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# A Geospatial Web Application to Map Observations and Opinions in Environmental Planning

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# A geospatial Web application to map observations and opinions in environmental planning

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ABSTRACT: The geospatial Web enables virtually everyone to contribute to the growing collection of geographically referenced information on the World-Wide Web. In this chapter, we present a Google Maps-based tool that enables Web users to contribute two types of information: annotations and their reference locations. We further differentiate annotations into observations and opinions regarding specific places. The potential of this approach for integrating local knowledge into environmental planning was assessed by conducting an online map-based discussion of organic farming among expert stakeholders in the Kawarthas area in Central Ontario, Canada. The discussion contents shed light on the participants' perceptions of the organic food market. Moreover, the experiment demonstrated how a map-based discussion forum can be useful for obtaining public input on planning and policy issues.

## 1 INTRODUCTION

Web 2.0 technology enables virtually everyone to contribute to the growing information base of the World-Wide Web. Since only a few years, mapping platforms such as Google Maps have enabled citizens to share their geographically referenced information and create an abundant geospatial Web, or GeoWeb (Lake et al., 2004; Haklay et al., 2008). Although the professional applications of this technology are still sparse, it could provide a means to engage stakeholders and the public in societal issues such as climate change adaptation and response (Sieber, 2007).

For the most part, recent GeoWeb advancements were made possible by new technologies and products available to both users and developers. In particular, Web mapping services such as Microsoft Live Maps, Yahoo Maps, and Google Maps have provided a reliable foundation for building GeoWeb applications. These services provide a transparent and interactive user interface with preloaded maps in combination with open application programming interfaces (APIs) and data formats, enabling the upload of user-generated, geographically referenced content.

GeoWeb and Web 2.0 technologies have mutually contributed to each other's progress by making it possible to create geographic "mashups", i.e. Web applications combining two or more data sources to provide a transparent service to end-users. Geographic mashups have put location-based information and services at the centre of media attention (e.g. Black, 2009) and contributed significantly to engaging the public in the opportunities of the Web 2.0.

In spite of its progress, the GeoWeb still lags behind in terms of primary characteristics of the Web 2.0, such as communication and collaboration. Geographic mashups are mostly limited to merging and displaying geographic data with little evidence of user-generated content that would support spatial analysis and geocollaboration. A notable exception is presented by Roth et al. (2008). It can be expected that improvements in related Geomatics technologies will soon broaden the scope of serious GeoWeb applications. Open-source GIS tools have become much more powerful and easier to use, which eliminates the significant cost of access to commercial

GIS programs. GPS and other positioning techniques have also become more popular as a component of mobile devices, making it much easier to generate geographically referenced data during daily activities.

A major problem that once faced GIS developers was the lack of geographic databases. Fortunately, many relational databases systems now have added support for geospatial data. For instance, PostgreSQL, MySQL, Oracle, and Microsoft SQL Server all have introduced spatial extensions that allow developers to work with spatial data natively and support spatial queries.

All the aforementioned advancements have made it possible to develop sophisticated geographic applications more efficiently. Such applications could, in turn, support end-users to shift from content consumers to content producers, and by doing so, close the gap between GeoWeb applications and the rest of the Web 2.0.

This chapter is organised into six sections. Section 2 provides a summary of research on map-based communication and deliberation within Geomatics and reviews public participation in environmental planning. In Section 3, we describe the architecture and current development stage of the Argoomap tool. This tool was used in the case study of organic farming in the Kawarthas, detailed in Section 4. The discussion of results in Section 5 is followed by conclusions and an outlook on future research in Section 6.

## 2  RESEARCH BACKGROUND

### 2.1  *Map-Based Communication and Deliberation*

Argumentation mapping (Rinner, 1999, 2001) combines online discussion forums with online mapping to encourage discussion participants to provide explicit geographic references for their contributions. Such references will enable map-based access to read the current state of a discussion as well as more advanced spatial queries and analyses of discussion contributions, such as finding contributions that refer to a specific area or finding all authors of any replies to contributions within a specific distance from a given location. The general goal of using argumentation maps is to facilitate communication and deliberation in spatial decision-making, as it occurs in many planning procedures.

In a series of case studies, the usability and usefulness of argumentation mapping for geocollaboration, public participation, and community engagement was assessed. Using the first-generation "Argumap" tool, Sidlar and Rinner (2007, 2009) developed simple metrics for geographically referenced participation, and Rinner and Bird (2009) conducted a contents analysis of map-based discussion messages. Using the re-developed "Argoomap" tool, Rinner et al. (2008) analyzed the geospatial relations between reference locations of arguments. Across these case studies, the researchers encountered large variations in the levels of participation and engagement, depending on the type of participants (student volunteers vs. general public) and timing of the user tests (during academic term vs. summer vacation time). Participants provided extensive feedback on different versions of argumentation mapping tools that were subsequently modified, in particular to offer a simplified user interface that mimics widely used online mapping tools such as Google Maps. Other tools that focus on mapping opinions and comments include MapChat (Hall and Leahy, 2008) and Discourse Maps (Verrutes et al., under review). The name "MapChat" was also used for a prototype tool for collaborative event planning that combines social networking applications with online mapping (Churchill et al., 2008).

In recent years, the emergence of the Web 2.0 and user-friendly online mapping techniques has created public interest in contributing information through Web-enabled geospatial tools ("volunteered geographic information", Goodchild, 2007). This trend has allowed researchers to instill public participation in planning processes (Seeger, 2008). For example, the publicly available Google Maps API has been used by researchers to develop public  participation tools for gathering location-specific information for land-use planning (Mueller et al., 2008), emergency planning (Tanasescu et al., 2006), and urban planning (Rinner et al., 2008).

When exploring Web 2.0 and GeoWeb applications, different types of user input can be distinguished. In many instances, users are enabled to upload stand-alone media (e.g. text, photographs, or videos), while in other cases, users contribute observations or opinions in response to existing information, or are invited to rate existing information or vote upon a given question.

With reference to Simon's (1965, 1977) framework for rational decision-making, Table 1 attempts to structure types of user contributions to different phases of decision-making. In the exploratory intelligence phase, field *observations* from users may inform the search for conditions that call for a formal decision-making process. In that case, a design phase would follow, during which users could propose alternative solutions to the decision problem in the form of comprehensive *contents*. In the subsequent choice phase, user *opinions* responding to, and expressing a preference among, the proposed solutions would be gathered and considered in choosing an alternative. Finally, if a review of a past decision occurs, evaluative *comments* would assist with assessing the success or failure of the chosen solution.

Table 1. Decision-making phases (Simon, 1965*, 1977**; Sabherwal and Grover, 2007+) and types of user contributions on the GeoWeb.

| Phase | Explanation[+] | Type of contribution | Example |
|---|---|---|---|
| Intelligence* | "The environment is searched for conditions calling for decisions" | Observations | Field observations of invasive species indicating possible need for protective action |
| Design* | "Possible courses of action are invented, developed, and analyzed" | Contents | Ideas, suggestions, and proposals on how to protect native species |
| Choice* | "An alternative course of action is selected" | Opinions | Argumentation and voting to support, or object to, specific conservation policies |
| Review** | "... assessing past choices" | Comments | Evaluation of conservation success through re-iteration of intelligence, and possibly other phases of decision-making |

## 2.2  *Participation in Environmental Planning*

Environmental planning requires the integration and synthesis of scattered information from numerous sources and coupling of this information for problem solving and decision-making (Fedra, 1993; Elmes et al., 2004). The emphasis is on increasing the use of local geospatial knowledge through local stakeholders' participation (Steinmann et al., 2006). Ensuring public (or stakeholder) participation in the environmental decision-making process is advantageous to both planning officials and stakeholders.  This is because any issue of local importance can be resolved at an early stage of planning and a better decision can be made. Furthermore, stakeholders' indigenous knowledge aids planners in interpreting local environmental and social data.

While stakeholder participation is important for the success of participatory decision-making, various conventional methods of public participation such as meetings or workshops have been found to be ineffective in addressing the needs of  stakeholders, because participation in such cases are affected by space-time constraints, and bureaucratic procedures (Carver et al., 2001). Parallel advancements in GIS technology, the Internet and the World Wide Web (WWW) have improved the possibilities for supporting public participation through "e-Participation" (Kearns and Bend, 2002; Macintosh, 2004; Hansen and Reinau, 2006) or asynchronous distributed discussions (Beaudin, 1999; Rinner, 2001, 2006). To date, a variety of Web-based GIS having various levels of technological sophistication have been used for environmental planning and participatory decision-making process (Kingston et al., 2000; Lee et al., 2000; Cetin and Dieker, 2003; Brown, 2007). Web-based participatory GIS (PGIS) is becoming a promising approach to incorporate local knowledge in spatial decision-making processes (Craig et al., 2002). The objective of PGIS is to integrate spatial technologies with stakeholder and expert knowledge for collective decision-making and problem solving.

The main challenge in  developing an efficient PGIS, however, is that local spatial knowledge is often narrative, qualitative, and contradictory, hence, its incorporation in a GIS is often very difficult (Elwood, 2006;  Elmes et al., 2004). To address this issue, attempts have been made by some researchers to make use of freely available and popular online map services (e.g., Google Maps) to integrate geographically-referenced discussion forums (i.e., qualitative data) and GIS components (Tanasescu et al., 2006; Mueller et al., 2008; Rinner et al., 2008).

Other challenges faced by Web-based PGIS concern the "digital divide" (Peng, 2001) and public understanding of spatial decision problems (Kingston, 2000; Carver, 2001). Addressing these challenges is an important step for the success of a PGIS as an efficient decision support tool. The challenges related to technological skills of the stakeholders lead to the need for more research regarding the improvement of the usability of existing PGIS by making it simple to use on one hand, and an efficient data collection, distribution, and display platform, on the other.

## 3   A GEOWEB-BASED DISCUSSION FORUM

The Argoomap tool (Rinner et al., 2008) consists of three major software components: the server-side database and application logic, and the client interface. On the server side, the MySQL database is used for storing and retrieving data (including locations, discussion structure and contents, and user data). The PHP programming language was used for data processing on the server and providing the client functionality. The MySQL database and PHP language are two popular choices for today's Web developers for a variety of reasons; they are both open source and therefore are of lower cost, in addition to having large active developer communities, which contribute to the support and documentation of these tools. On the client side, the Google Maps API is used to provide the core mapping functionality. The choice of the Google Maps API for geographic functionality was also driven by the same factors. Although Yahoo and Microsoft provide similar APIs, the Google Maps API was considered the most popular choice for Web-based mapping development.

Since the Google Maps API is a critical component of the Argoomap tool, it will be helpful to include a brief description of its architecture. The API provides a great way for programmers to build Web mapping application on top of Google Maps. It provides "objects" that developers can use and customize in their Web applications. These objects can be categorized and described, as shown in Table 2.

Table 2: Google Maps API object categories (Google, 2009) and their description.

| Object category | Description |
|---|---|
| Core and base objects, such as GMap, GLatLng, and GLatLngBox | These objects provide the core functionality for Google Maps. GMap is the primary object that defines the map presented to the user. GLatLng and GLatLngBox are used to represent points or rectangles of geographic locations. |
| Map Controls objects | These are the objects that can be added to GMap to support switching between map types (street map, satellite view, hybrid) and navigating the map through zooming and panning. The controls are customizable allowing developers to modify their appearance and behaviour. |
| Overlay objects, such as GMarker, GPolyline, and GPolygon | These objects are used to add geographically referenced data to the map, to create a mashup. Point features are represented by GMarker, lines by GPolyline, and areas by GPolygon. |
| Events | Events are what makes Google Maps application interactive, enabling the map to respond to user actions using the mouse or keyboard. Developers can define GEventListeners for different events and define what action to initiate. Events can be defined on any object that exists in the application, such as map controls, markers, or any other object that could be interacted with. |
| Services | These objects provide other functionalities that do not fall within the previous categories, including helpers to parse data, (reverse) geocoding, traffic overlays, KML and GeoRSS overlays, directions, Google Earth integration, etc. This category is being updated regularly, adding new features and services to facilitate geographic operations. |

The Argoomap tool makes use of all Google Maps API object categories. In addition to core and map control objects, Argoomap uses GMarker overlay to display referenced locations on the map and GInfowindow overlay to display the discussion contents of each marker. Interaction with users has been accomplished by using GEvents that respond to different actions based on the application's current state. Argoomap also utilizes parsing services to retrieve information from its database and display the initial state of the map-based discussion.

Figure 1 illustrates various states of Argoomap application. The initial view of Argoomap provides users with a full screen map that contains markers indicating the locations that have already been provided by users (Fig.1, main area). A click on any of the existing markers opens a window containing all the discussion threads that reference that geographic location (Fig.1(a)). Clicking on any of the discussion threads will open the post body and highlights all the markers referenced by this post (Fig.1(b)). Users can then reply to the post, which, by default, will include all the currently highlighted markers, but they also have the option to add other references or remove existing references from their reply (Fig.1(c)). Another way to add a new contribution is to click on an empty area of the map to create a new thread with one or more reference markers.
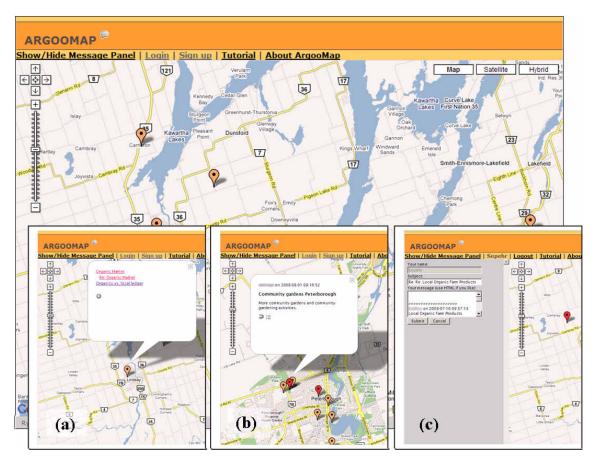


Figure 1. Various states of the Argoomap tool: initial view (background); (a) list of all messages referencing a selected marker; (b) display of a single discussion message and its highlighted reference markers; and (c) input form for replying to an existing discussion message.

The previous version of the Argoomap tool has gone through major improvements for this project. An important enhancement was the introduction of user management. This feature also grants the ability to restrict user access to different actions, if desired. There are currently five levels defined: no login required; login required for creating a new discussion thread; login required for replying to other posts; login required for reading the posts; and finally, login required for viewing the map. The administrator of the Web application has the ability to change this level in a configuration file. If any access restrictions are enforced, users will be prompted to login or register upon initiating a corresponding action.

Another improvement was the implementation of a side panel for the discussion forum, which makes browsing the existing posts easier. The side panel offers three alternative views, as shown in Fig.2: a thread view, which displays a tree structure of the discussion (Fig.2(a)); a user-based view, which groups each user's posts together (Fig.2(b)); and finally, a date view, which sorts the posts based on their submission date (Fig.2(c)). The main objective of this feature was to improve the usability for end users allowing them to access the discussion easily and effectively.
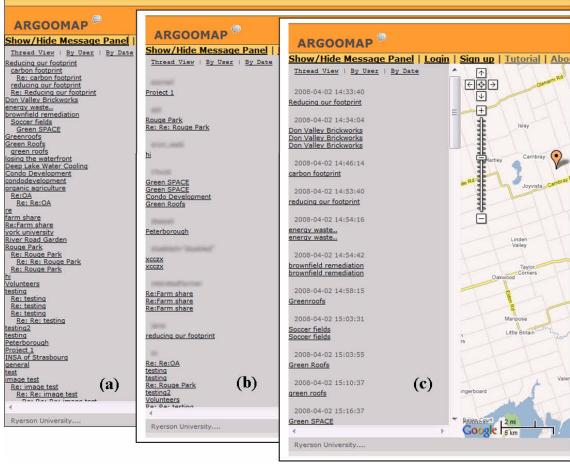
Figure 2. Alternative views of the side panel: (a) thread-structured view; (b) view sorted by user; and (c) view sorted by date of submission.

## 4   CASE STUDY OF ORGANIC FARMING IN THE KAWARTHAS

### 4.1   *Outline of methodology*

A study was conducted to evaluate the usability of the Argoomap tool as a Web-based GIS, as well as its effectiveness in community engagement. Such a topic was chosen wherein the local-knowledge levels of the stakeholders greatly vary and the issues that could be discussed are multi-faceted. This would aid in inferring usability and prospects of Argoomap as a Web-GIS planning tool for various other issues. Because organic food production is a rapidly growing field for entrepreneurship, it was chosen as the topic of discussion to gather the stakeholders' and experts' local knowledge. The study was conducted in the Kawarthas (Kawartha Lakes and Peterborough region), an important agricultural belt of Ontario. This study was carried out in collaboration with the Kawartha Heritage Conservancy (KHC), a non-profit organization based in Peterborough, Canada. The KHC has a Farmlands program where they work with farmers and local organizations to support innovative agriculture practices and promote the sale of organic and locally grown food.

   The Argoomap tool was used to engage stakeholders in a discussion of the problems and prospects of organic farming. A selected group of stakeholders was invited to participate in a discussion related to the prospects and problems of organic farming in the Kawarthas. Potential participants were identified and selected after a thorough internet search of websites related to organic farming in Kawartha and Peterborough. Approximately 70 email requests for participation were sent based on the review of farmers' forums and social networking sites, non-

governmental organizations in agriculture, related government organizations, and universities. Twelve individuals registered to participate in the study.

The discussion phase started on July 7, 2008 for a period of one week. The link to Argoomap was activated and the discussion during this period was monitored by the researcher. One starter thread (message) entitled "What are the problems and prospects of organic farming in Kawartha and Peterborough region" was posted by the researcher to facilitate the discussion. A reminder E-mail was sent to all the participants on July 10, 2008 to encourage more contributions. Another E-mail was sent on July 14, 2008 to inform the participants about an extension of the discussion period by one more week. Although increased participation was anticipated, the majority of the messages were posted in the first week and a more engaged discussion could not be obtained even after extending the time for discussion for one more week. During the course of the discussion, the researcher posted a reply to a discussion thread posted by a participant to demonstrate the use of the "reply" function of Argoomap and to encourage the participants to respond to the comments posted by others. The discussion was officially closed on July 21. However, on July 22, two discussion threads were submitted by a participant and these contributions were included in the data analysis.

Information from the Web server log file and questionnaire-based survey was used to assess the usability of the Argoomap. The data from Web server log file that were used for analysis included the number of times the participants accessed the tool, the time of the day during which the participants accessed the tool, the number of times the participants started a discussion thread or replied to a message, and the amount of time spent on the Argoomap page. The contents of contributions by participants were used to subjectively assess the quality of the discussion in understanding the role of Argoomap in engaging community through a common forum.

### 4.2  *Case study results*

During the two-week discussion period, Argoomap was accessed 24 times by the twelve participants. The chronology of contributions is shown in Figure 3. It should be noted that there was no contribution on the first two days (July 7 and July 8, 2008). On the third day (July 9, 2008), five messages were contributed by three participants. However, neither the reminder email nor the message confirming an extension of the discussion period generated significant input. Instead, the discussion tapered off after its fifth day.
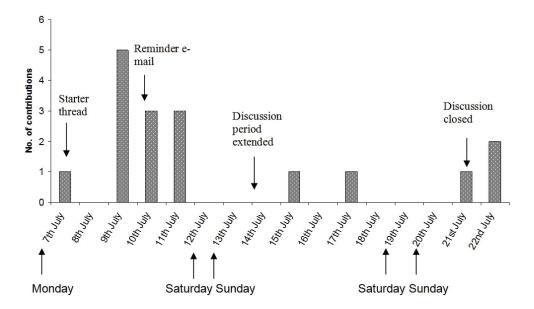


Figure 3. Chronology of contributions made by the participants

**Organic Farming** What are the problems and prospects of organic farming in Kawartha and Peterborough? [starter thread by researcher]

**Importance of local production** I think the first major issue to promote organic farming is to reduce the import \""cheaper\"" organic produce from countries and sell it at cheaper rates. This way, the farmers here are not encouraged to do organic farming. They concentrate on field crops like wheat and corn which have higher market, especially due to the recent oil price boom"

    Re: Importance of local production "Pick Ontario Freshness" marketing campaign by Ontario govt. is a good step to show support for farmers producing Local Food. [reply from researcher]

        Re: Re: Importance of local production   Probably in the current context of oil price hike, things may change

**Need for a new By-law** Ontario govt should create new by-laws to set a minimum level of food stocked by Ontario\'s grocery chains so that local produce have higher demands.

**Organic at the Peterborough Farmers** Market   There is a very limited amount of certified organic produce for sale at this market. This is disappointing since I would certainly purchase local grown organic produce if it was available. I currently have to get my organic produce from the larger supermarkets in town. I am not sure if these supermarkets buy from local organic farmers. On the other hand, this market does have vendors that sell good certified organic local meat products (beef, chicken and pork). The prices are relatively reasonable compared to non-organic products available. My family stocks up once a month on these meat products."

**Organic in Peterborough area** For fresh vegetables in season, you can also try By the Bushel delivery service. Not certified though farmer vendors are carefully selected. [reply through a new discussion thread]

    Re: organic in Peterborough area I think the govt should invest more money into advertising organic food. This can be easily done at public places such as public transportation facilities etc. In Toronto TTC trains one can see many forms of advertisements regarding health, education etc. Why not organic food?

**Local Organic Farm Products** Several local farms have started selling direct to consumers from their properties. These include those who are certified organic. Kawartha Choice marketing, promoting locally grown food, has a website that lists farmgate sales farms and these say whether they are organic or not.

    Re: Local Organic Farm Products  This is a great way of promoting of a website like this will help in reducing the time delays in getting certification, I think Current Issues? What do you think in your opinion are the barriers that discourage farmers to grow organic in your area?

**Issues are not only \"Organic\" but general agricultural issues too**   We should understand that organic farming is a subset of general agricultural practice or occupation. Therefore, one needs to think about the current agricultural issues too.<br>For example, the Ontario Govt\'s farmland Preservation plan prevents the farmers from selling their lands even though they get attractive prices from buyers. This I think should be made less stringent. Land is one of the \"assets\" of a farmer and in times of need, because of this by-law, a farmer cannot meet his urgent financial needs. This makes him remain in the vicious cycle only relying on crop profits to meet his financial needs. These types of stringent laws drastically reduces the entrepreneurship and the risk taking ability of of the framing community preventing a farmer from venturing into new activities like organic farming.

**Organic Food Consumption** .The organic food consumption pattern has been changed in Ontario.

**Organic farming in Ottawa**   We encourage farmers to grow organic produce by setting up farmers market right in the downtown Ottawa. I think farmers get good returns for their produce and encourage them to grow organic.

**Organics vs. local ledger**   What are the metrix to value local factory farmed chicken vs. organic chicken from NY?.

**Community gardens** Urban agriculture should be a major priority for city planners. There are many gardens around the city of Toronto such as garden of friends located here.

**Community gardens**   Various garden spots.

*A new discussion thread is identified by* **bold** *text, whereas others are replies.*

Box 1: Original contributions to the discussion.

The discussion was focused on the organic food market and local organic food production. In addition, some participants contributed opinions about agriculture in Ontario in general. Topics such as Ontario's farmland preservation, organic food consumption, prospects of urban agriculture and community gardening appeared in the discussions. Box 1 documents the participants' original messages contributed during the discussion phase.

The performance of the Argoomap was evaluated using a questionnaire survey. The survey consisted of three parts:

- Participants' skills in using a GIS and the Internet
- Understanding of the discussion topic by participants
- Ease with which various functions in the Argoomap could be used

Seven out of twelve registered participants gave their feedback by completing the questionnaire survey form, and two participants provided descriptive feedback through E-mail. The survey results from the seven participants are shown in Table 3. Five participants had a good GIS background. All participants were familiar with Web-based discussion forums. Five participants agreed that their familiarity with Google Maps was helpful in becoming familiar with the Argoomap, whereas one disagreed. Another participant did not comment on this question. Five respondents had a general understanding of organic farming and felt comfortable posting comments on the Argoomap. They agreed that the discussion topic was relevant to the current environmental issues, yet disagreed that their interest in organic farming increased by participating in this study. Only one participant agreed that the Argoomap is an effective platform for remotely gathering opinions whereas the other six did not provide any response.

Table 3. Participants' computer skills and understanding of the topic

| Participants' computer and Internet skills | Strongly Agree | Agree | Dis-agree | Strongly Disagree | No Comment |
|---|---|---|---|---|---|
| I have a good GIS background | 3 | 2 | 2 | - | - |
| I have good Internet skills and I am familiar with Web-based discussion forums | 6 | 1 | - | - | - |
| I am familiar with Google Maps and hence, it was easy to learn and use the Argoomap | 2 | 3 | 1 | - | 1 |
| **Understanding of the discussion topic** | **Strongly Agree** | **Agree** | **Dis-agree** | **Strongly Disagree** | **No Comment** |
| I have a understanding of the organic agriculture issue | 2 | 3 | 1 | - | 1 |
| I felt comfortable giving my opinions by posting comments | 1 | 4 | 1 | - | 1 |
| The discussion was relevant to the current environmental issues | - | 5 | - | - | 2 |
| My interest in organic agriculture increased by participating in this study | - | - | 5 | - | 2 |
| The Argoomap is an effective platform for remotely gathering opinions. | - | 1 | - | - | 6 |

The ease of use of the Argoomap was evaluated with respect to various functions of the tool. The results of this evaluation are shown in Table 4. In general, the participants found the Argoomap interface menu easy to understand. Only one participant found it "somewhat difficult". Except for one participant, the respondents found the functions such as registration, creation of user names and log-in names either "very easy" (4) or "easy" (2).

Map navigation through the zoom and pan tools did not pose any problems and, in general, was found to be "easy" by four participants and "very easy" by three of the participants. Reading the discussion threads was "somewhat difficult" for two of the participants whereas the remaining five found it either "easy" (3) or "very easy" (2). Only three participants found replying to a discussion thread "easy" while two found it "somewhat difficult". The other two did not use this function at all.

The ease with which one is able to start a new discussion in the Argoomap got similar response to that of replying to a message. Four participants found it "easy" to start a new thread

whereas two found it "somewhat difficult" and the other two participants did not use this function at all. It was interesting to find that five of participants did not face any difficulty in learning to use the Argoomap. Four participants reported it to be "easy" whereas one found it "very easy". The other two participants found the learning experience "somewhat difficult". The instructions on how to use the Argoomap provided through the tutorial were considered to be "very easy" to understand by one of the participants whereas it was "easy" for three of the participants. Of the remaining three participants, two found it somewhat difficult whereas one did not use the tutorial at all.

The participants encountered problems with switching between the task and the tutorial windows. Because the tutorial window opens in the same window-frame as the task, it was reported to be "very difficult" to use by two of the participants and "difficult" for one participant. Only one person found this option "easy". The overall reaction of the evaluators regarding Argoomap's efficacy as a Web-GIS tool were "good" (by four participants) and "satisfactory" (three participants).

Table 4. Subjective ease of using various functions of the Argoomap tool.

| Functions | Very easy | Easy | Somewhat difficult | Difficult | Very difficult | Did not use the function |
|---|---|---|---|---|---|---|
| Reading/understanding menu on the Argoomap interface | 2 | 4 | 1 | - | - | - |
| Creation of a username and login | 4 | 2 | - | - | 1 | - |
| Map navigation: Zooming and pan (moving around the map) | 3 | 4 | - | - | - | - |
| Ease of reading various discussion threads | 2 | 3 | 2 | - | - | - |
| Reply to a discussion thread | - | 3 | 2 | - | - | 2 |
| Starting a new discussion thread | - | 4 | 1 | - | - | 2 |
| Learning to use the Argoomap | 1 | 4 | 2 | - | - | - |
| Understanding the Argoomap tutorial | 1 | 3 | 2 | - | - | 1 |
| Ease with which one can switch between a task and the tutorial? | - | 1 | - | 1 | 2 | 3 |

## 5 DISCUSSION

The nature of the contributions during the discussion phase (Box 1) implied that the participants had a general understanding of organic farming and were interested in exploring organic food market issues. The discussion was focused on topics such as availability of organic produce, locally grown food, "buy local" vs. "buy organic" concepts, farm gate sales, and popularization of organic food market. All these topics are some of the ongoing issues in the global food market. Many consumers view buying local (through farmers markets or community-supported agriculture) as a promising alternative to an unsustainable global food production system that has adverse effects on the environment and local economy.

In this discussion, it was interesting to note that the participants raised the topic of "local vs. organic" farm products by asking how to "value local factory farmed chicken vs. organic chicken from NY". Understanding the difference between locally grown produce (conventional farming using fertilizer and pesticides), local organic produce (organic farming method with no synthetic fertilizer and pesticides), and imported organic food is important for consumers because consumers get confused with the concept of "buy local" vs. "buy organic". The concept of "buy local" is to invest in the local food economy and food grown by local farmers. Local food, generally sold through farmers markets and community-supported agriculture has the advantage of being fresh (LaSalle, 2008). However, local does not necessarily reduce the environmental impacts of fertilizers and pesticides unless it is organic. On the other hand, imported organic produce is criticized for its high food miles (fossil fuel consumption through long distance transportation) and carbon footprint (through processing and packaging). Thus, in the absence of locally grown organic produce, consumers are left with a difficult choice.

The issue of "Organic in Peterborough area" was mentioned by one of the participants who, even though interested in locally grown organic produce, had to buy imported organic produce from supermarkets. This suggests the need for encouraging local farmers to adopt organic methods of farming to meet consumer demand. The participants also discussed the regional availability of community food co-ops (cooperative grassroots organisations) and support services for farm gate sales. Some participants suggested the importance and need for government support for the popularization of local organic farm products. All these discussion topics shed light on consumers' perceptions of the organic food market.

Although the topics discussed by the participants indicated their interest and awareness of the organic farming market, the quality of the discussion itself could not be considered as a fully engaged discussion. It was expected that the participants would raise questions about the current issues in organic farming in the Kawarthas and provide their opinion about these, as well as respond to queries raised by other participants. In order for them to be actively involved in the discussion, the participants were invited to access the Argoomap frequently to see the new messages posted by others. However, with the exception of one, each participant accessed the Argoomap only once during a period of two weeks. Most of the participants, posted comments only once and did not involve themselves actively in the discussion. There were only six replies (four first-order replies and two second-order replies), and these replies were from only one participant who was actively engaged in the discussion.

The reason for this limited involvement may be the small number of twelve participants. This may be attributed to the lack of incentives provided to the participants for their time. The only benefits the participants gained were to learn about organic farming issues in the Kawarthas and current research in GeoWeb technology. An increased participation could perhaps have been obtained had some financial compensation been provided. The study could have also benefited, were it conducted as part of an official planning process.

The timing and length of the discussion phase is also likely a factor for the low rate of participation and lack of an engaged discussion. Due to time constraints, the discussion was open for two weeks only. A larger participant group and a longer time frame might have further revealed information about the Argoomap as a participatory GIS in community engagement. Furthermore, an in-depth discussion of the core issues of organic farming such as the current cost of organic certification, labour, weed management, problem soils for organic farming operations, or nearby organic processing facilities might have arisen, had any farmers participated in this study. However, the study was conducted during the summer growing season and therefore involvement from farmers was not achieved. One farmer, who had, at first, agreed to participate, could not do so because of time constraints. This identifies the necessity of allowing more time for discussion so that an engaged and effective discussion can take place.

Information from the Web server log file and questionnaire survey was used to evaluate the usability of the tool in terms of the ease of learning the Argoomap tool, the ease with which various functions of Argoomap can be used, and the participants' overall reaction to the tool's interface.

In order to be efficient and user-friendly, a tool should allow quick learning without spending a lot of time on training. In this study, no workshop or training was provided to familiarize the participants with Argoomap. The participants learned to use the tool by reading the tutorial provided within the Argoomap interface. The fact the participants were able to post a comment after reading the procedures given in the tutorial clearly indicates the "ease of learning" this tool.

The participants understood the tool and appreciated the concept of argumentation mapping. Every participant who contributed to the discussion created a new discussion thread. With one exception, all participants created discussion threads at the place about which they posted their comments (one participant created the placemarks at the place of his residence). The fact that the participants correctly created a discussion thread linked to a place of interest suggests that they understood the underlying concept. Moreover, multiple messages linked to a single placemark were submitted by one of the participants (Fig.1(b)), which was surprising since instruction on linking multiple messages to a single placemark was not included in the tutorial.

The assertion that the Argoomap is an easy to learn software application has also been confirmed by the survey in which five participants rated the learning experience to use the Argoomap as "easy". The participants' reaction to the Argoomap interface was either "good" or "satisfactory." The survey results show that the respondents were familiar with Web-based dis-

cussion forums and five survey respondents agreed that their familiarity with Google Maps helped them to learn to use the Argoomap tool. Two participants who did not complete the survey form provided their comments through E-mail. They described the Argoomap graphical user interface as "user-friendly".

It is difficult to ascertain why the participants chose not to comment on the effectiveness of the Argoomap tool as a platform for remotely gathering opinions. Only one participant agreed that the Argoomap is an effective platform for remotely gathering opinions whereas the other six did not provide any response. It can be speculated that the participants were exposed to a web-based GIS tool for the first time, and therefore did not have knowledge of the effectiveness of the other GIS tools; thus, they did not have a benchmark with which to compare the Argoomap, and so chose not to comment on its effectiveness.

Some participants liked the concept of the tool and they were able to appreciate the potential applications of the Argoomap for various planning purposes such as community gardening, locations for farmers markets, farmland preservation, and educational farms. The variety of themes that arose during the case study demonstrated the utility of the Argoomap; that it could be used for various kinds of planning processes for collecting the observations and opinions of local citizens.

6  CONCLUSIONS AND OUTLOOK

In this chapter, we presented a revised version of a GeoWeb tool for deliberation in spatial decision-making, along with a case study of public participation in environmental planning. Among the different types of volunteered geographic information enabled by the GeoWeb, the Argoomap tool specifically supports the expression of opinions and comments as part of the choice and review phases of rational decision-making.

The revision of the Argoomap tool was guided by previous case studies, in which users with computer skills could not easily handle the custom map navigation that was akin to commercial GIS user interfaces. We therefore chose the Google Maps API as the development platform in order to exploit the familiarity of a significant proportion of potential users with the mapping tools. However, the simplification of the user interface reduced the availability of analytical tools to monitor and assess the current state of a map-based discussion. This contrasts with other work including Simão et al. (2009), and Boroushaki and Malczewski (accepted), who extend map-based discussion support with multi-criteria analysis to achieve full analytic-deliberative decision support (Jankowski and Nyerges, 2003).

A different avenue of future research and development is the introduction of advanced discussion support functionality such as picture and video upload, querying, and automatic geo-referencing. We envision the Argoomap tool linked more closely with existing social networking platforms such as facebook, so that users could be notified about discussion activities in their favourite online environments. GIS functionality such as route calculation could also be useful to participants. In addition, we are exploring map-based discussion support on mobile devices. Finally, research on the Semantic Web may be of relevance to further development of argumentation mapping. For example, the meaning of discussion contributions needs to be clear, and a measure of trust in authors be provided, in order to enable serious uses such as in government decision-making.

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