shows the acreage and farm sales allocation processes that were just described. There would be fewer than 50 acres of production in 36 counties. Only nine counties posted production potentials of 250 acres or more, given regional metropolitan demand. Those nine counties would see gross farm-level sales in excess of $1 million. The higher productivity intervals of 50 to 249 acres and $250,000 to $999,999 in sales look to be the categories where the greatest increases of production and sales would occur.

TABLE 9

Distribution of Counties by Acres and Total Farm-Level Sales

Acre Intervals	Counties	Farm Sales Intervals	Counties
None	5	None	5
1 to 49	31	Under $250,000	38
50 to 99	18	$250,000 to $499,999	28
100 to 249	36	$500,000 to $999,999	19
250 or more	9	$1 million or more	9

Table 10 provides the results obtained by running $39.96 million in fruit and vegetable sales through the modeling system. In producing those farm-level sales, Iowa would require the annual equivalent of 232 jobs making $10.5 million in combined labor income (which includes payments to all workers and to the farmer). In so doing, Iowa farmers would require $12.83 million in inputs, which would further rely on 97 jobs making $3.6 million in labor income. When the workers in the farm and supplying sectors spend their earnings, they induce $10.35 million in additional Iowa output, which further requires 98 jobs making $3.08 million in labor income. All combined farm-level production, considering all linkages and household spending would generate $63.14 million in output, 428 jobs, and $17.1 million in statewide labor income.

TABLE 10

State of Iowa Farm-Level Economic Values of Fruit and Vegetable Production

	Direct	Indirect	Induced	Total	Multiplier
Output $	39,960,374	12,828,397	10,348,576	63,137,347	1.58
Value Added $	19,293,973	6,311,187	5,756,206	31,361,365	1.63
Labor Income $	10,459,384	3,577,569	3,087,654	17,124,606	1.64
Jobs	232.4	96.8	98.4	427.6	1.84

The previous table also lists multipliers. These are arrived at by dividing the total value by the direct value in each category. The output multiplier of 1.58 means that for each $1 in output, $.58 in output is sustained in the supplying and induced sectors. The multiplier of 1.64 for labor income means that for each $1 in labor income at the farm level, $.64 in labor income is supported in the rest of the economy. The jobs multiplier of 1.84 means that for every farm job, another 84/100th of a job is sustained in the rest of the Iowa economy.

Table 11 offers the total economic values that would be produced in Iowa were those same acres used to produce conventional row crops. It also serves as an estimate of the offsets that would accrue in the state economies when land is converted from one productive use to another. If the land required for fruit and vegetable production were used for corn and soybean production, it would generate $18.2 million in total statewide economic output. When direct, indirect, and induced linkages are considered, this would yield 85 total jobs and $2.7 million in labor income. (The multipliers in this table were to be interpreted in precisely the same manner as the previous example.)

TABLE 11

State of Iowa Farm-Level Economic Values of Corn and Soybean Production

	Direct	Indirect	Induced	Total	Multiplier
Output $	12,870,962	3,650,180	1,647,129	18,168,271	1.41
Value Added $	5,510,810	1,813,065	917,019	8,240,893	1.50
Labor Income $	1,268,197	898,877	490,522	2,657,597	2.10
Jobs	45.5	23.7	15.7	84.9	1.87

The previous two tables describe the maximum gains and the concomitant offsets that would result if land were shifted from corn and soybean production to fruit and vegetable production as described in this report. In consequence, there is net productivity growth in Iowa to the extent that a locally produced agricultural commodity replaces one that is imported. This is called import substitution, and it is a viable mechanism to develop regional economies by achieving greater levels of production self-sufficiency.

To the extent that Iowa producers are able to satisfy demands beyond the state's borders, it also has the potential of increasing the state's next exports of agricultural commodities, which also boosts in-state productivity. How robustly economic impacts accumulate, given the corn and soybean production offsets due to the fixed cropland assumption, depends on the extent to which Iowa producers significantly substitute locally grown foods for imported foods.

Retail Trade Possibilities

It has been suggested by many advocates for local foods development that it is a reasonable goal for farmers to seek greater returns on their effort by developing networks of farmer-owned fruit and vegetable retail establishments. There are many impediments to developing such a system of farmer-retailers. Farming by its very nature is a diffuse enterprise, and demands substantial management effort during growing seasons. Crop production and distribution periods overlap as some crops are harvested early, some mid-season, and others late in the year. An efficient subdivision of producer energy into both farm and retail management expertise, logistics, warehousing, processing, distribution, and direct sales has yet to be demonstrated by the research or actual, regional-scale enterprises.

Nonetheless, it is possible to envision a cooperative fruit and vegetable sales system. If such a system did develop to directly market locally grown commodities, then it is possible to identify the labor needs, rates of pay, and expected profit margins to owner-operators as well as to all other cooperative shareholders using national fruit and vegetable retail market characteristics from the U.S. 2007 Retail Census of Business.

Were Iowa to market 50 percent of its sales within the in-state metropolitan areas, and if the fruit and vegetable retail markets were to emulate national sales averages for establishment sales, labor, and returns to ownership, then Table 12 describes the direct potential value of that activity. The data are itemized by metropolitan market, and the greatest amount of sales. Required establishments, jobs, and labor income generation would be greatest in the Des Moines-West Des Moines area. Dubuque, due to Illinois and Wisconsin farmer competition, would have the lowest retail sales potential. In all, this research concludes that directly marketing half of their sales ($68.3 million) to consumers in Iowa's metropolitan areas would require 87 establishments, plus 595 jobs at those establishments earning a total of $15.2 million in labor income. Again, labor income includes wage and salary payments as well as returns to the proprietors.

As the state of Iowa already efficiently distributes fruits and vegetables via its existing grocery and other retail establishments, the addition of farmer-direct sales establishments in this scenario simply shifts those sales. **There is no net gain to the state economy assumed as a consequence of this activity; hence, no further estimates of the value of this activity are provided.**

TABLE 12

Fruit & Vegetable Direct Retail Activity

Iowa Metropolitan Areas	Retail Sales	Establishments Required	Jobs	All Labor Incomes
Ames, IA	3,303,842	3	19	492,286
Cedar Rapids, IA	8,791,183	8	57	1,455,470
Davenport-Moline-Rock Island, IA-IL	7,222,783	12	84	2,152,450
Des Moines-West Des Moines, IA	20,171,063	18	124	3,163,761
Dubuque, IA	2,128,761	3	21	528,657
Iowa City, IA	4,864,818	5	33	852,798
Omaha-Council Bluffs, NE-IA	12,863,980	27	188	4,791,967
Sioux City, IA-NE-SD	3,282,360	5	32	815,142
Waterloo-Cedar Falls, IA	5,644,151	5	37	934,447
Total	$68,272,942	87	595	$15,186,977

Conclusions and Cautions

This report is based on sets of successive assumptions. However, the longer the string of assumptions, the more tenuous one's confidence becomes in the outcome. Consequently, owing to the linear and linked nature of the modeling process, early assumptions carry great weight by the time final results are determined.

The research used 2008 farm-level and retail prices. That also was the collection year for the data in the modeling system that was employed. It was an atypical year in that there was a run-up in some food and farm input prices. Nonetheless, the alignment of the expected crop prices with the modeling structure assures that the job requirements and concomitant labor incomes are in temporal alignment.

Much more research needs to be conducted concerning the industrial relationships between production and retail activity to determine if more jobs truly are required to handle, transport, and distribute those goods than would otherwise exist to move the same volume of goods irrespective of the farm-to-retail configurations assumed in this report. As such, economic value conclusions for the fruit and vegetable markets are incomplete.

This exercise is consistent with economic and spatial theory in that dense metropolitan demand will hypothetically induce production proximate to that demand. Suppliers at greater distances will incur higher costs and will be less inclined towards this type of production. Those dynamics are captured with the methods used in this evaluation.

This has been a modeling process to produce sets of reasonable results given the chosen assumptions and the limits to the data. The job and income projections presuppose the ability to produce at much higher levels than currently exist in Iowa. It also assumes that a network of farmer-retailers is capable of emulating national sales patterns for establishments of that type. That assumption anticipates aggregated merchant and managerial maturity capable of providing those services.

Given these expectations, one must not forget that very high levels of fresh fruit and vegetable consumption in Iowa **are not met** by regional producers or by farmer retailers using direct distribution of their products. There are sound and powerful market antecedents for those facts that, despite this research, cannot be assumed away, legislated away, or ignored.

Appendix A

County Level Farm Sales and Estimated Production Acres

County	Potential Farm Sales	Acres Required	County	Potential Farm Sales	Acres Required	County	Potential Farm Sales	Acres Required
Adair	485,533	128	Floyd	131,181	35	Monona	478,538	126
Adams	227,363	60	Franklin	112,567	30	Monroe	95,215	25
Allamakee	143,590	38	Freemont	2,657,597	2.10	Montgomery	325,799	86
Appanoose	–	–	Greene	84.9	1.87	Muscatine	535,100	141
Audubon	451,066	119	Grundy	277,902	73	O'Brien	173,068	46
Benton	685,709	181	Guthrie	382,547	101	Osceola	108,185	29
Black Hawk	501,669	132	Hamilton	460,637	122	Page	392,920	104
Boone	694,093	183	Hancock	76,573	20	Palo Alto	–	–
Bremer	460,367	122	Hardin	414,446	109	Plymouth	436,854	115
Buchanan	618,650	163	Harrison	755,216	199	Pocahontas	–	–
Buena Vista	77,780	21	Henry	233,437	62	Polk	1,611,721	425
Butler	215,160	57	Howard	156,478	41	Pottawattamie	3,064,169	809
Calhoun	93,459	25	Humbolt	22,336	6	Poweshiek	493,837	130
Carroll	242,002	64	Ida	69,341	18	Ringgold	105,297	28
Cass	484,238	128	Iowa	635,084	168	Sac	76,594	20
Cedar	625,457	165	Jackson	624,096	165	Scott	1,063,406	281
Cerro Gordo	78,449	21	Jasper	900,281	238	Shelby	593,720	157
Cherokee	80,513	21	Jefferson	73,469	19	Sioux	430,849	114
Chickasaw	248,240	66	Johnson	1,009,109	166	Story	1,040,308	275
Clarke	147,257	39	Jones	684,464	181	Tama	631,186	167
Clay	–	–	Keokuk	426,970	113	Taylor	41,379	11
Clayton	340,392	90	Kossuth	71,635	19	Union	122,857	32
Clinton	1,075,255	284	Lee	46,806	12	Van Buren	30,401	8
Crawford	411,713	109	Linn	1,382,759	365	Wapello	34,422	9
Dallas	1,085,286	286	Louisa	265,529	70	Warren	1,115,979	295
Davis	–	–	Lucas	150,185	40	Washington	476,335	126
Decatur	101,767	27	Lyon	315,935	83	Wayne	98,213	26
Delaware	576,955	152	Madison	530,865	140	Webster	384,264	101
Des Moines	341,622	90	Mahaska	362,372	96	Winnebago	46,521	12
Dickinson	65,508	17	Marion	351,001	93	Winneshiek	248,632	66
Dubuque	758,687	200	Marshall	549,295	145	Woodbury	589,064	155
Emmet	22,983	6	Mills	629,484	166	Worth	56,196	15
Fayette	438,539	116	Mitchell	190,330	50	Wright	269,379	71
						State Total	**39,960,374**	**10,548**