

Information Technology in Support of Sustainable Food Choices

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Abstract. There has been a general shift towards industrial agriculture. An indication of this trend is that food in North America travels an average of more than 2000 kilometers before reaching the consumer. The lack of locally-produced food consumption impacts the health of the local environment and ecosystems. Conventional industrial agriculture, whose production is geared towards export, is concerned with producing as much food as possible for the least cost. As citizens of the world consider the potential impacts of climate change and various well-documented food scares, many are re-evaluating their choice of food on the basis of many more dimensions, which may include quality, freshness, local economic impact, safety, emissions, environmental impact, and social justice.

The work described in this paper describes a role for information technology in supporting this re-examination of food choices. Consumers might wish to act in environmentally-friendly ways, but they lack the necessary information. Trust is becoming an increasingly scarce commodity. In this context, we have established a virtual community on the web intended to link consumers wanting to buy locally-produced food with those who are producing it. This community is intended to be a source of information and discussion about the many environmental issues involved with food choices. Creating and nurturing this online community has been, and continues to be, challenging. Many producers may not have easy access to high-bandwidth internet connections, or even a home computer. For many, the idea of online communication is a new concept. This paper discusses the project from the perspective of online communities and decision support. It also outlines opportunities for further development and growth.

1. Introduction

There is a growing interest in the application of information technology to agriculture and food choices. There are many regional and international associations¹, events², and journals³ to promote development in this area. Conventional industrial food production has the goal of maximizing productivity and profit. The impetus for adoption of sustainable methods will not come first from within that industry. Rather, consumers can exert considerable influence on the availability of sustainable food choices by virtue of their purchases (Stolle et al., 2005; Cohen et al, 2005). This sort of consumption is becoming an important form of political activity.

Various researchers (Sonnino and Marsden, 2005; Lyson and Guptill, 2004) have noted a separation in agriculture between the adherents of the (conventional) productivist logic and those of a (specialized) logic of quality. Global-scale conventional agriculture might use information technology to maximize productivity and to ensure that farmers know about the latest technological advances (Navarro, 2006). Local-scale specialized agriculture might use information technology to manage the whole-farm enterprise. This dichotomy is reminiscent of distinction that McDonough and Braungart (2002) make between eco-efficient and eco-effective, while describing their triple top line approach. Conventional farming can be rated on a scale of eco-efficiency: such an enterprise could be called eco-efficient if in its efforts to maximize productivity, it also maximized the efficiency of natural resource use and minimized all negative impacts. It is possible for local-scale specialized agriculture to be eco-effective because some management approaches (such as holistic (Savory et al., 1998)) can actually provide benefit to the environment. The triple top line approach indicates that consumers should tolerate only the most eco-efficient alternatives until such time as eco-effective options exist. Born and Purcell (2006) caution policy makers who would say that local is inherently good, calling this the “local trap.” Although the distinctions between these two logics seem clear, Sonnino and Marsden (2006) point out that this is not necessarily the case: conventional producers want to appeal to consumers who have “green” preferences and specialized producers want to appeal to consumers who value convenience.

An interest in sustainable consumption may lead consumers towards specialized agriculture. Cohen (2006) lists five paradoxes inherent in the concept of sustainable consumption:

- it challenges the pervasive illusion of consumer sovereignty that exists in most developed countries;
- the attempts to create a separate space for analysis of sustainable consumption are undermined by efforts to place it under heading of sustainable production;

¹ International Network for Information Technology in Agriculture (INFITA), Pan-American Federation for Information Technology in Agriculture (PanAFITA), European Federation for Information Technology in Agriculture (EFITA), Asian Federation for Information Technology in Agriculture (AFITA), American Society of Agricultural and Biological Engineers (ASABE), International Commission of Agricultural Engineering (CIGR), International Association of Agricultural Information Specialists (IAALD).

² World Congress on Computers in Agriculture (WCCA), sometimes co-located with meetings of the other societies.

³ Journal of Information Technology in Agriculture, Journal of Agricultural Education and Extension.

- greater consumption efficiency and the growth of nominally “green” consumer preferences together lend themselves to undesirable rebound effects⁴;
- consumer policymaking in most advanced countries is very disorganized and regulatory responsibility is fragmented; and
- common interpretations of “consumer interest” do not normally endorse policy programs that intend to reduce the volume of consumption or the range of choices.

When the focus is on food, consumption efficiency and green preferences lead to very interesting choices with questionable sustainability. Should one interested in sustainable consumption always choose organic, regardless of where it originated or how it was produced and certified? The fairly recent development of large, conventionally managed, organic farms has created issues around intensification. Guthman (2004) describes how traditional organic farms are facing pressure to intensify their operations, which undercuts their ability to practice their truer form of organic farming. Duchin (2005) describes the use of input-output and life-cycle analyses in evaluating food choices. For example, Faist et al. (2001) found that more efficient cooling appliances had more potential to energy requirements than a wholesale shift to organically produced foods. Pretty et al. (2005) conduct a cost analysis focused particularly on food miles and the various costs of transporting food over great distances. The March 2, 2007 issue of TIME magazine featured a cover that read “Forget Organic. Eat Local.” Such a message is far too simplistic, although the cover story (Cloud, 2007) featured more balance. Unification of these various complex models in decision support tools for consumers can help those who are interested in sustainable consumption.

A guiding principle for many concerned citizens is the environment and the risks posed by climate change, which were recently detailed by the Intergovernmental Panel on Climate Change. Worldwide, agriculture accounts for about 20% of greenhouse gas emissions. These emissions come from the manufacture, transport, and application of inputs to crop production; the maintenance of farm animals; and the production, transportation, and storage of food for the consumer. The increasing interest in consuming locally-produced food can positively affect these emissions, as noted by Pretty et al. (2005). Other reasons for favouring locally-produced food include health of the land, health of the population, food safety, food security and sovereignty, an appreciation of (slow) food, and the economic and societal benefits of spending money close to home. Not all the aforementioned reasons are necessarily affected by proximity, yet the ability to make connections with local food producers improves trust, which then positively affects concerns like food safety. Embeddedness (Sonnino and Marsden, 2005) of local, specialized agriculture is of tremendous importance. Instead of focusing production on export to “grow food to feed families far away” (Bannatyne-Cugnet and Moore, 1994), feeding your neighbours and yourself creates qualitatively different relationships between producers and consumers. Some researchers (i.e. Sonnino and Marsden, 2005) have described the connections to local food in terms of alternative food networks (AFNs). For people in rural settings, these might be better called traditional food networks (TFNs). Despite the decreases in the productive capacity of land (Imhoff et al., 2004) and losses in terms of peri-urban agricultural production

⁴ Rebound effects are defined as indirect effects resulting from the changes in behaviour.

due to urbanization, these networks remain within reach of urban consumers, if they can be reconnected.

In Pollan (2006), Joel Salatin says that his is an enterprise of the information age. Described in great detail in his own book (Salatin, 2006), he is concerned both with managing his farm operation to maximize the health of the land and its long-term productivity and making connections to the community in which he lives. This paper is focused on a report of the efforts to use information technology in support of sustainable food choices, beginning from the perspective of enabling the connections between producers of food for local consumption and those who are interested in buying local. The rest of the paper is organized as follows. Section 2 provides a background to the research into sustainable food choices the opportunities for application of information technology. Section 3 describes the project undertaken at the University of Regina that is meant, amongst other things, to connect interested consumers to existing (alternative) food networks. Section 4 discusses what has been accomplished thus far and what opportunities exist for future work.

2. Sustainable Food Choices and Information Technology

Globalization means a wealth of food choices, but it can also have a negative impact on food safety, security, and sovereignty. How does a consumer decide amongst all these alternatives? Epistemic distance (Carolan, 2006) is important in setting priorities for consumers, but how can one effectively process all the variables? Waldfogel (2005) finds that consumer sovereignty is warranted in certain well-defined situations involving choices amongst familiar objects, but when people need to make intertemporal consumption choices (for example), “paternalistic interventions could improve their decisions.”

Before a consumer can choose a sustainable food item, the producer must be willing to produce sustainably. Carolan (2006) talks about the needs to make the benefits of sustainable agriculture more visible to farmers. To most, the benefits of sustainable agriculture are much less visible than those of conventional agriculture. Similarly, the costs of conventional agriculture are much less visible than those of sustainable agriculture. What sustainable farmers might call “wildflowers” or “biodiversity”, conventional farmers might call “weeds.” Increasing the scale of thinking, from a single farm to the entire watershed or foodshed helps to make the benefits of sustainable agriculture and the costs of conventional agriculture more visible. Labelling and “food miles” calculations are other ways the respective benefits and costs can be made more visible. Caution is required because of the limited perspective any one initiative can provide.

Consumer choices of food involve both intrinsic factors such as taste and extrinsic factors such as the retail environment, moderated by the demographics and status of the individual. Other, more abstract, factors such as *healthiness* and *humaneness of treatment* can also come into play. All of them help to frame the decision that must be made. People are finding that local food can meet their needs, either because of the properties which these foods are seen to possess or

because local foods present the opportunity to create a new relationship with their food based on reciprocity, trust, and shared values.

Duffy a (2005) reported on the need for reconnection as farming has become detached from the rest of the economy and the environment. Consumers who were surveyed, especially those less than 34 years of age, expressed little loyalty to locally-produced foods. Older and more affluent respondents were more interested in a range of issues related to food (though food safety and animal welfare had the interest of all respondents). Consumers surveyed felt that important messages about food would be communicated through television and other mass media outlets. Given the diverse set of interests within the food production industry, it is unlikely to find agreement about a message that would allow reconnection in a general way. Her conclusion is that communication of these important messages will be left to individual, under-resourced, fragments of the industry.

For Weatherell et al. (2003), a call in the United Kingdom to become more market-oriented and more proactive with respect to consumer demands must be met with an understanding of consumer preferences. Although the authors report that people are concerned about food issues, there is not a lot of tolerance for higher prices and the practical aspects of food choices – like freshness and appearance rated higher than more abstract ones like locality. Consumers must make tradeoffs in selecting food – this means decision support tools, but to ask people to give up on all the benefits that they readily perceive about supermarket food will not likely be successful. Ideally, the threshold for people to get involved with local food systems will be lowered, but their intuition (Rosson and Carroll, 2001) about food systems comes from the supermarket and this cannot be denied.

An opportunity to make sustainable practices more visible comes from food safety. “If an increase in free trade creates added risk of infection and disease, it is logical that food trade should have a strong national/regional limit. This is especially true for fresh products” (Nygård and Storstad, 1999). They found that the food products which most people considered to be unsafe were those products that were formerly produced in country. It could be that the defense against globalization and loss of sovereignty is social and political alliances between producers and consumers of local food. The relationship between food safety and origin is not necessarily based on facts, but rather goodwill and trust. In the absence of trust and direct relationships, traceability can be helpful (Wilson and Clarke, 1998) and it is becoming the regulatory norm.

Aside from food safety, food security is also an important issue since sustainable food choices must be available to be consumed. Wrigley (2002) describes the concept of food deserts as places within a city where no healthy food is available. These can be made clear by the mapping of access to healthy food as undertaken by Donkin et al. (1999).

Gareau (2004) also sees the potential benefits of using information technology to improve information sharing and ultimately positively affect the food security issues in a Mississippi county in the United States.

Holloway (2002) describes two efforts to make local food available on the internet. Epistemic distance is reduced, but in terms of sustainability, the physical distances cannot be overlooked. Yet, such websites may provide a connection to what is felt to have been lost, just as farmers' markets are for some an exercise in nostalgia (Holloway and Kneafsey, 2000). A more promising view of information technology and the internet is described in the next section, where the internet is used to connect people who are geographically close.

3. Local Food Project at the University of Regina

The local food project at the University of Regina began in late 2005 with a display at the Prairie Organic Workshop, held in Regina. That display was intended to start a discussion amongst stakeholders about how to provide consumers with web-based tools to find organic products that were grown or produced in Saskatchewan. After some initial meetings and conversations, a majordomo e-mail list service (lofo@cs.uregina.ca, lofo = local food) was started to facilitate discussions about possible future directions and funding for the project.

The first goal of the project was a directory of local food producers within the province of Saskatchewan. It was reasoned that if consumers could understand the variety of local food production within the province and had easy access to its suppliers, local food consumption would increase. Another goal of the project was to provide consumers with the means to compare the impact of their food choices. For example, if one was looking to buy beef, one should consider beef, and bison as a beef substitute, from all available sources and evaluate the relative impacts of each. Ideally such a tool would allow the consumer to express his or her own preferences that would affect the ultimate assessment of impact. These goals were consistent with the developing research agenda of the first two authors with respect to the development of personalized environmental decision support tools (Maciag, Hepting, and Slezak, 2005).

Although neither of these goals has been fully realized, the effort has now shifted to the development of a virtual community on the web at <http://lofo.uregina.ca>. This website officially opened in July of 2006. The rationale of the earlier efforts is embodied in this site. It began with the two goals of connecting consumers interested in local food with producers who were making it available and informing consumers about the economic, environmental, health, and social impacts of their choices. The idea of the website has been enthusiastically received, introduced to many by a postcard (see Figure 1). The community has been growing slowly. It now has 70 members: 62 consumers and 8 producers. People are asked to sign up an account on the site and then create a profile for themselves, identifying themselves and expressing interest for various locally-produced food items. The site began opportunistically as somewhat of a research-oriented development, but in hindsight it was the best place to start attracting involvement. Like those who seek a new relationship to their food, virtual communities present similar opportunities to their members (Kollock, 1999). There are some default choices made on the site that have been discouraging to those who would like to join, so a review of the website with respect to usability (Rosson and Carroll, 2001) is currently under way. The site is built with CivicSpace, an open source content management system (CMS) that is based on the the Drupal

CMS. Future versions will move to using Drupal instead of CivicSpace, as Drupal is the more active project.

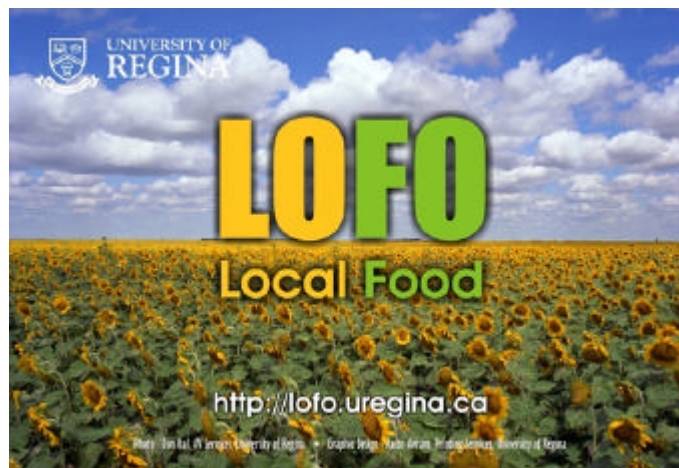


Figure 1. Postcard advertising the local food (LOFO) site. The sunflower field shown is just south of Regina, Saskatchewan.

Since its inception, two more goals have been added for the site after consultation with producers. A somewhat hidden motivation in this project has been to help local family farmers in their efforts to stay on the farm. It became clear that this effort alone may not provide enough immediate relief to allow anyone to stay on the farm. However, the community could facilitate the larger discussions about the necessary policy changes to foster farm stability. Therefore, the community will help to make local food production viable for producers and accessible to consumers. Some producers have said that they are supportive of the site but that they have enough customers and would have no use for using the site. This reaction is understandable but it does nothing to expose and grow the existing (traditional) food networks in the province. Therefore, the community will serve as a platform from which citizens can indicate their support for local, sustainable food. Knowing that producers with customers exist facilitates many more opportunities for growth.

Research (Koh et al., 2007) points to four items that determine the level of participation in a virtual community.

- leader involvement
- offline interaction
- usefulness
- quality technical infrastructure

The authors have provided leadership to the virtual community throughout its existence. In hindsight, it may have been an error to maintain the mailing list and the website, since it did not encourage people to move completely to the website. Nearly a year after its launch, not everyone on the mailing list has signed up on the website. Upon completion of the site review and redesign, the mailing list, as a separate entity from the website, will be discontinued. People presently on the mailing list will be invited to move onto the website, with as little effort as possible.

Early on in the project, many stakeholders were represented in person or by phone in a teleconference. At various times during the year, members of the stakeholders group have met in person on numerous occasions. Certainly there could be more opportunities to interact offline and these will be developed over time. One possible community member has said that he “would join if there were more activity on the site,” but there is little activity on the site because there are few members. The authors are exploring the use of community college non-credit extension courses as a way to get producers interested in the site and the possibilities that may exist for them with an internet presence.

The potential usefulness of the site is high, but it will only increase with more community members. Finding sources for local food is a demanding task that requires a lot of patience. Many of the producers may be happiest to interact in person or over the phone and it is difficult to transfer knowledge of the existing rich food networks onto the much less personal website. Over time, the usefulness of the community will increase. The question that will have to be left to future research is how to maximize a member’s benefit to him or herself and to the community while minimizing ancillary tasks that are needed to support those benefits. Presently, in addition to the website and mailing list already discussed, there are several e-mail lists that carry relevant information and several organizations that do similar work in this arena – but each of them is slightly different: “local” versus “organic” for example. The issues that Weatherell et al. (2003) identified are also relevant here.

The hardware infrastructure provided by Information Services at the University of Regina has been very good, but the configuration of the CMS software has provided some challenges. One hopes that no temporary issues ever stopped someone from participating.

4. Discussion and Future work

There is a large body of research dealing with consumer attitudes towards and selection of sustainable foods. Much of this research is done without direct consideration of the internet, except in the case of Holloway (2002). There is a great deal of potential in considering how to use the internet to present information in a way that becomes easily actionable. The tendency is to splinter and the challenge is how to keep everything together. This larger community must be addressed in some way. To get a model of an umbrella organization that can exist on the web and handle communication is also worthwhile. To move from a sense of “no wrong answers” to an accessible methodology for quantifying the relative sustainability of different food choices is

important. This information can be developed through the development and use of comprehensive computer models.

The internet, with open source software, can be used to improve the convenience of sustainable food choices, for producers and consumers by creating online clearinghouses for food items that facilitate both business to business and business to consumer transactions. Low-cost efforts to enable traceability of products will also improve the consumer's trust in producers and ease the adoption of these alternative food networks. No matter how successful local food initiatives may become, not everyone involved will develop personal relationships with one another. Therefore, as supply chains lengthen, it is important to balance local with convenience and security.

There is also the opportunity to use information technology to lower the threshold for participation in sustainable agriculture for producers and provide support for the strategic management decisions necessary in the farm's operation.

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References

- Bannatyne-Cugnet, J. and Moore, Y., *A Prairie Alphabet*, Tundra Books, March 1994.
- Born, B. and Purcell, M., Avoiding the Local Trap: Scale and Food Systems in Planning Research, *Journal of Planning Education and Research*, Volume 26, 2006, pp. 195-207.
- Carolan, M. S., Do You See What I See? Examining the Epistemic Barriers to Sustainable Agriculture, *Rural Sociology*, Volume 71, Number 2, 2006, pp. 232-260.
- Cloud, J., Eating Better Than Organic, *TIME Magazine*, Time Inc., March 2, 2007.
<http://www.time.com/time/magazine/article/0,9171,1595245-1,00.html>
- Cohen, M. J., Sustainable Consumption Research as Democratic Expertise, *Journal of Consumer Policy*, Springer Verlag, Volume 29, 2006, pp. 67-77.

- Cohen, M. J. et al., The new politics of consumption: promoting sustainability in the American marketplace, *Sustainability: Science, Practice, & Policy* | <http://ejournal.nbio.org>, Volume 1, Number 1, 2005, pp 58-76.
- Donkin, A. J. M. et al., Mapping access to food at a local level, *British Food Journal*, Volume 101, Number 7, 1999, pp. 554-564.
- Duchin, F., Sustainable Consumption of Food: A Framework for Analyzing Scenarios about Changes in Diets, *Journal of Industrial Ecology*, MIT Press, Volume 9, Number 1-2, 2005, pp. 99-114.
- Duffy, R., Reconnection in the UK food chain: Bridging the communication gap between food producers and consumers, *British Food Journal*, Volume 107, Number 1, 2005, pp. 17-33.
- Faist, M. et al., The impact of household food consumption on resource and energy management, *International Journal of Environment and Pollution*, Volume 15, Number 2, 2001, pp. 181-199.
- Gareau, S. E., The development of guidelines for implementing information technology to promote food security, *Agriculture and Human Values*, Volume 21, 2004, pp. 273-285.
- Guthman, J., The trouble with 'organic lite' in California: a rejoinder to the 'conventionalisation' debate, *Sociologia Ruralis*, Volume 44, Number 3, 2004, pp. 3-16.
- Holloway, L. Virtual vegetables and adopted sheep: ethical relation, authenticity, and Internet-mediated food production technologies, *Area*, Volume 34, Number 1, 2002, pp. 70-81.
- Holloway, L. and Kneafsey, M., Reading the Space of the Farmers' Market: A Preliminary Investigation from the UK, *Sociologia Ruralis*, Volume 40, Number 3, 2000, pp. 285-299.
- Imhoff, M. L. et al., The consequences of urban land transformation on net primary productivity in the United States, *Remote Sensing of Environment*, Volume 89, 2004, pp. 434-443.
- Koh, J., et al., Encouraging Participation in Virtual Communities, *Communications of the ACM*, Volume 50, Number 2, February 2007, pp. 69-73.
- Kollock, P., The Economies of Online Cooperation: Gifts and Public Goods in Cyberspace, in *Communities in Cyberspace*, M. Smith and P. Kollock (editors), Routledge: London, 1999.

- Lyson, T. A. and Guptill, A., Commodity Agriculture, Civic Agriculture, and the Future of U. S. Farming, *Rural Sociology*, Volume 69, Number 3, 2004, pp. 370-385.
- Maciag, T. J., Hepting, D. H. and Slezak, D., Personalizing User Interfaces for Environmental Decision Support Systems, *Proceedings of the International Workshop on Rough Sets and Soft Computing in Intelligent Agent and Web Technologies*, edited by D. Slezak, E. Menasalvas-Ruiz, C.-J. Liao, and M. Szczuka, pages 49–55, 2005.
- McDonough W. and Braungart M., *Design for the Triple Top Line: New Tools for Sustainable Commerce*, Corporate Environmental Strategy, Volume 9, Number 3, August 2002, pp. 251-258.
- Morris, C. and Buller, H., The local food sector: A preliminary assessment of its form and impact in Gloucestershire, *British Food Journal*, Volume 106, Number 8, 2003, pp. 559-566.
- Navarro, M., How Can Agricultural and Extension Educators Contribute to a Successful New Green Revolution?, *Journal of Agricultural Education and Extension*, Volume 12, Number 2, 2006, pp. 83-96.
- Nygård, B. and Storstad, O., De-globalization of Food Markets? Consumer Perceptions of Safe Food: The Case of Norway, *Sociologia Ruralis*, Volume 38, Number 1, 1998, pp. 35-53.
- Pretty, J. N., et al., Farm costs and food miles: An assessment of the full cost of the UK weekly food basket, *Food Policy*, Volume 30, 2005, pp. 1–19.
- Rosson, M. B. and Carroll, J. M., *Usability engineering: scenario-based development of human-computer interaction*, Morgan Kaufmann Series In Interactive Technologies, 2001.
- Salatin, J., *Holy Cows And Hog Heaven: The Food Buyer's Guide To Farm Friendly Food*, Chelsea Green Publishing, 2004
- Savory, A., Butterfield, J., and Butterfield, J., *Holistic Management: A New Framework for Decision Making*, Island Press, 1998.
- Sonnino, R. and Marsden, T., Beyond the divide: rethinking relationships between alternative and conventional food networks in Europe, *Journal of Economic Geography*, Volume 6, 2006, pp. 181-199.

- Stolle, D. et al., Politics in the Supermarket: Policitical Consumerism as a Form of Political Participation, *International Political Science Review*, Volume 26, Number 3, 2005, pp. 245-269.
- Waldfogel, J., Does Consumer Irrationality Trump Consumer Sovereignty?, *Review of Economics and Statistics*, Volume 87, Number 4, November 2005, pp. 691-696.
- Weatherell, C. et al., In search of the concerned consumer: UK public perceptions of food, farming, and buying local, *Journal of Rural Studies*, Volume 19, 2003, pp. 233-244.
- Wrigley, N., 'Food Deserts' in British Cities: Policy Context and Research Priorities, *Urban Studies*, Volume 39, Number 11, 2002, pp. 209-240.
- Wilson, T. P. and Clarke, W. R., Food safety and traceability in the agricultural supply chain: using the Internet to deliver traceability, *Supply Chain Management: An International Journal*, Volume 3, Number 3, September 1998, pp. 127-133.