



**A Social Network Analysis of the May 2009
NE-RCRD Local Foods Conference:
Technical Report**

*by Kathryn Brasier and Stephan J. Goetz
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draft

Introduction

A central objective of workshops or conferences such as the recent Local Foods Conference (May 2009, in Kerhonksen, NY) is to enhance networking among individuals working in the same subject area, for their mutual benefit and the benefit of their stakeholder communities. Yet measuring and documenting such networks and relationships can be a challenge, and it has generally not been carried out formally (O'Neil 2008). In this report we demonstrate how the tools of social network analysis (SNA) can be applied in a conference setting both to improve understanding of networks within a certain subject area – local and regional foods – and to document changes in the networks that occurred at the Local Foods Conference. We also link individual-level network measures, such as centrality and “connectedness,” to workshop evaluations and to individuals’ intentions to pursue relationships and activities as a result of the workshop.

Evaluation and Social Network Analysis: An Emerging Area

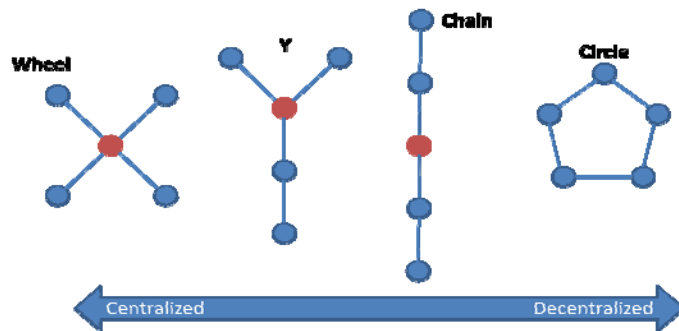
Evaluators increasingly use the theory and tools of social network analysis to understand a variety of issues and topics (Durland and Fredericks 2005) such as organizational effectiveness, institutional capacity, communication pathways, and leadership structure and performance. These tools attempt to identify successes and failures and to diagnose the organizational attributes and structural conditions (i.e., the formal and informal network characteristics) that lead to those differential outcomes.

Conference evaluations that use SNA are rare. We were able to find one on-line report of a network analysis conducted after the event using a sample of attendees (O'Neill 2008). The report highlights the growth in the overall network and the number of new connections made, particularly for those isolated prior to the conference. The report also provides a few examples of ego networks and how they grew and changed as a result of the conference.

More specifically, social network analysis can be used to compare and evaluate workshops or conferences and, perhaps more importantly, to understand the roles, positions and degrees of influence that individual workshop participants have before, during and after these events. For example, if one could identify the individuals with the largest number of people with their personal networks, they might be tapped for the purpose of distributing post-event information or for helping organize future events and follow-up trainings. Such knowledge of individuals’ roles could help to make future communications more efficient and effective.

Lessons can be learned from other research that documents efforts to evaluate multi-organizational collaborations and their outcomes. Funders of community-based projects – such as local food systems – increasingly require efforts to be multi-faceted and multi-disciplinary. They also require engagement of existing organizations and networks in the process of change (Cross et al., 2009). These complex, multi-organizational projects that focus on developing collaborations draw on multi-method techniques including network analysis to specifically assess the development of relationships among place-based organizations and the outcomes of these collaborations.

The following figure illustrates these points more concretely. Four different abstract network structures are shown, ranging from more to less centralized. The wheel network is one extreme; this network would fall apart completely if the central node (individual) were removed, since the remaining individuals do not have any connections to one another. Conversely, the circle network would survive the removal of any one actor, as the remaining individuals would still be connected to one another. In the real world one would expect to encounter a mixture of these various abstract types, and that different individuals within the networks have varying roles or degrees of “importance”.



Four network structures examined by Bevalas and colleagues at MIT. Each node represents a person; each line represents a potential channel for interpersonal communication. The most central node in each network is colored red. Source: Borgatti et al., “Network Analysis in the Social Sciences,” *Science*, 13. Feb. 2009, Vol. 323, pp. 892-5.

Borgatti et al. (2009:893) point out that the types of ties that individuals have with one another (e.g., similarities such as attending the same school; social relations such as relative or friend; interactions such as talking with vs. helping someone; and flows between individuals such as persuasion or resources) and also the direction of these ties (e.g., A knows of B but B has never heard of A) can influence relations within and outcomes of these networks. In addition, network structure is important in the sense that (p. 893) “teams with the same composition of member skills can perform very differently depending on the patterns of relationships among the members.” Perhaps most importantly, social network analysis extends the focus from only the individual’s characteristics to key outcomes (e.g., income) that depend both on characteristics (e.g., experience and education) *and* connections to other individuals.

This research reveals a number of network characteristics that facilitate collaboration, and point us toward three levels of network analysis.

- (1) First, we examine the structural characteristics of networks. Previous research has indicated that network characteristics, particularly cohesion, can make collaboration more efficient and enhance the flow of information throughout the group (Cross et al. 2009).
- (2) Second, we identify sub-groups within the overall network, which provide advantages and disadvantages, depending on the objective examined. Sub-groups can provide an important set of relationships focused on particular interests, and provide a 'home' or a place to connect into a larger network. However, the presence of multiple, distinct sub-groups with little overlap among them can indicate a fragmented network, and inhibit communication and information flow across the entire network.
- (3) Third, we examine the individual-level results. Tie strength, or the strength of relationships among participants (Cross et al. 2009), can facilitate communication, sharing, and trust-building. The growth of individuals' ego-networks can also draw in previously isolated individuals and connect them to needed resources and sources of information (O'Neill 2008). In addition, we identify actors who have greater importance in the network, and attempt to understand the experiences at the event of participants with different levels of network importance and connectedness. Finally, we provide preliminary analyses relating network position and the experiences of participants at the conference as well as behavioral intentions resulting from the conference.

Local Foods Conference Network Goals

One important goal of the Local Foods Conference was to increase the capacity, coordination, and communication across participating organizations, institutions, and individuals working on local food system development. One path to achieving this goal was to develop a Northeast-based network among attendees that could facilitate this communication and coordination. As such, multiple related objectives or hypotheses are examined here:

- (1) The conference increased the number of relationships among participants;
- (2) The conference increased the diversity or breadth of participants' relationships among the diversity of organizations represented (research/education, nonprofit, governmental, etc.);
- (3) The conference created or enhanced sub-groups that have the potential to coalesce around specific topics, projects, or locales.
- (4) The conference facilitated relationships among participants that enhanced their assessment of the conference and increased the likelihood of follow-up actions (e.g., resource sharing, collaboration) by participants.

Ultimately, this larger network that developed at the conference will increase future capacity for information sharing and formation of collaborative projects to address local food system issues in the Northeast.

Survey Method and Data Collection

At the heart of a social network analysis (SNA) is the notion of a connection or *link* between individuals, who are also known as *nodes*. In the case of this conference each participant was provided with a list of

all conference participants prior to the conference and asked to check off the names of those individuals “with whom you have had a two way (i.e., mutual) written or verbal exchange about the subject of Local and Regional Foods PRIOR TO THIS CONFERENCE.”¹ This could include requests for information, informal discussions, or project collaborations.” Clearly, this particular formulation of the network question leaves some room for interpretation by the individual respondent, and other formulations could be considered, including attempts to identify the intensity of the relationship (e.g., how frequent was the contact, or how much information was exchanged, both of which would allow weighted links to be constructed).² This yielded a “closed” network, since only individual participants at the event were listed on the form. Each form contained a unique identifying code for the individual, which was generated randomly (see Appendix 1 for a copy of the forms).

Individuals were asked to submit another form (blue sheet) at the end of the conference, on which they were asked to check off any new connections made DURING THE CONFERENCE. Participants knew that they would be doing this and had the opportunity to check off names as they formed new connections during the event. They were also instructed that “You do NOT need to check off those you already identified in the first (pre-conference) survey.” Nevertheless, a number of respondents repeated names from the first survey and these were removed during the data cleaning stage.

Of the 101 individuals registered for the conference, 67 (66.3%) completed both the pre- and post-conference surveys. However, since all registrants were listed and therefore could be chosen by a participant, all registered conference participants are included in the following network analyses.³ The data were cleaned and hand-recorded as a sparse matrix in a spreadsheet and read into and analyzed using the UCInet software (available at URL: <http://www.analytictech.com/downloaduc6.htm>) and NetDraw was used to create network maps. In the analyses below, we discuss three networks: pre-conference (reported relationships existing before the start of the conference), in-conference (relationships reportedly formed during the conference), and total network (the combination of the pre- and in-conference networks, representing the Northeast local foods network now).

Description of conference participants: Demographics of participants indicate that 55.4% were female, and represented all 11 states in the Northeast US.⁴ Together, Pennsylvania (14%) and New York (39%) sent the majority of conference attendees. For the purposes of this analysis, we categorized participants

¹ For future studies a form that can be scanned is highly recommended; having laptops available for automated data entry is even better, although in that case no paper back-up copies are generated.

² As part of a consistency check, the resulting matrix can be tested for symmetry. With symmetry (A lists B and B lists A), confidence that the relationship is robust is greater than if only one individual identifies the link (A lists B but B does not list A, which produces an asymmetrical relationship). The question may have been misinterpreted in a number of cases where, for example, conference speakers were listed by attendants as being in the network but those speakers did not reciprocate by also listing the individual. On the other hand, this permits a distinction between *directed* and *non-directed* networks. This needs to be clearly identified in the instructions in future surveys.

³ Three conference speakers were among the 34 individuals who did not complete both surveys. These individuals are likely to be chosen, creating an asymmetry of information in the network data. This highlights the need to strongly emphasize before and during the conference the importance of completing the survey *for everyone*.

⁴ In addition, 10 people came from states outside the Northeast.

into three organizational types: academic/educational (research and extension) (74%), private or non-profit groups (15%), and governmental agencies (11%).

Results

Network Structure: Summary network statistics for the Local and Regional Foods Conference are reported in Table 1, and maps of the networks are in Figure 1.

Table 1: Summary statistics for the LFC network

Statistic ⁵	Pre-conference	In-conference	Total network
Number of ties	629	814	1429
Average number of ties (out)	6.2	8.1	14.1
Average number of ties (in)	6.2	8.1	14.1
Range of out degrees	0-27	0-31	0-57
Range of in degrees	0-27	0-23	0-40

The number of ties created at the conference more than doubled the existing ties in the region, from 629 pre-conference to 1,429 in-conference. The mean number of ties was 6.2 before the event, indicating that the individuals attending the conference were relatively well-connected even prior to the event. On average, each person added about 8.1 ties to their personal networks. This results in a in-conference average of 14.1 ties to others in the Northeast interested in local food system development. The range of these ties was 0-27 before the event and 0-31 (out) and 0-23 (in) during the event. Some individuals indicate very high numbers in their total network, following the conference, with a maximum of 57 sending ties and 40 receiving ties.

Measures of Cohesion: The density measure is the percentage of total possible ties that are actually present.⁶ In our case the density of relationships centered on local and regional foods in the Northeast US increased from 6% pre-conference to 14% in the total network following the conference. As an evaluation measure this represents an increase of 8 percentage points, or an increase of 42.9% in the density of relationships during the nearly two-day event. This could serve as a benchmark against which other conferences of a similar nature can be evaluated.

Statistic	Pre-conference	In-conference	Total network
Density	.06	.08	.14
Average distance (among reachable pairs)	2.5	2.3	1.9
Diameter	6	5	4
Clustering coefficient	.407	.147	.298

⁵ Note that these statistics include values of 0 for those who did not respond, thus lowering the densities and mean scores. For example, when excluding those who did not complete the network rosters, the pre-conference out-degree mean was 9.1 and the post-conference out-degree mean was 11.8.

⁶ See, for example, Jackson (2008: 29).

The average distance among reachable pairs⁷ indicates the average of the geodesic distances (shortest paths) between every pair of conference participants. Pre-conference this value was 2.5, indicating that on average there are 2.5 people between each pair of participants. The average for the total network formed after the conference was 1.9, indicating that the conference resulted in a more compact network where information can flow more easily because it has to go through fewer people to be passed along.

Pre-conference, about half (49.5%) of all geodesic distances were 1 or 2, with another 40.6% of geodesics of 3. During the conference, the percent of relationships within 1 or 2 steps increased to 62.9%, with a drop to 33.6% at step of 3. For the total network, the percentage of relationships within 1 or 2 steps is a remarkable 86.0%, with an additional 13.8% at step 3. The maximum geodesic distance (diameter) decreased from 6 pre-conference to 4 for the total network.

Although the networks have relatively small distances among participants, it is likely that there are 'clusters' of individuals who are more closely tied, perhaps based on interest in similar local foods projects or because they live in the same state or region (i.e., a geographically-based interest). The 'clustering coefficient' in Table X is the average of the densities for each individual conference participant's immediate 'neighborhoods' (the people they are connected to). This statistic indicates how dense the set of ties are within each person's neighborhood. In comparison to the overall density of the pre-conference network (.06), the average individual neighborhood density is quite high (.407), indicating that most participants entered the conference with fairly dense localized relationships. However, by the end of the conference, this average density fell to .251, indicating that participants extended their personal networks and reached out to individuals who didn't already exist in their personal neighborhoods.

One goal of the conference was to extend networks beyond and across existing divisions, such as those by state or by individual's type of institutional setting. One way to assess this is to compare the density of relationships (the proportion of potential ties that are present) pre- and in-conference within and between blocks defined by these divisions. For example, table X provides densities within and between groups defined by institutional setting. The values indicate the proportion of total possible ties that are present between the members of the two groups; the diagonal values indicate internal ties only. Reading along the diagonal of Table X, which shows the preconference densities, we can see that 6.9% of possible ties were present among individuals associated with academic or educational institutions, 11.9% were among non-profit/private organizational representatives, and 13.6% within government representatives. Governmental representatives had a stronger density pre-conference than the other groups (and they also made up the smallest share of participants, at 11%). External ties were generally smaller than internal ties preconference (e.g., 6.1% between academics and non-profits); note that these relationships are not symmetrical. This is one manifestation of the sociological concept of *homophily* – like is attracted to like (people within sectors are more likely to have connections).

⁷ The pre-conference and in-conference graphs are not fully connected, meaning some dyads (pairs of nodes) do not have paths that connect them.

Preconference Density (standard deviation)	Academic/ educational (75)	Non-profit, private (15)	Government (11)
Academic/educational	.069 (.253)	.061 (.240)	.040 (.196)
Non-profit	.052 (.221)	.119 (.324)	.036 (.187)
Government	.038 (.190)	.067 (.249)	.136 (.343)

During the conference, the density of external ties increased for all pairs of groups. The largest density of sending ties for members of nonprofit/private groups was with government representatives (.080 - larger than internal ties); similarly, the largest density of sending ties for members of government groups was with academic/educational representatives. Note that the highest density for academic/educational representatives was for internal ties (.088). This suggests that members of non-profit and governmental organizations were more likely to reach out to create relationships with members of other groups during the conference.

In-conference	Academic/ educational (75)	Non-profit, private (15)	Government (11)
Academic/educational	.088 (.283)	.085 (.279)	.061 (.239)
Non-profit	.080 (.271)	.067 (.249)	.097 (.296)
Government	.056 (.229)	.048 (.215)	.045 (.208)

Densities for the total network indicate that although higher proportions of ties are still internal to these groups, the proportions for the external ties also increased. These statistics indicate that network relationships were built both within and across organizational type. In addition, the standard deviations of the densities within the cells increase from pre-conference to in-conference, suggesting that the heterogeneity within groups increased. Institutional affiliation grew to have less meaning after the conference.

Total Network	Academic/ educational (75)	Non-profit, private (15)	Government (11)
Academic/educational	.154 (.361)	.147 (.354)	.101 (.301)
Non-profit	.132 (.338)	.186 (.389)	.133 (.340)
Government	.092 (.289)	.115 (.319)	.182 (.386)

Another indicator of the extent to which boundaries of pre-existing organizational affiliations were stretched is the external-internal (E-I) index. This index compares the ties internal to a group to those external to a group, and ranges from -1 (all ties internal) to +1 (all ties external) (Hanneman and Riddle 2005). A significance test can be carried out by using a permutation test. Pre-conference ties are largely clustered by organizational affiliation, as the E-I index is -.339 and significant ($p < .05$). Ties made during the conference also have a tendency toward clustering (E-I index of -.277, and significant). The E-I index for the newly created total Northeast local foods network is -.294 and significant, again indicating clustering; however, the (absolute) value of the index is higher than the pre-conference index value, suggesting a small relative shift from internal to external relations.

Table X. E-I Index by State Affiliation

State	Pre-conference E-I Index	In-Conference E-I Index	Total Network E-I Index
Maryland (n=9)	0.448	.878	.676
Massachusetts (n=6)	.446	.925	.728
New Hampshire (n=6)	0.176	.953	.722
New York (n=39)	-0.581	.350	-.066
Pennsylvania (n=14)	-0.039	.659	.427
Vermont (n=6)	0.000	.778	.519
Washington, DC (n=3)	.556	1.000	.803
West Virginia (n=3)	.500	.840	.815
Other (n=10)	.467	.786	.709

States with fewer than 3 participants (Connecticut, New Jersey, and Rhode Island) are not shown.

A similar analysis by state indicates growth in cross-state relationships during the conference. Participants from all states developed more external ties at the conference than internal ties, as indicated by higher in-conference E-I index values than pre-conference values. Two states, New York and Pennsylvania, came into the conference with higher ratios of internal to external ties, as indicated by the negative E-I Index values. These two states also had the highest number of participants (39 and 14, respectively) at the conference. During the conference, participants from these two states developed more external connections, as indicated by the positive and higher values of the in-conference E-I Indexes. Only New York maintained a negative E-I Index for the total network, indicating slightly higher proportion of internal ties following the conference.

Network-Level Measures of Centrality:

An important indicator of network structure is how centralized the network is, or how many of the relationships flow through a given proportion of the nodes. High centralization means that a few people control the flow of information. This can be good if information is more easily and widely transmitted, but it can also be detrimental, for example, if important information is withheld from network members. The statistic is calculated as a measure of the variability of the individual actors' centrality measures, and is expressed as a percentage of a theoretically perfectly centralized network. The statistic reaches 100% when all actors choose one and only one person with whom to communicate. A decentralized network is represented by a network centrality approach 0%, or when the relationships are not concentrated among a small number of actors but spread across actors. The pre-conference and in-

conference networks are each relatively decentralized in terms of both sending ties (out) and receiving ties (in). The newly created Northeast local foods network is a bit more centralized, with a statistic of 43.3% (out) and 26.1% (in), indicating that there is greater variability in the number of reported ties within the total network, and fewer people hold a high proportion of the total number of relationships within the network.

Statistic	Pre-conference	In-conference	Total network
Degree centralization (out)	21.0%	23.2%	43.3%
Degree centralization (in)	21.0%	15.1%	26.1%
Betweenness centralization	6.7%	4.3%	3.9%

Betweenness is another way to understand centrality. Some authors have argued that this is the most important centralization measure in the sense that it “best ‘captured’ the essence of important actors in the graphs” (Wasserman and Faust: 215, citing Freeman 1979). Similar to the degree centralization, it is a measure of the variability in betweenness scores for all network participants. For an individual, betweenness is a measure of how many relationships one actor is ‘in between’, indicating a potential broker role. The group-level statistic indicates the level of variability in the individual measures; a high value suggests that a small proportion of people are in between most of the relationships, with the rest of the network nodes in between relatively few relationships (Hanneman and Riddle). Although this statistic generally remains small, the decrease in the betweenness centralization statistic indicates that there were more direct relationships formed at the conference, reducing the number of people lying in-between connections or serving as “brokers.”

Sub-groups

Two main approaches can be used to understand how, and to what extent, a network is composed of sub-groups. Such information can help to identify: (1) number and size of sub-groups; (2) the degree of separation between sub-groups and the efficiency of information flows across sub-groups; (3) individuals who play important roles connecting sub-groups or who are isolated from sub-groups. For this analysis, we are particularly interested in using sub-group analysis to identify potential work groups interested in a specific topic, project, or locale.⁸

These two approaches differ in terms of the starting point: (1) starting with dyads and identifying sub-groups that are tied together by their internal relationships; or (2) starting with the overall structure of the network and looking for potential divisions among participants’ relationships (Hanneman and Riddle 2005). We look at both approaches, as they provide different information about the networks.

⁸ We did not ask about interest in specific topics or projects coming out of the conference. This information could be useful for identifying and assessing sub-groups, and for post-conference follow-up to enhance the links within these sub-groups.

*Dyad-Based Sub-Groups:*⁹ A highly restrictive definition of a subgroup is that of cliques. Cliques are tight groups in which all members are tied to all other members of the group. This results in a large number of relatively small groups. A relaxation of this approach is that of n -cliques, in which individuals are members if they are connected to every other member at a distance no more than n steps ('friend of a friend' relation). The next modification is that of n -clans, in which participants are considered members if they are connected to every other member at a distance no more than n steps but also the node connecting them to the clique must be a member of that clique. A further relaxation of the definition of sub-groups is that of K -cores. K -cores are sub-groups in which members are connected to at least some number (k) of other participants in the group. In this analysis, we have defined $k=3$, meaning that to be a member of the 3-core, the conference participant has to have direct relationships with at least 3 other members of the group. This allows individuals to be participants as long as they have connections to some proportion of the group without requiring connections with all members (clique). Sub-group definitions such as k -cores focus on relationships among which there are redundancies in direct relations (meaning multiple flows of communication and greater cohesiveness) (Wasserman and Straus). Using this definition, there are 33 sub-groups identified pre-conference and 8 identified in the total network following the conference. However, in the total network, one sub-group contains over 90% of the relationships, and the remaining sub-groups each contain about 1 %. This pattern continues regardless of the definition of k . This indicates that the entire network following the conference is a relatively cohesive group in and of itself, with most individuals connected to the overall network by at least 3 other people.

Sub-structures: This top-down approach identifies areas within the networks in which relationships are more dense internally than externally. The approach helps to identify potential holes in the network where there are vulnerabilities, or where the removal of an individual or connection might isolate some sub-group. Prior to the conference, the network analysis indicates 6 'blocks', or groups that could be isolated; five of these contain the individuals who were isolated from the larger network, while the 6th contains the rest of the network. The total network after the conference has 2 blocks, with one of these blocks containing 2 people. This indicates that the conference resulted in creating connections among those who were previously isolated. It also suggests that although there is 1 'cut-point' (an individual who, if removed, would result in the isolation of a group from the rest of the network), this would result in the loss of only 1 person. This is an indication of network resiliency, as there are multiple, redundant pathways by which actors are connected to the network.

A further analysis (lambda set) suggests that a single dyad between two extension professionals (one each located in New York and Pennsylvania) is the most important relationship maintaining the integrity of the total network. The highest proportion of the flow of relationships goes through this dyad, and its loss would result in the greatest level of disruption to the overall network. The next level of individuals with a high proportion of relationships include two faculty members from New York, an extension professional from New York, and three of the speakers.

⁹ To calculate sub-groups, the data need to be symmetrized, using a process by which directed relations are simplified as present/absent. In this analysis, a tie is considered present if either actor listed the relationship.

Individual Network Statistics

The third level of analysis of networks is that of the individual node, or conference participant. Here we focus on two groups of measures, centrality and ego net-based measures. Centrality indicates how central an individual is to the total network, and is measured in multiple ways. One is simply the number of ties to others (degrees), both those sending (out - 'I pick you') and receiving (in- 'you pick me'). People with more sending ties have a greater ability to influence others, and to draw on the resources of multiple individuals and their networks. The number of receiving ties (in) indicates how prominent he/she is in the network. As described in table X, the average number of ties pre-conference is 6.2, during the conference it is 8.1, and for the total in-conference network it is 14.2. We also calculated the ratio of in-conference degrees to pre-conference degrees. The average ratio was 1:3.0 for out degrees and 1:2.2 for in degrees. This means that on average, each person reached out to 3 additional people for every person they had before the conference. Similarly, each person on average received 2.2 new ties at the conference for each person they had in their networks prior to the conference. We also calculated the proportions of individuals' total networks that were derived during the conference. This proportion was 60% for both out and in degrees.

	N	Mean	Minimum	Maximum
Ratio of pre-conference ties to in-conference ties (out)	69	3.0	0	22
Ratio of pre-conference ties to in-conference ties (in)	101	2.2	0	13
Proportion of total networks received in-conference (out)	69	0.6	0	1
Proportion of total networks received in-conference (in)	101	0.6	0	1

Of those who completed the network roster, 4 indicated no ties before the conference. These individuals reported an average of 10.8 new contacts made at the conference. Those who were already well connected also increased their networks, as indicated in the table below. Interestingly, there is no significant linear relationship between the number of degrees before and during the conference (among those who completed the rosters). There were seven people with more than 20 pre-conference ties. Of these, four added significantly to their networks (13, 17, 23, and 31 new ties) and three added only modestly (6, 8 and 8 new ties). This perhaps indicates different personal approaches to networking, or perhaps a kind of upper limit to the number of people one wants to be reasonably connected to.

	Categories of pre-conference out degrees (quartiles) (excluding those who did not respond)			
Statistics for out degrees during conference	0 ties pre-conference (4)	1-7 ties pre-conference (31)	8-13 ties pre-conference (20)	13 or more ties pre-conference (14)
Mean	10.8	11.6	11.7	12.7
Minimum-Maximum	3-17	3-22	0-24	0-31

A second measure is that of betweenness, or the proportion of network relations which the person is 'in-between'. Those with high betweenness are more likely to be able to connect others, or broker relationships. As described earlier, the average and maximum betweenness scores decrease from pre-

conference (.9) to the new total network (.6), indicating that more direct relationships were formed and individuals are less likely to be 'in between' relationships (or in a position to filter or broker relationships).

Betweenness measures	N	Mean	Minimum	Maximum
Pre-conference ¹⁰	101	.9	.0	7.5
In-conference	101	.8	.0	5.1
Total Network	101	.6	.0	4.5

The second type of individual level statistics is associated with individuals' networks, or 'egonetworks'. These networks are centered on one individual and include all those directly related to him/her. Egonet statistics indicate the size and extent of the networks within which individuals work. For simplicity, we present descriptive statistics for the symmetrized ego-networks only.

Mean (min-max)	Preconference	In-conference	Total network
Size (n=101)	9.0 (0-33)	13.9 (0-35)	21.7 (0-60)
Density (n=96)	46.7 (0-100)	23.3 (0-100)	41.1 (0-100)
Diameter (n=78)	2.1 (0-4)	3.3 (0-6)	2.9 (0-5)
2 Step Reach (n=101)	46.0 (0-86)	78.0 (0-97)	88.4 (0-98)
Reach Efficiency (n=101)	42.1 (0-100)	37.4 (0-100)	20.9 (0-100)
Brokerage (normalized) (n=101)	0.2 (0-0.5)	0.4 (0-0.5)	0.3 (0-0.5)

The size statistic is simply the number of people in a person's ego network. The average increased from 9 pre-conference to nearly 22 for the total network, meaning that on average, conference participants added nearly 13 people to their individual networks. Density indicates the proportion of total possible ties present among all participants in each person's ego network. Before the conference, on average, each person had about half (46.7%) of possible ties present; the density of the new total network is slightly lower (41.1%). This change suggests that conference participants brought new people into their ego networks but these new people are not as connected to the other members of the ego network. Diameter of an ego network is the longest path length between two nodes in the ego network. As suggested by other results, the average diameter of the ego networks increased, indicating that connections within ego networks were stretched. Two-step reach is the proportion of the whole

¹⁰ These statistics are normalized betweenness values.

network that ego can reach within 2 steps. This increased from 46.0 to 88.4%. Relatedly, reach efficiency is two-step reach normalized by dividing by the size of the entire network, and indicates how efficiently an individual (ego) can reach a large proportion of the network. In other words, it reflects the extent to which s/he is able to maximize his/her reach in the network given ‘investments’ in primary contacts, and the extent to which his/her primary contacts have large number of connections (Hanneman and Riddle 2005). As expected, the proportion of the network ego can reach increased from pre-conference to the total network. Ego’s primary contacts ‘pay off’ in that those contacts have the ability to reach a large proportion of the total network. Efficiency, however, decreased; as the density of direct relations increased, the number of new contacts reached through primary contacts decreased.

Brokerage is the number of pairs of nodes within ego’s network who are not directly connected to each other; this statistic is normalized by dividing by the total number of pairs in the egonetwork. High values indicate that ego lies in between many of these otherwise unconnected pairs of actors, and thus can play a role as ‘broker’ of these relationships. The normalized brokerage statistic pre-conference is, on average, 0.2, meaning that the average ego lies in between 20% of unconnected actors within their egonetworks. This average increases during the conference, as participants reached out to others and increased their personal networks; however, the other nodes within ego’s network did not necessarily develop direct connections, so ego has the opportunity to develop a role as a broker of these relationships.

Network Statistics and Conference Evaluations

As described above, participants were asked to complete an evaluation form in addition to the network roster at the end of the conference. Here we report a summary of these results, and bivariate analyses of the evaluation results and individual network measures.

The evaluation instrument asked for an assessment of the conference as a whole, of individual speakers, and plans following the conference. We also retained a few demographic variables from the registration information and matched these data to the evaluation data. The overall conference assessment question asked participants to indicate extent of agreement with the following statement: “This conference provided me with new perspectives and insights that I intend to employ in my work in the coming year.” 93.5% agreed or strongly agreed with this statement.

	Strongly disagree	Disagree	hard to say	agree	strongly agree	Total
Frequency	0	1	3	37	20	61
Valid Percent	0.0	1.6	4.9	60.7	32.8	100.0

Given this distribution, it is difficult to differentiate conference participants based on network participation or background information. Indeed, correlations of demographic data (gender, organization, state) indicate no significant differences in conference assessment by these background

variables.¹¹ Only two measures of individual centrality, pre-conference out degrees and total out degrees, are marginally significant with the conference evaluation measure. Note however the number of negative correlation coefficients for degrees (with the exception of the number of in degrees during the conference), suggesting that people who were well-connected prior to and after the conference had slightly lower overall evaluations of the conference.

Table X. Correlation Coefficients between Individual Centrality Network Statistics and Overall Conference Evaluation Item (“This conference provided me with new perspectives and insights that I intend to employ in my work in the coming year.”)

Correlation coefficient (Pearson’s r) (n=61)	Pre-conference	In-conference	Total Network
degrees (out)	-0.244+	-0.123	-0.233+
degrees (in)	-0.181	0.036	-0.106
Betweenness (normalized)	-0.210	-0.046	-0.232+

(+ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$)

Table X. Correlation Coefficients between Centrality Indicators and Overall Conference Evaluation Item (“This conference provided me with new perspectives and insights that I intend to employ in my work in the coming year.”)

	Correlation coefficient (Pearson’s r) (n=61)
Ratio of pre-conference ties to in-conference ties (out)	-0.073
Ratio of pre-conference ties to in-conference ties (in)	-0.102
Proportion of total networks received in-conference (out)	0.134
Proportion of total networks received in-conference (in)	0.108

(+ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$)

Conversely, the coefficients for the relationship between the evaluation responses and the proportions of total network relations that came out of the conference as well as density of ego networks are positive. Together these trends suggest that those with the highest evaluation of the conference were those who had smaller but perhaps more dense networks prior to the conference. These individuals used the conference to extend and expand their personal networks.

Table X. Correlation Coefficients between Individual Ego-Network Statistics and Overall Conference Evaluation Item (“This conference provided me with new perspectives and insights that I intend to employ in my work in the coming year.”)

Correlation coefficient (Pearson’s r) (n=61)	Pre-conference	In-conference	Total network
Ego-Network Size	-0.219+	-0.124	-0.221+
Ego-Network density	0.115	0.147	0.169
Ego-Network Reach Efficiency	0.105	0.010	0.059

¹¹ Interestingly, there is a significant correlation between gender and pre-conference out degrees; women had higher numbers of relationships coming into the conference.

Ego-Network Broker (normalized)	-0.011	-0.147	-0.169
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(+ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$)

Another set of questions asked participants whether they planned to undertake any of a series of activities as a result of the conference.

Activity	Percentage checking 'yes'
Follow up with one or more participants regarding further research initiatives	78.1
Follow up with one or more participants regarding further extension initiatives	50.0
Follow up with one or more participants regarding further practice initiatives	42.2
Explore new partnerships in my state or region	62.5
Pursue funding opportunities related to regional and local foods system development	48.4
Seek additional information regarding one or more of the topics discussed at the conference	73.4
Revise or expand my current research or extension program	51.6

Demographic correlates of these items were mostly non-significant. Marginally significant analyses using cross-tabulations indicated that conference participants representing different organizations indicated different plans, largely based on the missions of these organizations (i.e., members of education organizations indicating intentions to follow up with participants related to extension programs). Women were more likely to indicate interest in practice initiatives, although this is only marginally significant as well.

Here we focus on those items most likely related to network development (following up with participants and exploring partnerships). Overall, only a few relationships are significant. The below analysis examines the relationships between the identified follow-up activities (dichotomous variables) and the categorized network variables. The network variables are categorized into three groups using percentiles, resulting in groups with relatively equal numbers of cases.

Follow up with one or more participants regarding further research initiatives: Those who indicated interest in following up with participants regarding research initiatives were those who were more prominent during the conference (higher in-conference in degrees), those who were more prominent in the overall network (higher total network in degrees), and who have higher proportions of their networks (in-degrees) formed at the conference. It is also worth noting that the only significant relationships for those interested in research initiatives were those related to network centrality, particularly those that indicate prominence in the network. This perhaps indicates the higher prominence and visibility of researchers at the conference.

		In-conference in-degrees			
Follow up re: research		Low	Medium	High	Total
	No	40.9%	17.4%	6.2%	23.0%
	yes	59.1%	82.6%	93.8%	77.0%
	Total	100.0%	100.0%	100.0%	100.0%

		Total network in-degrees			
Follow up re: research		Low	Medium	High	Total
	No	37.5%	15.8%	11.1%	23.0%
	yes	62.5%	84.2%	88.9%	77.0%
	Total	100.0%	100.0%	100.0%	100.0%
		Proportion of total network ties received in-conference (in-degrees)			
Follow up re: research		Low	Medium	High	Total
	No	40.0%	12.5%	17.6%	23.0%
	yes	60.0%	87.5%	82.4%	77.0%
	Total	100.0%	100.0%	100.0%	100.0%

Follow up with one or more participants regarding further extension initiatives: Those who indicated interest in extension initiatives were those who have a higher proportion of their networks (out-degrees) formed at the conference. However, note that this relationship is not linear; those participants in the highest category were about evenly split in terms of plans to follow up. Conference participants interested in extension initiatives had ego networks following the conference that had lower densities (meaning few connections among those within their ego networks) and were more likely to play a brokerage role within their ego networks, connecting those who did not have direct connections themselves. This suggests that those with extension interests used the conference to stretch their personal networks and plan to work with those individuals they brought into their networks to develop extension programs.

		Proportion of total network ties received in-conference (out-degrees)			
Follow up re: extension		Low	Medium	High	Total
	No	68.0%	29.4%	47.4%	50.8%
	yes	32.0%	70.6%	52.6%	49.2%
	Total	100.0%	100.0%	100.0%	100.0%
		Total network density (ego-network)			
Follow up re: extension		Low	Medium	High	Total
	No	35.0%	47.6%	70.0%	50.8%
	yes	65.0%	52.4%	30.0%	49.2%
	Total	100.0%	100.0%	100.0%	100.0%
		Total network brokerage (ego-network)			
Follow up re: extension		Low	Medium	High	Total
	No	84.6%	43.5%	39.3%	50.0%
	yes	15.4%	56.5%	60.7%	50.0%
	Total	100.0%	100.0%	100.0%	100.0%

Follow up with one or more participants regarding further practice initiatives: Those with high betweenness scores and those with a higher number of out-going relationships formed at the conference were more likely to indicate intentions related to practice initiatives. In other words, individuals who are 'in between' many relationships within the total network following the conference

are interested in practice initiatives; they also reported a higher number of relationships they formed at the conference.

		Total network betweenness			
Follow up re: practice		Low	Medium	High	Total
	No	52.4%	77.3%	38.9%	57.4%
	yes	47.6%	22.7%	61.1%	42.6%
	Total	100.0%	100.0%	100.0%	100.0%
		In-conference out-degrees			
Follow up re: practice		Low	Medium	High	Total
	No	61.5%	70.0%	33.3%	57.4%
	yes	38.5%	30.0%	66.7%	42.6%
	Total	100.0%	100.0%	100.0%	100.0%

Explore new partnerships in my state or region: Those with both low and high reach efficiency of their personal networks formed at the conference were more likely to express interest in pursuing partnerships in their state or region. High reach efficiency indicates a high ‘pay-off’ for the investment in direct contacts – those contacts have multiple, non-redundant contacts. Individuals with a high reach efficiency might have made crucial connections at the conference that would allow them to form partnerships. On the other hand, those with low reach efficiency during the conference might have been exploring potential relationships without finding the ‘right’ connectors; they may also be interested in partnerships, but the relationships formed at the conference were not connecting them efficiently.

		In-conference reach efficiency of ego-network			
Explore partnerships		Low	Medium	High	Total
	No	17.4%	45.5%	18.8%	27.9%
	yes	82.6%	54.5%	81.2%	72.1%
	Total	100.0%	100.0%	100.0%	100.0%

Conclusion

The intent of this report was to document an approach for using social network analysis to examine the impact of a conference, specifically the Northeast Local foods Conference. The main goals of the conference were to share knowledge related to research, extension, and practice of local food development and to forge and strengthen relationships that could grow into collaborative efforts. Social network analysis has been a crucial tool for documenting the growth of the relationships and for highlighting the current and future impact of those relationships.

We used social network analysis tools to networks of conference participants before, during, and after the conference. We briefly summarize the findings of this analysis related to our four specific hypotheses.

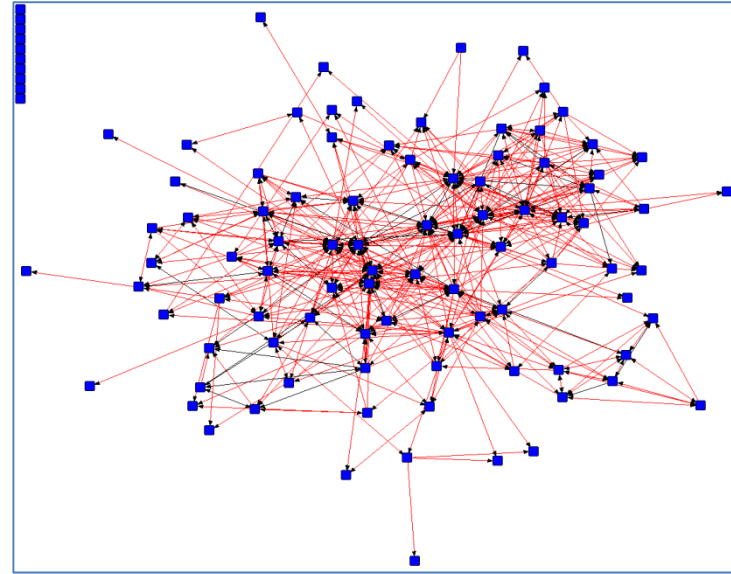
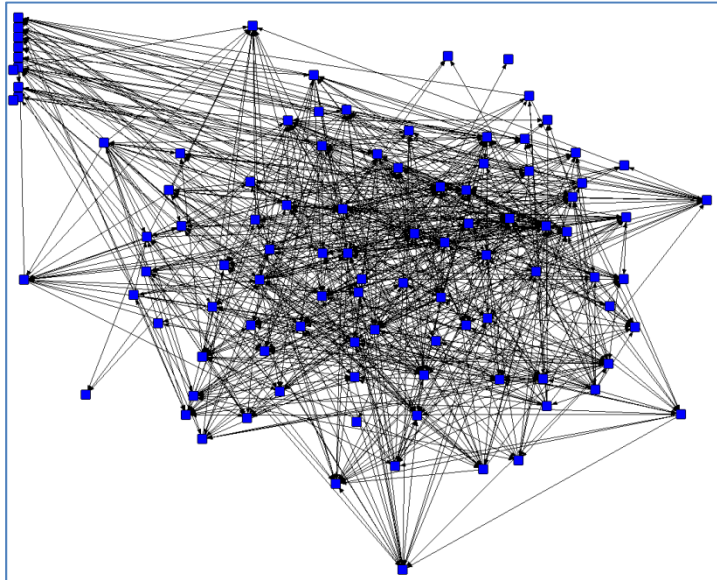
- (1) *The conference increased the number of relationships among participants.* Overall, the network increased the number of relationships among conference participants by 814 ties, with each person adding on average 8 ties to their personal networks. In addition, each person added 3 people to their personal networks for each 1 person that had in their network prior to the conference. The conference linked people who prior to the conference had been disconnected. The total network of people interested in Northeast local foods became denser, with smaller distances between people. This increases the likelihood that information can flow within the network, enhancing the potential for sharing and collaboration. Interestingly, we found that the conference allowed people to make direct connections to other participants. However, conference participants added on average 13 people to their personal networks (egonets); these individuals though were not as connected to the others in ego's networks, suggesting the potential for future brokerage roles.
- (2) *The conference increased the diversity or breadth of participants' relationships among the diversity of organizations represented (research/education, nonprofit, governmental, etc.).* Individual conference participants did extend their personal networks. They formed relationships with people outside their organizational type and outside their states. Governmental and non-profit representatives, as well as those from states with fewer people at the conference, particularly developed relationships outside their organizational and geographic homes.
- (3) *The conference created or enhanced sub-groups that have the potential to coalesce around specific topics, projects, or locales.* The sub-group analysis did not reveal specific sub-groups before, during or after the conference. The network is cohesive, without sub-components, and most conference participants are connected to the network through multiple, redundant pathways. We did not include questions in the instrument about areas of interest or potential projects that would have helped to identify such groups. We recommend that future conference evaluations that are interested in development of sub-groups (as potential work groups or collaborations) include information that would allow for identification of similar interests or topics. In addition, the network analysis identifies crucial individuals who, if lost, would result in significant disruption of the network. It is suggested that these individuals be made aware of their role in this network, so that they can foster communication and collaboration throughout the network.
- (4) *The conference facilitated relationships among participants that enhanced their assessment of the conference and increased the likelihood of follow-up actions (e.g., resource sharing, collaboration) by participants.* In general, conference participants reported that the conference was effective in terms of providing them information and insights. However, network relationships are only weakly related to this evaluation; those with larger networks before and following the conference had slightly more negative views of the conference. There was significant interest among conference participants in follow-up activities. Relatively few network statistics influenced this likelihood. Interestingly, different network characteristics influenced different types of follow-up activities. For example, prominence of individuals increased the likelihood of pursuing research initiatives. Network expansion and brokerage indicators were influential for those interested in extension and practice activities.

This experience indicates the potential for using social network analysis to examine the effectiveness of conferences with the goal of forming relationships. We recommend conducting similar assessments for future conferences. We also recommend conducting surveys of conference participants at some length of time following the conference to identify actual collaborations (information sharing, resource sharing, resource development, etc.) that occurred as a result of the relationships formed at the conference.

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Figure 1. Network maps showing (a) pre-conference relations, (b) in-conference relations, and (c) combined relations (red lines are pre-conference, black lines are in-



conference).

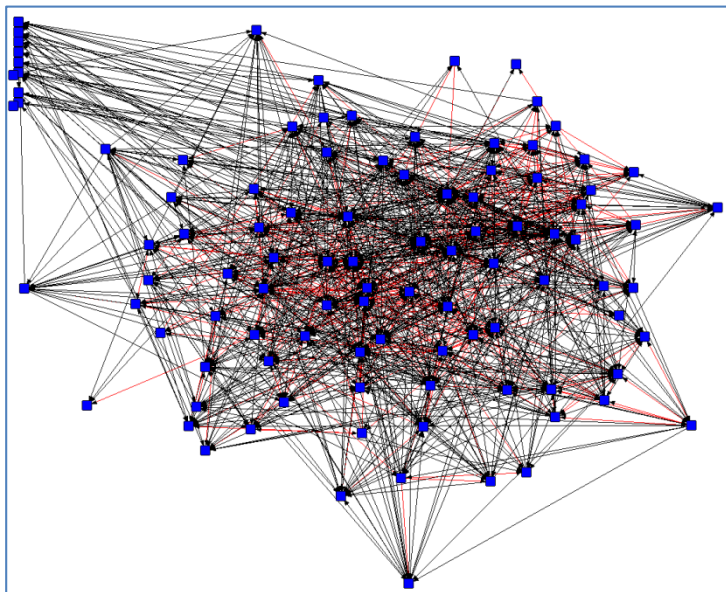
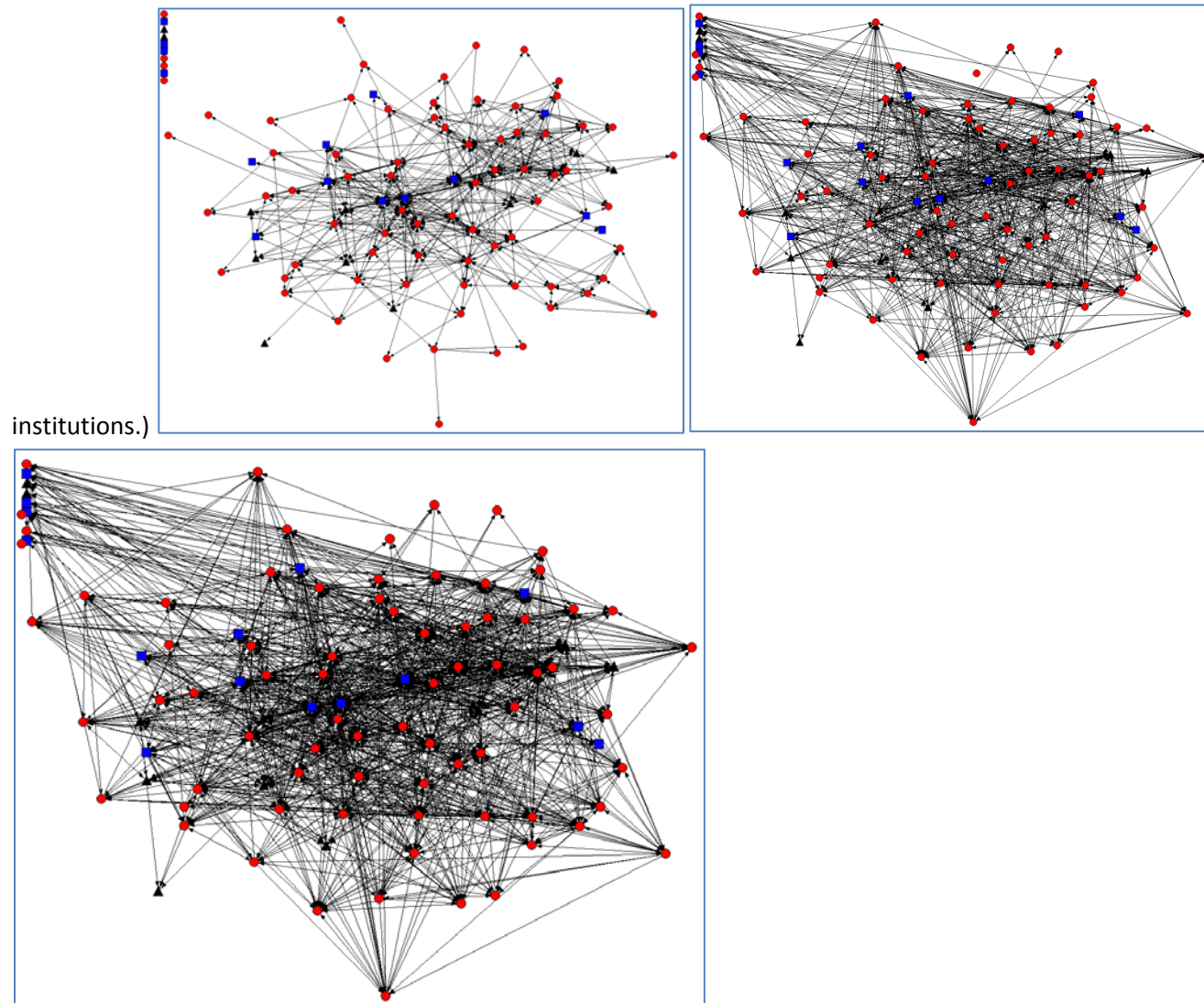


Figure 2: Network Maps showing institutional affiliation of conference participants pre-conference, in-conference, and for the total network. (Red circles indicate academic/educational institutions, blue squares are private/non-profit groups, and black triangles are governmental



Appendix 1: Survey Forms



Dear Conference Participant and Colleague:

Welcome to the Local and Regional Foods Conference! A major goal of this conference is to strengthen existing networks and to create new networks around the subject of local and regional foods systems in the Northeast. To evaluate whether we're achieving this goal, we ask you to complete this very brief research survey [green paper] *now* as well as another similar survey *at the end* of the conference. We will summarize the changes in networks that have occurred here at the conference, along with other evaluation information, in a conference report to be shared with all those who attended.

Any information collected in this survey will be presented only in statistical summaries. Your responses will be kept strictly confidential, and your name will never be linked to your responses in presentations or publications.

Please complete this survey at this time and place it in the box on the registration table before you move on to conference events. This effort should take less than five minutes of your time.

There is also a second survey form (blue sheets of paper), that we ask you to drop off at the end of the conference. Please do not forget to do so, as this will provide us with very valuable information. You may fill out this form during the course of the conference.

THANK YOU!

Pre-Conference Survey: Your Local Foods Networks

Please place a check mark next to the names of those conference participants listed below with whom you have had a two-way (i.e., mutual) written or verbal exchange about the subject of Local and Regional Foods PRIOR TO THIS CONFERENCE. This could include requests for information, informal discussions, or project collaborations.

The names of all conference participants will be listed here on one sheet.

LastName, FirstName A ____

LastName, FirstName B ____

LastName, FirstName C ____

LastName, FirstName D ____

Etc.

After-Conference Survey: Conference Evaluation and Your Local Foods Networks Now

*Please place a check mark next to the names of those conference participants listed below with whom you have had a two-way (i.e., mutual) written or verbal exchange about the subject of Local and Regional Foods **DURING THIS CONFERENCE**. This could include requests for information, informal discussions, or project collaborations. You do NOT need to check off those you already identified in the first (pre-conference) survey.*

Insert names of all conference participants:

LastName, FirstName A ____

LastName, FirstName B ____

LastName, FirstName C ____

LastName, FirstName D ____

Etc.

Contact info:

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CONFERENCE EVALUATION

Please complete this evaluation form and return it to this conference’s registration desk in the box labeled ‘conference evaluation’. Your input is very important and will be used to plan future programs. Forms may also be mailed to the conference organizers [The Northeast Regional Center for Rural Development; 7E Armsby Building, The Pennsylvania State University; University Park, PA 16802-5602 USA] or faxed to (814) 863-0586. THANK YOU!

1. Please describe what you liked the most about this conference.

2. To what extent do you agree with the following statement: “This conference provided me with new perspectives and insights that I intend to employ in my work in the coming year” (Circle one)

Strongly agree Agree Hard to say Disagree Strongly disagree

3. Please indicate how much you think each of the presentations listed below contributed to the overall goals of the conference. (Circle one)

4.

a. Kate Clancy - What Are We Talking about When We Talk about Local and Regional Food Systems?

Greatly Considerably Moderately Somewhat Minimally

b. Clare Hinrichs - What Do We Know and What Do We Need to Know about the Community Impacts of Local and Regional Foods?

Greatly Considerably Moderately Somewhat Minimally

c. Dawn Thilmany - Consumers of Local Foods: Civic Minded or Seeking Assurances?

Greatly Considerably Moderately Somewhat Minimally

d. Mike Hamm -

Greatly Considerably Moderately Somewhat Minimally

e. Jerry Cosgrove – Local Foods Systems Policy

Greatly Considerably Moderately Somewhat Minimally

f. Rich Pirog - Making The Power Of The Food And Agriculture Network Really Work In Iowa’s Value Chain Partnerships Project

Greatly Considerably Moderately Somewhat Minimally

5. Which of the following are you likely to do as a result of this conference? Please check all that apply.

- Follow up with one or more participants regarding further research initiatives
- Follow up with one or more participants regarding further Extension initiatives
- Follow up with one or more participants regarding further practice initiatives
- Revise or expand my current research or Extension program
- Seek additional information regarding one or more of the topics discussed at the conference
- Pursue funding opportunities related to Regional and Local Foods System development
- Explore new partnerships in my state or the region

- Other (please add): _____

6. Please list up to 3 poster presentations that you think were most informative (author or title):

7. Please list up to 3 roundtable sessions that you think were most informative (author or title)

8. Please list up to 3 issues or ideas that came out of the panel you think were most informative.

8. Please indicate how the Northeast Center can be more helpful to you in your work related to local and regional foods:

In this space, please provide any other comments you may have.

THANK YOU!