

Can Twitter Enhance Food Resilience? Exploring Community Use of Twitter using Communicative Ecology

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Abstract

Food resilience - providing affordable access to a nutritionally balanced food supply - is a major sustainability challenge for growing urban populations worldwide, particularly in the developing world. This paper reports the use of Twitter for building urban food resilience through a case study of an urban agriculture community in Indonesia. A rule-guided qualitative content analysis is used to interpret meaning from digital text data and to bring methodological strength of quantitative analysis. In this study, communicative ecology theory is used to frame our understanding of the emerging themes in terms of topic of tweets, intention of tweets, and parties involved in the communication. We found that support for participation in urban agriculture is the most dominant content of communication and extending reach is the common intention of tweets while internal community networks are the most visible parties involved.

Keywords

Twitter, food resilience, content analysis, urban agriculture, social media.

INTRODUCTION

More people have now lived in cities than in rural area (Pearson 2010). According to a United Nations report, cities are the fastest growing area of human habitat where more than 60% of world population are forecast to live in by 2030 (UNFPA 2007). In 2015 alone, there will be 26 cities with more than 10 million inhabitants (Odom 2010). This has posed a number of challenges in terms of sustainability. Carbon footprints, mass energy consumption, and food supply are some of the imminent challenges which will require a comprehensive strategy to equitably address social, economic, and environmental aspects. Food supply is a particular example of a wicked problem in sustainability (Pryshlakivsky and Searcy 2013). As the size of population grows, it not only requires tackling the issue of availability, but also distribution, consumption, and waste of foods. It is 'wicked' because a broad range of stakeholders may see the problems differently and solving one aspect of the problem can cause another different problem to emerge (Pryshlakivsky and Searcy 2013).

In the context of urban environment, food problems can be divided into food security and food quality issues. Food security deals with ensuring sustainable food production and consumption in an affordable manner while food quality relates to achieving nutritional balance as part of healthy lifestyle. Both these goals also involve minimising impacts to the environment. The above can be summarised as being *food resilient*. To achieve such a goal, the role that community plays alongside that of governments and corporations cannot be overlooked. Urban agriculture is one of the community initiatives that has existed to help people in urban area become food resilient (Sumner et al. 2010). It contributes to solving the problem of food supply by linking production and consumption of food closer, thus making it affordable and accessible to more people (Smit et al. 2001). It also helps to regain productive use of land in urban spaces as opposed to inhabitation (Pearson et al. 2010).

The use of information and communication technology (ICT) is critical in augmenting the potential of urban agriculture to realise food resilience. Odom (2010) asserts that design interventions with ICT can benefit the urban agriculture community by increasing the visibility of urban agriculture, engaging diverse stakeholders, and improving agriculture practices. Hearn et al. (2014) extend this notion by arguing that social media and mobile technology as an ICT artefact also play a role in augmenting sustainable urban food systems. They contend that social media provide affordances to social network which transcend boundaries between people and institutions that help accelerate information transfer and learning processes.

The research underlying this paper aims to understand the ways social media can enhance community resilience particularly in urban food systems. In this paper we endeavour to understand the versatility of Twitter as one of the major social media platforms in enabling a systematic effort toward urban food resilience. Thus, the research

question guiding this paper is: *how does an urban-based community use Twitter in fostering food resilience?* To address this question we conduct an empirical study on an urban agriculture community in Indonesia and employ qualitative content analysis as a technique to interpret meaning from Twitter data. Through this study, we aim to theorise about the role of social media as a communication and collaboration tool within diverse stakeholders of community program. Specifically, we draw from communicative ecology theory (Hearn et al. 2014) to elaborate the multiple dimensions of Twitter for communication in community program. The paper is structured as follows. Following this introduction, a brief literature review is presented. Next, the case study and methodology are described followed by a summary of findings. After discussing the implication of the findings, the paper concludes with future direction of the research project.

LITERATURE REVIEW

Resilience

The notion of resilience originally stemmed from physics. It refers to the ability of a physical subject to bounce back when confronted against external pressure (Bodin and Wiman 2004). It has since been adopted to a range of different fields including psychology, ecological science, public health, and organisational studies (e.g., Buikstra et al. 2010). Resilience can be seen as a process or outcome, although Norris et al. (2008) suggest that the literature seems to predominantly view it as a process. On the other hand, Magis (2010) argues that resilience is an intermediate state of being that indicates social sustainability. In both cases, process and outcome, resilience refers to the capacity of a subject to cope with changes or disturbances in a positive trajectory. We argue that resilience can be a process or outcome depending upon the time of assessment. We define resilience as a quality of a subject in overcoming challenges in an environment characterised by changes and uncertainty.

Resilience is a positive attribute that can be applied at an individual, group, regional or national level. Norris et al. (2008) delineate that the ultimate goal of resilience is wellbeing. In realising such a goal, Folke et al. (2010) argue that there are two different forms of response towards resilience: adaptive and transformative. An adaptive strategy capitalises on learning, experience, and knowledge to cope with disturbances in a means that preserves current stability domain (Berkes et al. 2003). In contrast, a transformative strategy means coping with disturbances in a way that results in a new system structure (Walker et al. 2004). Both strategies may not be mutually exclusive and can occur in a cyclical term (Berkes et al. 2003).

Based on the generality of disturbances, resilience can be differentiated between general and specified resilience (Folke et al. 2010). General resilience refers to the capacity to cope with all kinds of shocks including uncertainty in all situations. On the contrary, specified resilience implies a narrow scope of the capacity to cope with a particular disturbance arising from a particular set of sources. Example of the latter includes food resilience of local residents or disaster resilience of people in a vulnerable area. Embedded in complex socio-ecological food systems, food resilience implies the amalgamation of social, environmental, and economic factors within a spatial and temporal scale (Thompson and Scoones 2009). At any scale, resilience should take into account the locality of the issues addressed (i.e., resilience of what to what) while acknowledging the broader contextual factors that shape the resilience discourse. In the context of urban food resilience, this includes considering who are the constituent groups related to the issues addressed, what resilience would look like to them, and how the capacity to adapt and transform sustainable food practices is developed. The distinction between urban and rural in this context is also critical because of the cultural and political concerns that affect transformation in food systems (Thompson and Scoones 2009).

Urban Agriculture and Food Resilience

Urban agriculture can simply be understood as practicing agriculture within city boundaries in order to cater for urban populations (Smit et al. 2001). Despite the seemingly simplistic idea of the term, urban agriculture has been widely practiced all around the world and has long been rooted in traditional culture (Smit et al. 2001). Urban agricultural practice has included a variety of dimensions such as land ownership, production method, motivation, and farmer typology. Further, Smit et al. (2001) contend that urban agriculture resembles an industry that has impacted profoundly on the livelihoods of individuals, households, and communities.

Urban agriculture practices in developing and developed countries are generally perceived as being quite different (Pearson et al. 2010). The former has been predominantly triggered by food security whereas the latter tends to be more recreational. In both cases, the benefits of urban agriculture are qualitative and quantitative. Quantitatively, it helps reduce hunger and problems of access to food supply. On the qualitative part, it assists in achieving nutritional balance for the urban population. Food resilience not only includes food security in terms of numbers, but also quality. Smit et al. (2001) outline that attitudes towards urban agriculture may differ between practitioners with different socioeconomic statuses. For a low-income group availability of food supply may be the primary motive, while middle- and higher-income groups respectively may perceive recreational and entrepreneurial activity as the main motivation.

Social Media for Resilience

The use of social media in resilience building has been widely studied particularly in the area of disaster resilience (e.g., Acar and Muraki 2011). Taylor et al. (2012) report that social media has been used as psychological relief to the impacted individuals in the event of disaster. Tim et al. (2013) convey that social media acts as a boundary spanner between parties facilitating collective action in response to natural disasters. Valecha et al. (2013) argue that using social media for disaster recovery brings advantages due to its speedy information distribution, near real-time unfolding of events, and collaborative nature required for humanitarian assistance.

However, little has been done to examine the use of social media for resilience building in a non-crisis situation. The moderating nature of social media in this setting may be different from a crisis situation. For example, the ability to provide near real-time content is secondary in non-crisis contexts. Patton et al. (2013) reveal the patterns of Twitter use in the event of natural disasters in light of visualising communication content during and post-disaster. They argue that Twitter content is dominated by news agencies sharing factual information about the disaster event and general public expressing sympathy for the impacted people.

On the general use of Twitter, Java et al. (2007), using a vast amount of automated Twitter data, assert that people use Twitter for daily chatter, conversation, sharing information, and reporting news. Previous studies seem to be aligned in delineating the typical use of Twitter in general and specific circumstances. However, Urquhart & Vaast (2012) call for theorisation of social media roles by examining its adoption and use in different contexts. This is particularly driven by the nature of social media data that are often out of context when treated as a large chunk of raw data. boyd et al. (2010) argue that Twitter's technological features such as message brevity coupled with mobile technology have afforded its users communication with a small amount of effort needed. This lends itself to a potentially versatile use of ICT which warrants further investigation in a variety of contexts.

Communicative Ecology and Social Media Use

Communicative ecology theory promotes using an ecological perspective to understand how people in social networks negotiate membership, trust, and action (Foth and Hearn 2007). It emerges from the notion of networked individualism which contends that individuals through the diffusion of ICT are engaged both in a collective and networked nature of social interaction (Wellman et al. 2003). They project themselves as a cohesive group in the former, while appearing as "an ego-centric yet still well-connected" (Foth and Hearn 2007) to a portfolio of sociability in the latter. Foth & Hearn (2007) further argue that tension between offline and online and between global and local also shapes the interaction pattern of social networks.

Communicative ecology interprets communication practice in three different yet interconnected layers; technological, discursive, and social (Foth and Hearn 2007). The technological layer refers to device materials and properties that shape communication. Next, the discursive layer denotes actual content of communication while the social layer translates into the social relationship between communication parties. Hearn et al. (2014) outline how the use of social media and mobile technology can be framed by applying communicative ecology particularly in the case of sustainable urban food systems. It can be applied to a range of food chain systems including production, acquisition, distribution, consumption, and wastage of foods. They also call for further empirical studies on the application of this framework.

THE CASE STUDY

Indonesia Berkebun (Indonesia Urban Farming) is a community group that promotes, encourages, conducts, and supports urban agriculture practices across cities in Indonesia. It was originally started as a social movement in October 2010 and initiated by a handful of people with diverse backgrounds ranging from urban planners and architects to students and housewives. The primary motives of its foundation are to contribute to solving problems of sustainability in three areas; economic, educational, and ecological (Indonesia Urban Farming 2014b). Through urban agriculture, it aims to build food resilience by making food supply to urban dwellers healthier and more reliable at an affordable cost. It also aims to promote environmentally sustainable behaviours through educating urban residents on sustainable food systems. Founded in Jakarta, the capital city of Indonesia, it has now established itself as a large community group with networked presence in 30 cities and 8 universities (Indonesia Urban Farming 2014a). Indonesia Berkebun (IB) can be regarded as an interest-driven voluntary association with strong links to geographical locations. Community members are connected both through online and offline interactions. They regularly hold events such as community gardening, workshops, exhibitions, and food markets in addition to home-farming which are run independently across cities.

The distinct feature of this community group is its sheer use of social media for communication. The community has set up one official Twitter account and one Facebook page for every city that is part of its community networks. These accounts are publicly available and run independently across cities. Examples of these Twitter

accounts are @JktBerkebun (Jakarta), @BdgBerkebun (Bandung), and @MLGBerkebun (Malang). Additionally, there is another official Twitter account that acts as a hub that mediates communication between community networks and members across the country: @IDBerkebun. As of 26 July 2014, the number of @IDBerkebun followers is 74,100 with more than 87,400 tweets having been posted since March 2011. The second largest account in the network is @JktBerkebun with 11,100 followers and around 32,000 tweets.

METHODOLOGY

Qualitative content analysis is selected as the method of data analysis due to its usefulness in interpreting meaning from text data. Mayring (2000) denotes that rule-guided qualitative content analysis is well-regarded because it brings the methodological strength of quantitative methods to the analysis of text data. Gilham (2000) asserts that qualitative content analysis is essential in identifying substantive components of human communication.

Our goal in this study is to describe a phenomenon of Twitter use in communication between members of a vast, regional community networks. Previous studies have examined Twitter use by individuals, organisations, and temporal communities around disaster events, but little has described the use of Twitter by an interest-driven community in a local and regional context. Taking this into account, we followed an inductive approach of content analysis which is well-suited for a phenomenon with limited theories available (Hsieh and Shannon 2005). In so doing, we used a rule-based analysis as suggested by Mayring (2000) and Kohlbacher (2006). The principles include (1) preparation of materials, (2) use of pilot data, (3) category definition, (4) inductive category development and revision, and (5) inclusion of quantitative analysis.

In selecting which Twitter data to analyse, we concur with Urquhart & Vaast (2012) who assert the distinction between 'central texts' and 'less central texts' in social media data is critical. They argue that along with the rise of 'big data' it is imperative to select which data slices that will bring a depth of analysis. Further, they contend that central texts should be analysed more deeply than others, while less central texts are used for triangulation. In this study, we consider Twitter data from the main account of IB, @IDBerkebun, to be the central texts. This is due to its role as a hub of the community's communication network. The data may only be sourced from one account, but the nature of Twitter data allow a single tweet to contain rich conversational aspects particularly in the case of retweet (boyd et al. 2010). To select a set of sample data, we captured 6315 tweets from @IDBerkebun Twitter feeds from 24 February to 16 July 2014 using NCapture, a web browser add-on from NVivo (standard software for qualitative data analysis). Once the data were collected, we exported them to an Excel spreadsheet for easier data analysis. The tweets were in Indonesian language and translated to English when quoted in this paper.

We divided the tweets based on the months they were posted resulting in the following number of tweets in full month: 2157 (March), 767 (April), 1170 (May), and 1462 (June). April data was used as a pilot while May data was selected for the actual data set. Before coding the pilot data, we developed content analysis measures to reflect the dimension of communication we are interested in while considering the research question (Kohlbacher 2006). In this regard, we turn to communicative ecology theory which offers a lens for scoping the role that social media plays in sustainable food systems (Hearn et al. 2014). The measures are (1) topic of tweets, (2) intention of tweets, and (3) parties involved in the communication. We then developed an initial coding after reading every tweet in the pilot data including images that may be included. The list of initial codes were then refined and reduced into categories to describe the whole data set. The categories were then summarised in a hierarchical structure to better make sense of the data (Hsieh and Shannon 2005). The unit of analysis is a tweet, a 140-character that constitutes a single Twitter post. In assigning the codes, we assess the most dominant meaning of the tweet particularly in the case of retweet which may contain a number of different perspectives of communication by different Twitter users. Finally, we coded May data using coding options from the pilot data and count the frequency of the code as a quantitative part of our analysis.

FINDINGS

Categories from the data

Based on inductive development of categories, the resulting categories are presented in Table 1, Table 2, and Table 3 along with the results of data analysis listing the frequency of codes (to be discussed below). The categories are structured hierarchically following the content analysis measures. The measures – topic of tweets, intention of tweets, and parties involved, respectively – are the equivalent of the three layers of interpretation as suggested in communicative ecology theory: discursive, technological, and social layer. The first measure, topic of tweets, includes four main categories which are information exchange, community engagement, empowerment, and culture and lifestyle. On the intention of tweets, the categories are brokering, extending reach, and socialising. Finally, the categories from the parties involved include single or self-referral, individual user, internal community networks, and external party.

Table 1. Coding scheme definitions and frequency of codes on *topic of tweets*

Coding option	Definition of the code	Frequency	% of Total
(1) Information exchange			
a. Seeking & sharing factual information	Exchanging information based on fact or from credible sources (e.g. news, research)	150	12.82%
b. Seeking & sharing practical information	Exchanging information with practical implications (e.g. tips on how to, where to buy)	84	7.18%
c. Seeking & sharing relative information	Exchanging information based on the perceptual knowledge (e.g. perceived benefits, experience)	67	5.73%
d. Seeking & sharing event information	Exchanging information around event (e.g. schedule, location, event reporting)	114	9.74%
(2) Community engagement			
a. Community development	Showcasing efforts toward developing the community socially and economically (e.g. initiation of a new community network)	63	5.38%
b. Support for participation	Encouraging and showcasing participation in community activities (e.g., sharing farming progress, social support)	338	28.89%
c. Showcasing individual achievement	Showcasing milestone of success in individual participation (e.g. first-time planting, first yield, and harvesting of individual farms)	110	9.40%
d. Showcasing collective achievement	Showcasing milestone of success in collective participation (e.g. first-time planting, first yield, and harvesting of community gardens)	51	4.36%
(3) Empowerment			
a. Empowering individuals	Delivering messages toward empowering individual person (e.g. individual farmer)	9	0.77%
b. Empowering community	Delivering messages toward empowering a group of people (e.g. urban dwellers)	5	0.43%
c. Empowering nation	Delivering messages toward empowering people as a nation (e.g. Indonesia)	2	0.17%
(4) Culture & lifestyle			
a. Regional culture	Contents related to local culture (e.g. regional language)	26	2.22%
b. Urban lifestyle	Contents related to lifestyle and trends in urban environment (e.g. vertical garden)	7	0.60%
c. Leisure activities	Contents related to fun and enjoyment	144	12.31%
Total		1170	100%

The nature of communication shown in the tweets of @IDBerkebun is influenced by the mechanics of Twitter, which divides posts into ‘original’ tweets or retweets. An original tweet is a tweet that is posted without being directly triggered by a tweet from other users. In other words, this is a tweet that originates from the mind of the account owner. On the other hand, a retweet is a form of direct and indirect conversation with a number of other users. A retweet is triggered by a mention using ‘@’ syntax from other users. The mentioned user then does a retweet by adding the syntax ‘RT’ or “...”. Every tweet that starts with such syntax is regarded a retweet regardless of the number of mentions included in that tweet. For a detailed evaluation of tweet and retweet mechanics, see boyd et al. (2010).

Table 2. Coding scheme definitions and frequency of codes on *intention of tweets*



Coding option	Definition of the code	Frequency	% of Total
(1) Brokering	Directing tweets to one or more specific users	26	2.22%
(2) Extending reach	Broadcasting or forwarding tweets from others without modifications (e.g. RT) to further the reach of the message (to its followers)	770	65.81%
(3) Socialising	Adding comments to a previous tweet as a way of interaction (e.g. greeting, endorsement, support, answering questions)	374	31.97%
Total		1170	100%


Table 3. Coding scheme definitions and frequency of codes on *parties involved in communication*

Coding option	Definition of the code	Frequency	% of Total
(1) Single or self-referral	No twitter user is mentioned or only its own Twitter ID is mentioned (self-mentioned)	50	4.27%
(2) Individual user	At least one other individual Twitter user is mentioned and does not mention organisation's or internal networks' Twitter account	269	22.99%
(3) Internal community networks	At least one internal networks' Twitter account is mentioned despite individual Twitter user may have been mentioned too	685	58.55%
(4) External party			
a. Public organisation	At least one public organisation's Twitter account is mentioned	22	1.88%
b. Private organisation	At least one private organisation's Twitter account is mentioned	144	12.31%
Total		1170	100%

For each category and sub-category we provided the definition and inclusion criteria to make for a consistent application of the coding schemes as shown in Table 1, 2, and 3. For example, when a Twitter user shares information about the benefits of urban agriculture or certain crops for health, we code this as sharing relative information unless they were sourced from the news or research results reported by a credible source such as a newsagency's Twitter account. Likewise, when people share an image of a plant with descriptive or no caption, we code this as sharing factual information. When the image is captioned with the intention of showing progress of farming practices, we code this as showcasing participation as part of the community. Table 4 highlights example of tweets from the data set.

Table 4. Example of tweets from the data set

Tweet by @IDberkebun	Category from each measure
 <p>“@User201: What type of chili is this?? @IDberkebun http://t.co/sE76Rmq18P” cc maestro chili sis @User111</p>	(1) Exchanging factual information (2) Brokering (3) Individual user
RT @User202: @IDberkebun @SahabatHijauku @User203 @Madiunberkebun all admins... please help does anyone have red ginger seeds..?	(1) Exchanging practical information (2) Extending reach (3) Internal community networks
RT @User113: In addition to veggie farming, I fulfil my rice needs from this field :) cc @IDberkebun @JktBerkebun http://t.co/1li03qbqTR	(1) Empowering individuals (2) Extending reach (3) Internal community networks
RT @User211: Vertical garden on house fence at Tebet.Kreatif. Try grow some veggies, more productive isn't it?@JktBerkebun @IDberkebun http://t.co/GDXbTbd0pC 	(1) Urban lifestyle (2) Extending reach (3) Internal community networks
“@User211: Posing with the chief of Airforce base Halim @_TNIAU @JktBerkebun Thanks Chief, next time we drop by again ok? :) http://t.co/7zvxyHCUjh ”	(1) Leisure activities (2) Extending reach (3) Public organisation
Don't forget to share stories & photos on web @IDberkebun www[indonesiaberkebun]org or link: http://t.co/m4EiDCvbwZ ok! :D	(1) Support for participation (2) Socialising (3) Self-referral
RT @BdgBerkebun: Our strawberry has now blossomed yeaayy \m/ #ngebongbarengLagi #Bandung #farming #community #vegetables... http://t.co/Gwoo8pYD0q	(1) Showcasing collective achievement (2) Extending reach (3) Internal community networks
RT @UntrtaBerkebun: cool! "@User217: time to yield the green beans.. let's harvest. :) @User102 @IDberkebun #SepetakKebun http://t.co/d8CSHMAJEF	(1) Showcasing individual achievement (2) Extending reach (3) Internal community networks

	<p>“@User220: WHOSE EYES ARE NOT INTERESTED IN A STALK OF CELERY LIKE THESE @UIBerkebun http://t.co/SIfwQbtaRm” cheers mate! Cc @User290</p>	<ol style="list-style-type: none"> (1) Leisure activities (2) Socialising (3) Internal community networks
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We also distinguish harvesting events as a milestone that warrants a separate category due to its dominant occurrence. In the culture and lifestyle category, leisure activities include seemingly trivial activities such as taking ‘selfie’ pictures while on a community event, expressing the joy from participation, responding to fun quizzes about urban farming, and daily chatter as part of a community including jokes and greetings. In the regional culture sub-category, we include all tweets that were posted using local, non-national language. These tweets aim to encourage participation from members of regional community networks, although the dominant meaning is to maintain sociability with members in a cultural way that is close to home.

Frequency of the codes

In the first measure, the highest proportion of tweet topics are support for participation (28.89%), seeking and sharing factual information (12.82%), and leisure activities (12.31%). The empowerment category has the lowest proportion of tweets with empowerment of individuals, community, and nation each are 0.77%, 0.43%, and 0.17% respectively.

As for the intention of tweets, a high percentage are on extending the reach (65.81%) while socialising and brokering are 31.97% and 2.22% respectively. In the parties involved, a majority includes internal community networks (58.55%) followed by interaction with individual user (22.99%) while the smallest proportion being involving public organisation (1.88%).

DISCUSSION

Hearn et al. (2014) argue that communicative ecology theory has the potential to guide in examining the phenomenon of social media use for sustainable urban food systems. We extend this theoretical framework and illustrate its application in the case of Twitter as a single social media platform. The technological layer refers to the affordances provided by technology which in this case represented by the mechanics of Twitter. Twitter’s functionality such as retweets and mentions shapes the communication intents of the community understudy. Likewise, Twitter’s versatility as shown in the user-driven syntax also influences the contribution of technology to communication practices. Brokering intention in the communication, for instance, is derived from Twitter’s retweet capability. Instead just simply used to extend the reach of the messages to an audience of followers, it has been used to direct the messages towards specific users who might be an authoritative person pertinent to a follow-up communication. This practice is different from simple mention in Twitter in which a follow-up communication does not involve inclusion of a third party. Brokering can work in this case because a sense of community has been present which allow directing messages to members who are previously known to have a certain set of skills and expertise. Despite the low proportion of brokering in the data set, this practice indicates the functional contribution that Twitter can play in communication within a community network.

The discursive layer in communicative ecology theory implies ideas which are contained in the message that is transferred in the communication. It is about the stories and narrative that make up the conversation. From the frequency of the codes, support for participation emerges as the most dominant theme in the communication between community members. Taking the category up one level, the total frequency of codes for community engagement constitutes the majority of the communication content accounting for 48.03% of the total data set. This focus corresponds to the goal of the community group in nurturing urban food resilience. In so doing, a vast majority of the tweets (69.75%) in this category has included the use of images. Images have also been used in virtually all categories accounting for 67.69% of the total data set. This highlights the prevalence of digital text data in social media which do not only consist of simple text, but also a multitude of digital data such as URL links and images (Urquhart and Vaast 2012). We argue that the sheer use of multimedia items in the communication of IB community members is idiosyncratic and important in delivering the goal of urban food resilience in the community. Previous studies have not highlighted this particular type of contents in Twitter communication with most studies described Twitter contents for general use (e.g., Java et al. 2007) and ad-hoc purposes (e.g. event reporting, disaster relief). The use of images have so far only been discussed in specific online social networking platform such as Flickr for photography enthusiasts (Ploderer 2011). Our finding may hint a further analysis towards the convergence of digital data across social media platforms.

Another noteworthy finding from the discursive layer is the relatively high proportion of content on leisure activities (12.31%). Java et al. (2007) categorise typical uses of Twitter being daily chatter, conversation, sharing

information, and reporting news. The above findings were based on tweets which are separated out of context which thus making daily chatter and conversation seem trivial and irrelevant. Scheepers et al. (2014) conducted a survey on typical use of social media, with Facebook being the case study, and concluded that it is used for information seeking, hedonic activities, sustaining strong ties, and extending weak ties. The hedonic activities have been attributed to fun, enjoyable activities such as exchanging gossip and play activity for entertainment purposes. Again, we argue that in a loose context these leisure activities may seem meaningless but in a purposeful community such as IB they are part of the social support and motivation required among the community members. To build community resilience, social support is required particularly in its role to make the sense of community persistent (Norris et al. 2008). In designing human-computer interaction, playfulness is a valid strategy for design intervention and powerful enough to encourage user participation (Choi et al. 2011). Thus, the recreational nature of participation found in this study may indicate opportunities for design intervention using social media in a community context.

On the social layer of communicative ecology, the emphasis is on the social relationship that transpires between individuals and also between individuals and institutions. The findings suggest that the communication has been dominated by interaction with internal community networks, i.e., other urban agriculture community groups which are part of IB networks. This is likely influenced by the role of the @IDBerkebun Twitter account as a communication hub between the community networks. IB has been structured like a formal organisational structure yet the membership is open and voluntary and expansion of the network occurs naturally. This quasi organisational structure of community networks highlights the governance and nature of social networks that can provide sustainable mechanisms for a community-based organisation. The structuring of IB organically into social media platforms informs a unique way of governing community program. Another point of discussion can be made around the links to public and private organisations. To build community resilience, it is imperative for a community to maintain relationships and trust with institutions that can leverage community capacity (Norris et al, 2008). In the case of IB, both public (e.g. the Indonesian Airforce Squad, public schools) and private institutions were involved in augmenting urban agriculture practice that ultimately leads to the goal of a food resilient urban population. They do so through sponsorships, corporate social responsibility program, and a number of other cooperative programs.

Communicative ecology theory conceives communication practices between parties as multimodal, multilayered, and multi-perspective (Foth and Hearn 2007). The ecological perspective means it takes into account a variety of communication media, relationships between communication dimensions, and tension between communication actor's beliefs. This study examines Twitter as a sole communication medium which may seem at odds with the holistic approach that the theory espouses. Nevertheless, our study takes the first step to analyse the efficacy of communicative ecology theory in understanding how social media can shape community engagement by revealing the versatility of Twitter as an ecosystem on its own in the studied community. The study shows how Twitter has been the main vehicle for the community to augment participation and expansion of the network. Likewise, by using communicative ecology we can highlight the variety of perspectives in using Twitter as a communication tool in a community context. Further analysis using communicative ecology should address how the theory can extend our understanding on how food resilience can be enhanced through the use of Twitter and other social media platforms. The addition of analysis on other communication modes is also critical in our further effort to understand the role social media plays in enhancing community resilience. And our study in this instance has paved the way to understand how social media is appropriated and shapes civic engagement within the community.

CONCLUSION AND FUTURE WORK

This paper has reported how Twitter has been used to facilitate communication between members of an urban agriculture community through the use of qualitative content analysis. This communication took place in the context of building urban food resilience. The reported study was set in the context of investigating how social media, and particularly Twitter, can enhance the food resilience of an urban-based community in a developing country like Indonesia. However, the link between Twitter use and an increase in food resilience is a subject of further research that constitutes a broader research agenda on this topic. This study sought to extend our understanding of the use of Twitter in this context using communicative ecology. We have found that communicative ecology can be used to illustrate the versatility of Twitter for community initiatives. The use of Twitter can be understood in three layers of interpretation; technological, discursive, and social. The most dominant themes found in the study were support for participation, extending reach, and the linking to internal community networks. This paper has made an important contribution by outlining the wider application of communicative ecology in social media platforms and exemplifying how Twitter is appropriated and shapes civic engagement within an urban-based community.

Nevertheless, the study has several limitations. It only captured the Twitter feeds of a single account and might present bias due to the episodic nature of this data. Future work will be conducted on extending the sample data

and using other 'less central texts' data for corroboration and triangulation. The inclusion of fieldwork data such as interviews and observation with the studied community is also critical in adding complete ecological perspective of communication and the links to resilience process. Further investigation may also be conducted to follow up the study findings such as the convergence of social media data, consideration of other social media platforms, and strategies for design intervention on using social media for resilience.

REFERENCES

- Acar, A., and Muraki, Y. 2011. "Twitter for Crisis Communication: Lessons Learned from Japan's Tsunami Disaster," *International Journal of Web Based Communities* (7:3), pp. 392-402.
- Berkes, F., Colding, J., and Folke, C. 2003. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press.
- Bodin, P., and Wiman, B. 2004. "Resilience and Other Stability Concepts in Ecology: Notes on Their Origin, Validity, and Usefulness," *ESS Bulletin* (2:2), pp. 33-43.
- boyd, d.m., Golder, S., and Lotan, G. 2010. "Tweet, Tweet, Retweet: Conversational Aspects of Retweeting on Twitter," in: *43rd Hawaii International Conference on System Sciences*. Hawaii: IEEE Computer Society, pp. 1-10.
- Buikstra, E., Ross, H., King, C.A., Baker, P.G., Hegney, D., McLachlan, K., and Rogers-Clark, C. 2010. "The Components of Resilience—Perceptions of an Australian Rural Community," *Journal of Community Psychology* (38:8), pp. 975-991.
- Choi, J.H.-j., Foth, M., Farr-Wharton, G., and Lyle, P. 2011. "Designing for Engagement Towards Healthier Lifestyles through Food Image Sharing: The Case of I8dat," *Proceedings of the INTERACT 2011 Workshop on Promoting and Supporting Healthy Living by Design*.
- Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T., and Rockström, J. 2010. "Resilience Thinking: Integrating Resilience, Adaptability and Transformability," *Ecology and Society* (15:4), p. 20.
- Foth, M., and Hearn, G. 2007. "Networked Individualism of Urban Residents: Discovering the Communicative Ecology in Inner-City Apartment Buildings," *Information, Communication & Society* (10:5), pp. 749-772.
- Gilham, B. 2000. *Case Study Research Methods*. London, UK: Continuum.
- Hearn, G., Collie, N., Lyle, P., Choi, J.H.-J., and Foth, M. 2014. "Using Communicative Ecology Theory to Scope the Emerging Role of Social Media in the Evolution of Urban Food Systems," *Futures* (forthcoming).
- Hsieh, H.-F., and Shannon, S.E. 2005. "Three Approaches to Qualitative Content Analysis," *Qualitative Health Research* (15:9), pp. 1277-1288.
- Indonesia Urban Farming. 2014a. "City and Campus Networks." Retrieved 24 February 2014, from <http://indonesiaberkebun.org/networks>
- Indonesia Urban Farming. 2014b. "Tentang Indonesia Berkebun." Retrieved 9 February 2014, from <http://indonesiaberkebun.org/indonesia-berkebun>
- Java, A., Song, X., Finin, T., and Tseng, B. 2007. "Why We Twitter: Understanding Microblogging Usage and Communities," *Proceedings of the 9th WebKDD and 1st SNA-KDD 2007 Workshop on Web Mining and Social Network Analysis*: ACM, pp. 56-65.
- Kohlbacher, F. 2006. "The Use of Qualitative Content Analysis in Case Study Research," *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (7:1).
- Magis, K. 2010. "Community Resilience: An Indicator of Social Sustainability," *Society and Natural Resources* (23:5), pp. 401-416.
- Mayring, P. 2000. "Qualitative Content Analysis," *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (1:2).
- Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F., and Pfefferbaum, R.L. 2008. "Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness," *American Journal of Community Psychology* (41:1-2), //, pp. 127-150.

- Odom, W. 2010. "'Mate, We Don't Need a Chip to Tell Us the Soil's Dry': Opportunities for Designing Interactive Systems to Support Urban Food Production," *ACM Designing Interactive Systems*, Aarhus, Denmark: ACM pp. 232-235.
- Patton, R.M., Steed, C.A., Stahl, C.G., and Treadwell, J.N. 2013. "Observing Community Resiliency in Social Media," *Lecture Notes on Computer Science, Part V*, B. Murgante (ed.), Berlin, Heidelberg: Springer-Verlag, pp. 491-501.
- Pearson, C.J. 2010. "Challenging, Multidimensional Agriculture in Cities," *International Journal of Agricultural Sustainability* (8:1&2), pp. 3-4.
- Pearson, L.J., Pearson, L., and Pearson, C.J. 2010. "Sustainable Urban Agriculture: Stocktake and Opportunities," *International Journal of Agricultural Sustainability* (8:1&2), pp. 7-19.
- Ploderer, B. 2011. "Understanding Participation in Passion-Centric Social Network Sites." Melbourne: The University of Melbourne.
- Pryshlakivsky, J., and Searcy, C. 2013. "Sustainable Development as a Wicked Problem," in *Managing and Engineering in Complex Situations*, S.F. Kovacic and A. Sousa-Poza (eds.). Springer Netherlands, pp. 109-128.
- Scheepers, H., Scheepers, R., Stockdale, R., and Nurdin, N. 2014. "The Dependent Variable in Social Media Use," *Journal of Computer Information Systems* (54:2), pp. 25-34.
- Smit, J., Ratta, A., and Nasr, J. 2001. "Urban Agriculture: Food, Jobs, and Sustainable Cities." New York, NY: United Nations Development Program (UNDP).
- Sumner, J., Mair, H., and Nelson, E. 2010. "Putting the Culture Back into Agriculture: Civic Engagement, Community and the Celebration of Local Food," *International Journal of Agricultural Sustainability* (8:1&2), pp. 54-61.
- Taylor, M., Wells, G., Howell, G., and Raphael, B. 2012. "The Role of Social Media as Psychological First Aid as a Support to Community Resilience Building. A Facebook Study from 'Cyclone Yasi Update'," *Australian Journal of Emergency Management* (27:1), //, pp. 20-26.
- Thompson, J., and Scoones, I. 2009. "Addressing the Dynamics of Agri-Food Systems: An Emerging Agenda for Social Science Research," *Environmental Science & Policy* (12:4), 6//, pp. 386-397.
- Tim, Y., Yang, L., Pan, S.L., Kaewkitipong, L., and Ractham, P. 2013. "The Emergence of Social Media as Boundary Objects in Crisis Response: A Collective Action Perspective," *34th International Conference on Information Systems*, Milan, Italy.
- UNFPA. 2007. "State of World Population 2007: Unleashing the Potential of Urban Growth," UN Population Fund, New York, NY.
- Urquhart, C., and Vaast, E. 2012. "Building Social Media Theory from Case Studies: A New Frontier for IS Research," in: *33rd International Conference on Information Systems*. Orlando, USA.
- Valecha, R., Oh, O., and Rao, H.R. 2013. "An Exploration of Collaboration over Time in Collective Crisis Response During the Haiti 2010 Earthquake," *34th International Conference on Information Systems*, Milan, Italy.
- Walker, B., Holling, C.S., Carpenter, S.R., and Kinzig, A. 2004. "Resilience, Adaptability and Transformability in Social--Ecological Systems," *Ecology and society* (9:2), p. 5.
- Wellman, B., Quan-Haase, A., Boase, J., Chen, W., Hampton, K., Díaz, I., and Miyata, K. 2003. "The Social Affordances of the Internet for Networked Individualism," *Journal of Computer-Mediated Communication* (8:3), pp. 0-0.

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