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Perspectives

Linking Sustainable Agriculture and Public Health: Opportunities for Realizing Multiple Goals

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partnerships in communities across the country. Two case studies—fruits/vegetables and dairy—are briefly presented to illustrate the opportunities.

KEYWORDS:

Sustainable food systems | economic development | community-based food systems | fruit and vegetable consumption

INTRODUCTION

To develop an analysis of what it means for domestic agriculture and dietary goals associated with public health to “find one another” it is necessary to view the moment both historically and globally. As we move through the 21st century, it is useful to consider our relationship to food. In the 20th century we moved from a nation of farmers to an urbanized nation, with little individual connection to the food production we rely upon on a daily basis and an ever increasing percentage of young people having no generational connection to farming. Thus, the medical and nutritional/public health fields typically focus on the product—the food supply—with little thought to the process, nes[1] nor Healthy oods consume ency of producti her owner labor or

Howeve onsider alterna od supply for gene ion. While there are 3 billion by 2025 an n will grow from our consump hould consume a, fats/oils, or sugar s about 1.2

In addition, there are multiple effects of development on agricultural production and dietary standards, one typical change as a country develops and the standard of living increases is increased per capita meat consumption. The less vegetarian a person's diet, the more land required to produce their food. For example, using 1990 data and considering world grain production versus world grain requirements offers a striking picture.6 “Grain equivalent” is the grain effectively consumed by an individual that is either eaten directly or consumed by animals that are then consumed by humans. If the world ate like the average person in China, consuming about 300 kg per year of grain equivalents, we would have been awash in grain in 1990. If this continued with current production levels and projected population growth to 2030 we would still have plenty to feed everyone. However, if the world consumed like Americans (800 kg of grain equivalent per person per year), we would be well short of our needs by 2030 (assuming constant production). While the potential for a second green revolution with biotechnology producing a great abundance is possible, it seems less than prudent to develop a single strategy for producing a sufficient, healthy food supply for the future world's population.

In addition, these raw number needs do not account for the stress on water supplies from increased population, increased development, and increased need for agricultural production. The United Nations estimates that 48 countries are currently either water stressed 50.7 Thus, at the gl d an increase in food c he United States a thwest, that are wate n levels of agricultu ation water.

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begs the question: Are we short-changing, future domestic food security through growing dependence on a distant food supply? Additionally, the American Farmland Trust[9] estimates currently that 86% of our fruit and vegetable production occurs on land that is under threat of development. Similarly, 63% of our dairy, 39% of our meat, and 35% of our grain is produced on lands under threat of development. In the 5-year period from 1992 to 1997, states like Illinois, Alabama, New York, Mississippi, and Arizona saw in excess of a 100% increase in their loss rate of prime agricultural land.[10] In other words, this phenomenon of productive land capacity loss is widespread across the country—it requires a national dialogue as well as a great deal of local action. We also have a declining base of farmers with a 17% farm number decline from 1974 to 1997 and an additional 4% loss between 1997 and 2002.[11] Should we continuously reduce our natural resource assets and human skill base for food production? Rather, does it make sense to ensure that we maintain the productive capacity of our landscape across the country for future generations?

From a dietary standpoint, this should be of great concern. It is clear that, excepting tobacco use, poor diet and physical inactivity are the leading causes of death in United States.[12] This implies that agriculture and public health are intimately connected. However, a recent report from USDA's Economic Research Service finds[13] that we would need to increase our fruit and vegetable production by approximately 13 million acres (b uld allow for full a ation. Therefor ently incapabl sume a healthy od supply; and, sim the future without ources base and h orollary to this, conomy or environr re all part of the biol

CONC

Considering functional principles for health and sustainability now and into the future is a useful beginning:

1. The preservation and enhancement of our natural resources for future generations.
2. A healthy population with each person able to realize their potential, maintaining a quality standard of life as they mature and age.
3. A vibrant, sustainable economy that fits the 21st century.

This suggests a strategy—a strategy that links agricultural production, diet/public health, and economic development. This can be succinctly framed from the standpoint of community-based food systems. Community-based food systems can be thought of as collaborative efforts to build more locally based food systems and economies. They prioritize local resources and local markets, emphasize social equity and environmental sustainability, and rely on relationships among growers and eaters, retailers and distributors, processors and preparers of food within the community.[14] “When local agriculture and food production are integrated in community, food becomes part of a community's problem-solving capacity rather than just a commodity that's bought and sold.”[14]

Focusing on relationships in communities is a good starting point for considering a sustaina ties around the 4 dir mics allows develop tandard of life as th nt; (2) farming r landscape rather th ironmental outcome ther than degr mes that allow rks of small busines dscape.

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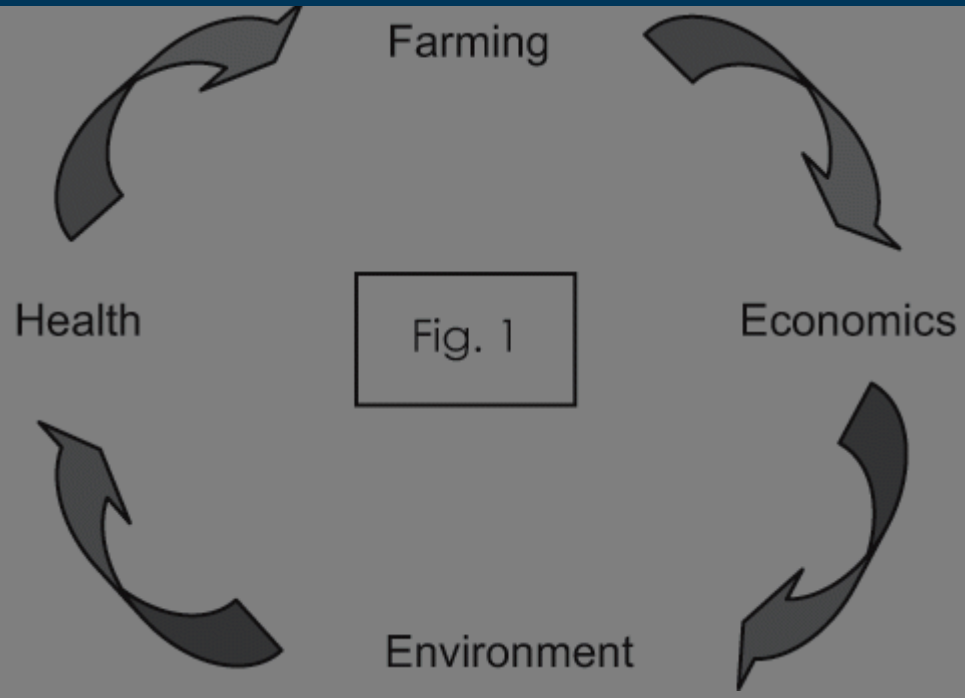

Fig. 1

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How would we incorporate the idea and practice of sustainability into this framing of healthy, livable communities? As we move toward greater sustainability in health, farming, economics, and the environment, we will continually identify shortfalls to our practices. Our precise notions of what sustainability is and is not continually evolves and develops and becomes more find-tuned. Ten years from now we will have more advanced precision to our concept of sustainability than we do today and 20 years from now it w l as a product ng their role in prese er job than my dad xpensive now, an kids will farm an blished data, 20

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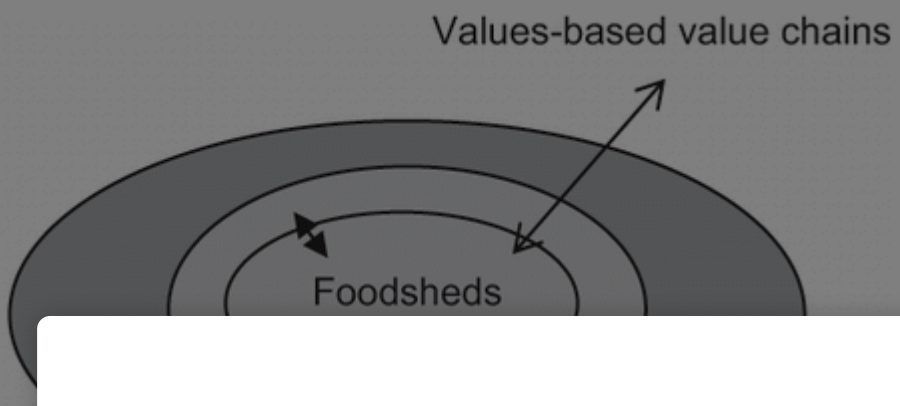
source be used that incorporates the same environmental, social, and economic traits desired in the local?

How do we put this in a food system context and maintain a perspective regarding the volume of food required to feed a national population of 300 million people—about 360 billion pounds of food? There are 3 schools of thought in the literature that can be integrated to help conceptualize a vibrant, sustainable network of community-based food systems. Kloppenburg et al[15] have developed the “foodshed” concept (see Figure 2). While there are a number of facets to the concept, the spatial aspect is most critical to this analysis. Similar to the drainage area of a watershed, a foodshed is the area from which a people's food “drains.” In its simplest terms, it is a spatial relationship to our food system. In the context outlined above, a community would seek to reduce the drainage area of its food system.

FIGURE 2. Foodshed Concept.



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However, most consumers currently prefer to source most of their at-home food from grocery stores and supermarkets. Also, nearly 50% of consumer food dollars are spent on food consumed outside the home.[18] Extending the supply chain beyond the direct consumer–producer can utilize the concept of values-based value chains.[19] The conceptual intention is to maintain transparency in the supply chain in which values desired by consumers begin with the producer and are identity-preserved as they move to the consumer. In addition, the concept implies a greater degree of price-making by producers (for example, cost plus pricing), insuring a viable farm given sufficient markets. It is intended as a way to build more distant relationships between producers, consumers, and intermediaries involved in moving food from field to fork over the course of a year.

Linking the concepts of foodsheds, civic agriculture, and values-based value chains implies a dynamic relationship between self-provisioning (i.e., home and community gardens), direct market relationships (i.e., farmers' markets, farm stands, and CSAs), and indirect market relationships (i.e., retail markets, institutional food meals, restaurants) in a manner that maintains a consistent set of values. Also, it allows for reframing the food system in a community such that it does truly become part of the problem solving toolkit and reinforces diet-related public health efforts. However, if consumer demand does not exist or develop, then this is all an exercise in wishful thinking

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environment, 77% thought government policy should be oriented toward helping family owned or operated farms, and 59% thought the family farms should be supported even if it meant higher food prices.

The preceding frames a strategy of linking food-related public health goals and agricultural production within community-based food systems and serves to lay the basis for two case studies derived from Michigan. These identify opportunities to link agricultural production opportunities directly to dietary guidance and public health issues while also incorporating notions of community and economic development and environmental sustainability. The first of these concern fresh fruit and vegetable production and consumption.

Case Study—Fruits and Vegetables

Consider two views of the apple. First, an apple is an apple is an apple; second, an apple is different depending on where it was grown relative to its consumption point, how it was grown, and/or who grew it. From the standpoint of a sufficient food supply, at the current moment in history, the first consideration of an apple will probably suffice. The overall goal of public health campaigns is typically conceived of, for example, as the consumption of recommended levels of fruits and vegetables. However, consumption patterns fall far short of this.[22] People consuming an average 2000-ca…able consump…rom recomm…e vegetables by 183%…e decreased by 35%.

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selection. If we linked agricultural production with dietary guidance, we could begin to target both the quality and quantity of consumption. Asami et al[23] reported a 10% to 40% increase in total plant polyphenols in organically and sustainably produced crops relative to those conventionally produced. An even greater potential for impacting the nutritional quality of crops may be through variety selection. Genotypic variation within particular crops has been identified as a feasible tool for improving levels of beneficial phytochemicals.[24] One study[25] reported up to an 8-fold difference in glucosinolate concentrations (an abundant phytochemical in broccoli connected to reducing risk of certain cancers in humans) across 32 varieties of broccoli. Indications are that we can link increased levels of beneficial phytochemicals through production and selection strategies.

We are also beginning to develop an understanding of strategies to enhance agriculture's utility as an economic development tool for place-based development in communities across the country. We can approach such concepts by asking scenario questions such as “What would it mean to small business and job creation across the country if production and consumption were linked locally to achieve dietary guidance public health goals?” Cantrell et al[26] investigated Michigan fruit and vegetable production. Historically, Michigan fruits and vegetables have been marketed predominately to the processing sector with 74% of fruits and 44% of vegetables grown sold for

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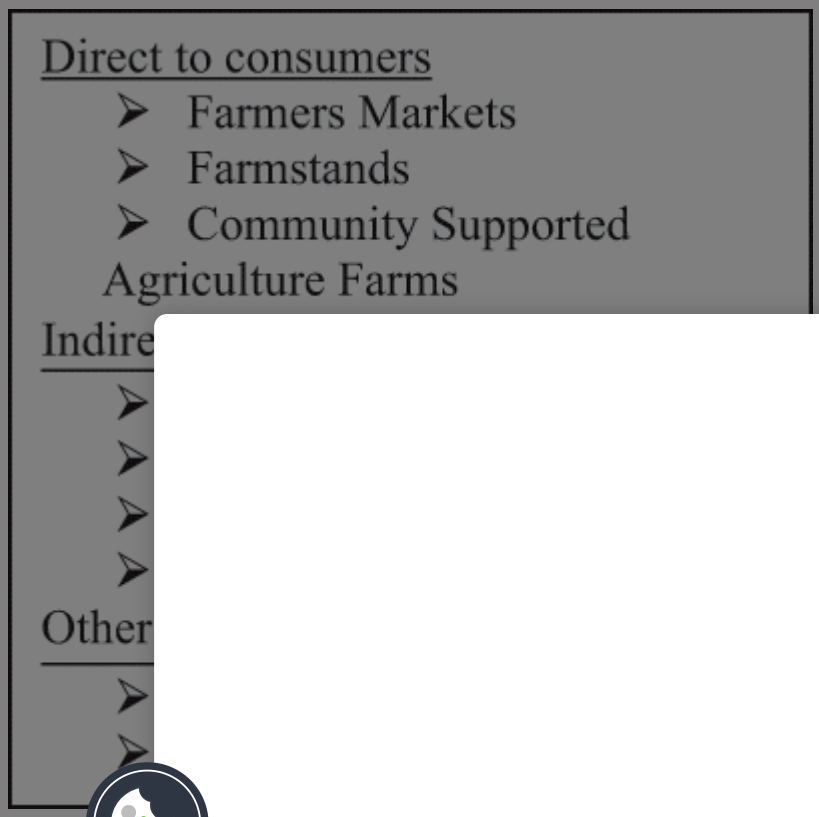
5600 new jobs. A reasonable conclusion from these studies is not the absolute number of new jobs but rather the suggested link between job creation, the development of agriculture as a viable business for individuals and families, and the provisioning of a diet that meets current dietary guidelines.

Then we might ask ourselves the question: What are ways to develop linkages between producers and consumers such that agricultural production was linked to a healthy diet. Figure 3 indicates a number of strategies for these linkages. Farmers markets and other direct market strategies receive a great deal of emphasis but probably have limitations in their ultimate ability to deliver a large percentage of a family's dietary needs. Also, consumers appear to largely prefer accessing their at-home food from grocery stores and supermarkets.[21] Thus, indirect market strategies, with imbedded value chains, are an important component in the full mix of opportunities.

FIGURE 3. Strategies for Linking Producers to Consumers.



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directors in such sourcing within Michigan.[28] Three hundred of 684 school food service directors indicated that they would be interested in purchasing food directly from a local producer if pricing and quality were competitive and a source was available (73% of those responding). If their vendor or the state warehouse distributor offered it as part of the contract services, the positive response rate increased to 83% of respondents. Food service directors indicated an interest in purchasing fruits and vegetables as well as animal products. A survey of Oklahoma food service directors[29] indicated similar response rates to these types of questions.

It is thus clear that there is potential to link the provisioning of sufficient levels of fruits and vegetables for all of America's population with the production of those crops as an economic development tool for communities across the country; an additional 13–14 million acres of fruit and vegetables spread across 50 states provides a lot of opportunity. This has the simultaneous capacity to help increase the economic vitality of both rural and urban communities while providing economic and public health incentives for preserving the productive capacity (land and water as well as human skills) for future generations. Fruit and vegetables are only one component of our diet. While analyzing all components is beyond the scope of this article, one additional case study with animal products may be useful.

Case Study—Dairy Production

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dairy products or 1.3 billion pounds to meet 62% of the unmet needs. This would require the production from an extra 94,000 cows at 22,000 pounds annual production per cow[33] (58,000 for meeting 62% of unmet need) or 137,000 cows at 15,000 pounds annual production per cow[34] (85,000 for meeting 62% of unmet need). A typical grain-based dairy cow produces about 22,000 pounds of milk and a typical pasture-based cow produces about 15,000 pounds of milk annually. In 2002 the average Michigan dairy farm size was about 90 cows.[35] Thus, if developed as grain-based dairies, this would require from 650 to 1050 more average-sized dairy farms across Michigan. If they were pasture-based dairies, this would required 950–1520 average size farms across Michigan. This represents an opportunity to consciously consider catalyzing new farms to improve the health of America's population.

Why might this be important? What might different production strategies mean to maximize environmental attributes in our production systems while preserving future landscape production potential? The dominant form of dairy production today is grain based. That is, the primary feed is a balanced formulation heavily based on corn and soybeans. Michigan had approximately 8 million acres of cropland; 2.1 million acres of soybeans, and 2 million acres of corn for grain in 2002.[33] (This is prior to the current focus on corn-based ethanol production.) An analysis of pesticide usage indicates that approximately 3 pounds of total pesticides were used per acre of corn produced (1997 Michigan

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Finally, several studies have investigated the startup and production costs of grass-based relative to grain-based dairies. The bulk of the data indicates that pasture-based dairies are less expensive to capitalize and operate, with greater returns per cow and per hundredweight of milk. In one study, investigators compared a 250-cow grass-based dairy and a 1,000-cow grain-based dairy.[35–40] They reported facilities, equipment, and machinery costs of about $670 per cow with total investment of about $4,000 per cow in the pasture-based system; the grain-based dairy had facilities, equipment, and machinery costs of $1,895 per cow and total investment of $5,500 per cow. Investigators also estimated lower ownership costs both per cow ($241 versus $429) and per hundredweight of milk produced ($1.61 versus $1.95, at 15,000 and 22,000 pounds of milk sold, respectively). Another study of dairies in 4 states demonstrated increased profit per cow and per hundredweight of milk in the pasture-based dairies.[41] A literature review of the economic, social, and environmental differences between grain-based and pasture-based dairies is available.[42]

There is great potential to link dairy needs from a public health perspective with production opportunities to the benefit of both while also enabling new business formation across the country. Furthermore, it is clear that this could be utilized as a strategy, in part, to strengthen diversity of production strategies and further strengthen our ability to preserve natural resources for our children's children.

SUMM

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Related Research Data

Calcium Intake Trends and Health Consequences from Childhood through Adulthood
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The gap between food intakes and the Pyramid recommendations: measurement and food system ramifications
Source: Food Policy
Comparison of the Total Phenolic and Ascorbic Acid Content of Freeze-Dried and Air-Dried Marionberry, Strawberry, and Corn Grown Using Conventional, Organic, and Sustainable Agricultural Practices
Source: Journal of Agricultural and Food Chemistry
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Source: Unknown Repository

Actual Causes of Death in the United States
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REFERENCES

1. US Department of Health and Human Services and US Department of Agriculture. Dietary Guidelines for Americans, 2005. 6th ed. Washington, DC: US Government Printing Office; 2005. http://www.health.gov/dietaryguidelines/dga2005/document/pdf/DGA2005.pdf (Accessed: 15 January 2008).

   Google Scholar

2. US Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd ed. Washington, DC: US Government Printing Office; 2000. http:// 15 January 2008)

   Googl

3. US Ce
   http:// 2007).

   Goo

4. USDA es by Regio
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5. Kanto Capita Food

Economic Report No. 772 . 1998 . ERS: US Department of Agriculture;

Google Scholar

6. Hamm MW. Calculated from Worldwatch Institute data. http://www.worldwatch.org/

Google Scholar

7. United Nations Environment Programme. The World's Freshwater Supplies. http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/19.htm (Accessed: 24 October 2007).

Google Scholar

8. Huang S, Huang K. Increased US Imports of Fresh Fruit and Vegetables. 2007; USDA ERS Report FTS-328–01. http://www.ers.usda.gov/Publications/fts/2007/08Aug/fts32801/fts32801.pdf (Accessed: 24 October 2007).

Google Scholar

9. American Farmland Trust. Farming on the Edge Report: What's Happening to Our Farml 24 October 2007)

Googl

10. Ameri http:// ctober 2007).

Go

11. Hamm culture. http:// pdf (Acces

Googl

12. Moktad , AM , Marks , JS , Stroup , DF and Gerberding , A. 2004 . Actual causes of death in the United States, 2000 . JAMA. , 291 : 1238 – 1246 .

PubMed | Web of Science ® | Google Scholar

13. Buzby JC, Wells HF, Vocke G. Possible Implications for U.S. Agriculture From Adoption of Select Dietary Guidelines. 2006. ERS Report #31. http://www.ers.usda.gov/Publications/ERR31/ (Accessed: 9 July 2008).

Google Scholar

14. C.S. Mott Group for Sustainable Food Systems at MSU. Food connections: capital area community food profile. http://www.mottgroup.msu.edu/portals/mottgroup/downloads/CACfoodprofile.pdf (Accessed: 24 October 2007).

Google Scholar

15. Kloppenburg , J , Hendrickson , J and Stevenson , GW . 1996 . Coming into the foodshed . Agric Human Values. , 13 : 33 – 42 .

Google Scholar

16. Lyson r : 42 – 45 .

Googl

17. DeLin tivation . Agric

18. Unitec d CPI, Prices griculture Econo http:// January 2008)

19. Leopold Center for Sustainable Agriculture. What is a Value Chain? http://www.valuechains.org/valuechain.html (Accessed: 24 October 2007).

Google Scholar

20. Wimberley RC, Vander Mey BJ, Wells BL, et al. Our Changing World: The Globalization of Food and How Americans Feel About It. http://sasw.chass.ncsu.edu/global-food/foodglobal.html (Accessed: 24 October 2007).

Google Scholar

21. Food Processing Center, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. Attracting Consumers With Locally Grown Products. http://fpc.unl.edu/Reports/Locally_Grown_Consumer_Survey_Report.pdf (Accessed: 24 October 2007).

Google Scholar

22. United States Department of Agriculture Economic Research Service . 2004 . Loss-Adjusted Food Availability , Washington, DC : United States Department of Agriculture Economic Research Service .

Google

23. Asami n of the total pheno rry, straw agricultural practi

24. Schr the quantity of phy

25. Farnha etic and enviro ency of

Web of Science ® | Google Scholar

26. Cantrell P, Conner D, Erickek G, Hamm MW. Eat fresh and grow jobs. http://www.mottgroup.msu.edu/Portals/mottgroup/downloads/EatFresh.pdf (Accessed: 24 October 2007).

Google Scholar

27. Swenson D. The Economic Impacts of Increased Fruit and Vegetable Production and Consumption in Iowa: Phase II. http://www.leopold.iastate.edu/pubs/staff/health/health.htm (Accessed: 24 October 2007).

Google Scholar

28. Izumi , BT , Rostant , OS , Moss , MJ and Hamm , MW . 2006 . Results from the 2004 Michigan Farm-to-School Survey . J Sch Health. , 76 : 169 – 174 .

PubMed | Web of Science ® | Google Scholar

29. Oklahoma Food Policy Council and Kerr Center for Sustainable Agriculture. The Oklah od Service Survey d: 24 Octob

Googl

30. Unitec 1909–99. FoodR htt (Accessed: 24

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31. Nickla childhood throug

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32. McNamara , PE , Ranney , CK , Kantor , LS and Krebs-Smith , SM . 1999 . The gap between food intakes and the Pyramid recommendations: measurement and food system ramifications . Food Policy. , 24 : 117 – 133 .

Web of Science ® | Google Scholar

33. United States Department of Agriculture. 2002 Census of Agriculture. http://www.nass.usda.gov/QuickStats/PullData_US.jsp (Accessed: 15 January 2008).

Google Scholar

34. Kriegl T. Dairy Grazing Farms Financial Summary: Fourth Year Report, Data from 2003, 2002, 2001, and 2000, Regional/Multi-State Interpretation of Small Farm Data. http://cdp.wisc.edu/pdf/glgnreport_yr4.pdf (Accessed: 15 January 2008).

Google Scholar

35. United States Department of Agriculture. 2002 Census of Agriculture. http://www.nass.usda.gov/census/census02/volume1/mi/st26_1_017_019.pdf (Accessed: 9 July 2008).

Google Scholar

36. Hamm default.htm (Acces

Googl

37. Digiac Farming Syste

htt tober 2007).

Googl

38. Ricket

http:// d: 24 Octob

Googl

39. Brees M, Horner J. 2005 Dairy Budgets. University of Missouri; 2005. http://www.agebb.missouri.edu/mgt/budget/annldary.htm (Accessed: 24 October 2007).

Google Scholar

40. Horner, J. Rickard T. Larger Scale Dairy Grazing Farms Offer Opportunity in Missouri. http://agebb.missouri.edu/mgt/grazing.htm (Accessed: 24 October 2007).

Google Scholar

41. Kriegl T. Dairy Grazing Farms Financial Summary: Third Year Report. Madison, Wis: Center for Dairy Profitability, University of Wisconsin-Madison; 2003. http://cdp.wisc.edu/pdf/glgnreport_yr3.pdf (Accessed: 24 October 2007).

Google Scholar

42. Conner D, Heller MC, Cocciarelli S, Hamm MW. Opportunities in Dairy Grazing Farms: Assessing Future Options. http://www.mottgroup.msu.edu/Portals/mottgroup/Opportunities%20in%20Grazing%20Dairy%20Farms.pdf (Accessed: 24 October 2007).

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