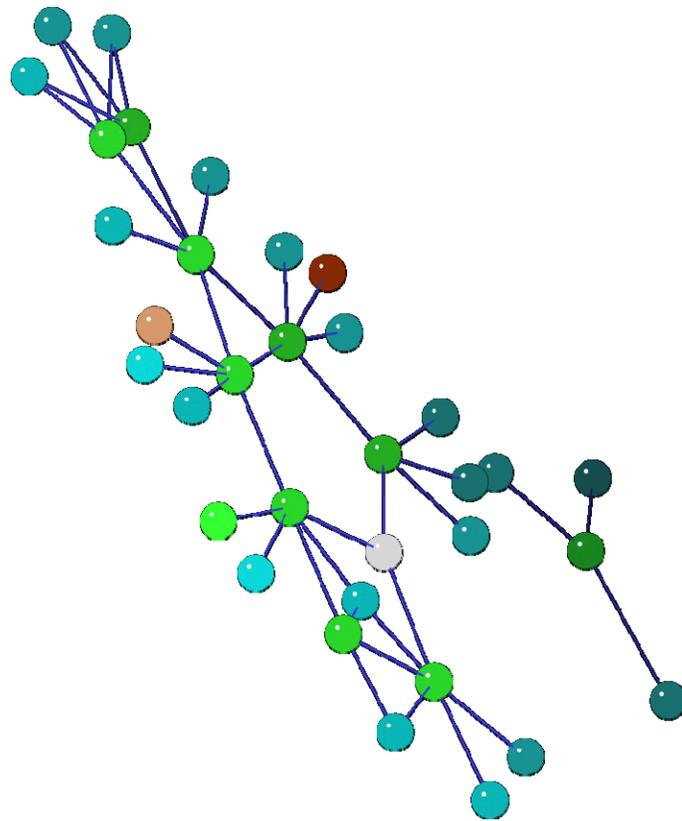


"HELP YOURSELF AND GOD WILL HELP
YOU"



**Community social capital in the context of the natural
resources management: Social network analysis of the
farmers' networks in the village of Blat, South Lebanon**

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ABSTRACT

This research presents a case study assessing community social capital and potential leadership amongst farmers in the village Blat, South Lebanon and it was conducted in November 2010. The social capital was approached from the network aspect with the use of social network analysis (SNA) and it was assessed with the network closure and the structural holes concepts, conflict resolution mechanisms and willingness to monitor and report on a rule breaking. In addition, central farmers, based on multiple network centrality measures, were identified, revealing the potential community leader(s) and the most suitable farmer(s) for the capacity building abroad.

The assessment of the communal social capital and identification of the central farmers shows following results. Firstly, support network results indicate that the network is non-existent outside farmers' closest families, hence there is no bridging social capital between farmers. Secondly, knowledge network reflects both bridging and bonding social capital and has positive implications for the NRM. Thirdly, monitoring and conflict resolution norms are not strong in the farmers' community, potentially hindering the NRM. And finally, identification of the most central farmers revealed that different selection of the farmers could be done by the project implementers.

Keywords: social network analysis (SNA), social capital, natural resource management, monitoring, conflict resolution mechanisms, key players, South Lebanon

ACRONYMS

AFIAL	Association of the Friends of the Friends of Ibrahim Abd El Al
GSS	General Social Survey
KPP-Pos	Key Player Problem – Positive
LRA	Litani River Authority
NRM	Natural Resource Management
SNA	Social Network Analysis
UNDP	United Nations Development Programme
UNIFIL	United Nations Interim Force in Lebanon
WUA	Water Users Association

1. INTRODUCTION

The social capital and leadership are suggested to have positive effects on the effective organization of the individuals and to be crucial for the initiation of and viability of resources management at the local level (Bodin and Crona, 2008). The focus of this research is exploration of the farmers' social network structure in order to assess the communal social capital and reveal central individuals, i.e. potential leaders who could facilitate collaboration and establishment of the Water Users Association (WUA). Certain network structural characteristics facilitate cooperation and are linked to trust, learning and leadership which are important aspects of natural resources management (NRM) (Bodin et al., 2006).

The study area of interest is village Blat, South Lebanon, where only one farmer is irrigating the land (UNDP Lebanon, 2010b). In the seventies Litani River Authority (LRA), in collaboration with FAO and UNDP, prepared a study of the Hydro Agricultural Development project of South Lebanon, with the first phase of the study being Canal 800 project. However, these works were interrupted by Lebanese war in 1975 and only in 2002 Canal 800 project was reviewed and updated (Karaa, 2007). With the canal being built, it will supply irrigation water to South Lebanon from West Bekka valley (UNDP, 2010). Still, main target of the project is establishment of the very much needed WUA as a necessity for the good management and implementation of the irrigation projects (Karaa, 2007).

I approach social capital and leadership from the social network perspective, employing the structural network measures helping me identify network aspects of the social capital and key or central individuals. Identification of the latter is one of the primary aims for the use of graph theory in the social network analysis (SNA) (Zemljič and Hlebec, 2005). SNA is also useful as a diagnostic tool when promoting collaboration and knowledge sharing (Cross et al., 2002). In addition, conflict resolution mechanisms and monitoring, prerequisites for the successful common resources management, are included in the assessment of the community social capital (Bodin and Crona, 2008; Ostrom, 2008).

1.1. Research purpose

The purpose of this case study is the exploration of the farmers' social network structures and subsequent assessment of the social capital and identification of the central farmers, potential leaders facilitating the WUA establishment. The social capital and the most central farmers will be assessed from the social network stance (Creswell, 2007:103-106). The social capital will be assessed firstly, by the quantification of the farmers' social network characteristics, using concepts of the network closure (Coleman, 1988) and the structural holes (Burt, 1992). Secondly, by the assessment of the conflict resolution mechanisms and thirdly, by evaluation of the farmers' monitoring and reporting attitudes (Bodin and Crona, 2008:2767). Moreover, key individuals will be disclosed with various network centrality measures for individual actors and for a set of actors (Wasserman and Faust, 2009; Borgatti, 2006).

Due to the action nature of the research, I will provide solution for the selection of the most suitable farmer to be sent for the capacity building abroad (Mikkelsen, 2005:132-

33). Implementation of change initiatives requires identification of central individuals to influence them first, before trying to influence whole community (Borgatti, 2006:22). Identification of central farmers is needed due to two reasons: they will be selected for capacity building abroad, hopefully disseminating the knowledge within the farmers' community, and for the awareness building aiming at the change of the existing norms (Lebanese Recovery Fund (LRF) et al., 2010).

1.2. Problem statement and research question

Establishment of the WUA presupposes that farmers would be able to or willing to cooperate with each other. These assumptions are based on the local ownership of the WUA, enabling farmers equitable distribution of the irrigation water¹, monitor this distribution and resolve potential conflicts on their own (AFIAL, 2010). However, the situation in the project villages is not that straight forward. Survey conducted by UNDP has shown that farmers are distrustful and non-cooperative. Furthermore, there were warnings that care should be taken in regard with local influential actors who could take over the WUA and affect equitable water distribution (UNDP Lebanon, 2010a).

Nevertheless, this lack of social capital in the village could be further exacerbated by the sectarian divisions. Sectarianism is still strongly present in the Lebanon and it became reinforced and more pronounced after the civil war and through 1989 Document of National Understanding ("Ta'if Accord") (Norton, 2007; Ofeish, 1999; Hudson, 1997). Sectarianism is complex phenomenon and is not necessarily synonymous with religion. It may imply intolerance of sectarian "others", whereas religiosity does not necessarily imply it and can be passive regarding intolerance of the "others". Moreover, sectarian individuals are not necessarily religious in practice and this is quite common in Lebanon (Ofeish, 1999).

According to Norton (2007:120-23) four factors can explain continuation of sectarianism after the Lebanese civil war. Firstly, intercommunal violence during the civil war transformed socially heterogeneous communities into homogeneous ones. Secondly, economic inequality and corruption further strengthened sectarianism through dependence of the population on the sectarian political leaders' (zu'ama) patronage, dispensing jobs and political favours. Thirdly, sectarian presence is due to the revival of religious leaders who attract less fortunate people with criticism of corruption. And fourthly, regional deterioration of Sunni - Shi'i relations, encouraging younger Shi'i to identify themselves in sectarian terms (Norton, 2007).

Ofeish (1999) further claims that the main factor for the continuation of sectarianism is Lebanese elite's desire for control, that sectarianism is therefore purposeful and mainly a political tool for exaggeration of the "ethnic" significance and promotion of communal identities against others. Lebanese elite uses sectarianism for maintaining power by dividing population along the sectarian lines. It further serves two more purposes. Firstly, it creates elite's constituency, composed of people believing that their access to resources depends on their association with the elite and secondly, enables diffusion of demands for reforms by popular classes by dividing them across sectarian lines (Ofeish, 1999).

¹ Karaa, 2010

Research questions trying to reveal network structure regarding the fragmentation of the community due to the lack of trust amongst farmers and potential sectarian divisions are as follows:

RQ1: Which are the structural characteristics of the farmers' social network?

Sub RQ: Are there any heterogeneous network components (sub-groups) based on the religious affiliation of the farmers?

Sub RQ: Are there any general network components?

During my stay in the field I realized that often there is an influential villager, i.e. "hakim", people turn to for advice². Influential and trustworthy individuals are important since farmers will have to resolve their conflicts within WUA, by establishing mediation and arbitration centre (AFIAL, 2010). Further, farmers will be able to appoint, if they wish to, external monitor to oversee distribution of the irrigation water (AFIAL, 2010). However, internal monitor could be another option and according to Ostrom (1990) internal monitoring creates robust institutions. Research questions regarding conflict resolution mechanisms and monitoring are as follows:

RQ2: Are there any influential actors / institutions to which farmers' could turn to:

Sub RQ: for conflict resolution

Sub RQ: for the reporting on the rule breaking

And finally, according to the project documentation (Lebanese Recovery Fund (LRF) et al., 2010) and key informants³, one or two farmers from each village would be selected for the capacity building abroad and central individuals with communication channels, enabling them to diffuse the knowledge gained, should be revealed. Further, they have to be trustworthy and influential in order to not just diffuse the knowledge but also to bring farmers together for the participation in the common cause. Research question regarding potential leadership is as follows:

RQ3: Who is (are) the key player(s) in the farmers' social networks?

1.3. Structure of the thesis

Introductory chapter, with the specification of the research problem, purpose of the study and formulation of the research questions, will be followed by the theoretical explanation of the social capital in general and the network structure of the social capital, such as the concepts of the network closure and the structural holes. Furthermore, it will also elaborate on the key individuals' potential roles in the network. Third chapter consists of methodological background of the study and it will be followed by the analytical framework (chapter 4), presentation of the results (chapter 5) and discussion (chapter 6)

² Bahsoun, 2010

³ Karaa, Gharib, Nassif, 2010

chapters, which are the essence of the study and will represent the answers for the research questions. The study will be summarized with the conclusion chapter (chapter 7).

2. THEORETICAL FRAMEWORK

2.1. Social Capital

The core idea of social capital concept, analogous to physical and human capital, is that social networks have value and that social capital consists of social networks and the norms that arise from them. Social networks involve mutual obligations and they foster norms of reciprocity (Putnam, 2000:19-20). Further, social capital can be etiologically and consequentially distinguished from human capital in respect that social capital is quality created between people, whereas human capital is pertained to individuals. Therefore, social capital is complementing human capital (Burt, 1997a:339).

The social capital concept has been approached from two perspectives with first defining it as a network composed of individuals with certain resources, whereas the second perspective argues that the social structure itself represents social capital (Burt, 1992:11-12). Burt (1992:12) further argues that both aspects are needed for the formulation of the social capital definition: the social capital being individual resources and the network structure itself at the same time (Burt, 1992:15). Central features of the social capital are (Pretty and Smith, 2004):

(a) trust (Coleman, 1988; Coleman, 1990:41; Putnam et al., 1993:167; Woolcock, 1998; Woolcock and Narayan, 2000; Lin, 1999),

(b) reciprocity (Putnam, 2000:19-20; Woolcock and Narayan, 2000; Coleman, 1988),

(c) common rules, norms and sanctions (Putnam, 2000; Putnam et al., 1993; Coleman, 1988; Coleman, 1990; Woolcock and Narayan, 2000) and

(d) network structure (Putnam et al., 1993:167; Bourdieu in Portes, 1998:3; Woolcock and Narayan, 2000:226; Coleman, 1988; Burt, 2000).

Trust reduces transaction costs in financial terms and time needed for monitoring others and therefore facilitates cooperation. However, it can be easily broken and takes time to be built (Pretty and Smith, 2004) and when members of the community are distrustful or even in conflict, cooperation is hard to be achieved (Baland & Platteau, 1998 in Pretty and Smith, 2004:633). Trust can be broken down into trust in those we know and those we do not, with the latter arising from the confidence in social structure (Pretty and Ward, 2001).

Reciprocity increases trust and establishes long term obligations between people. There are two types of reciprocity that can be distinguished: specific and diffuse. The latter refers to continuing relationship of exchange that is repaid and balanced over time, whereas the former refers to simultaneous exchanges of equal value (Pretty and Ward, 2001).

Common rules, norms and sanctions represent mutually agreed norms of behaviour, also referred to as “the rules of the game”. They affect individual’s confidence to invest in cooperation, knowing that others will participate as well due to the sanctions punishing rule breakers. The rules are set out either by formal authorities, such as laws, or they are informal ones shaped by individuals and communities, whereas norms are preferences indicating how one should act. Social capital implies balance between individual rights and communal responsibilities (Pretty and Ward, 2001).

However, network structure is essential for the social capital (Pretty and Ward, 2001). Network connections can be distinguished in terms of connections within, between and beyond groups, referring to bonding, bridging and linking social capital (Pretty and Ward, 2001; Woolcock, 2001). However, this distinction is a matter of perception since linking social capital can be perceived as bridging social capital as well. In this study bridging and bonding social capital amongst farmers will be assessed with the network closure and structural holes concepts.

Even though social capital is usually perceived from its positive aspects, there is also negative side of it: its mechanisms can have negative consequences by trapping actors in harmful relationships (Portes, 1998; Pretty and Smith, 2004; Portes and Landolt, 1996). What is more, positive outcomes for some can be detrimental for others (Moore et al., 2009). Portes (1998) distinguishes four negative consequences of social capital: restrictions on individual freedoms, excess claims on group members, exclusion of others and downward levelling norms.

As it was pointed out earlier social capital can generate trust and therefore reduce transaction costs⁴ in NRM. However, this is true if social capital already exists. In case of its non-existent, then building it can be costly in terms of establishing and maintaining social relationships (Ballet et al., 2007). Ballet et al (2007) further argue that its implications for the NRM are dependent on the values and norms in which social capital is embedded in. Potential lack of conflict resolution and monitoring norms amongst farmers in this study could be perceived as communal norms detrimental for the long-term NRM.

2.2. The network structure of social capital

The network aspect of the social capital indicates that network structures themselves represent key element of social capital (Burt, 1992; Carlsson and Sandström, 2008). Certain network structures are assumed to provide better resources and are perceived as indicators of social capital (Carlsson and Sandström, 2008).

There are two divergent concepts regarding the relationships between network structure and social capital. They are represented in the concepts of the network closure (Coleman, 1988) and the structural holes (Burt, 2000; Burt, 1992). Burt argues (2000:350) that network closure and structural holes (brokerage) represent network concepts affecting the flow of information and what individuals can do with it. Information not only circulates

⁴ In financial terms and time needed for the monitoring of others (Pretty and Smith, 2004)

within the groups first before it starts circulating between the groups but it also circulates more within the groups (Burt, 2000:350-351).

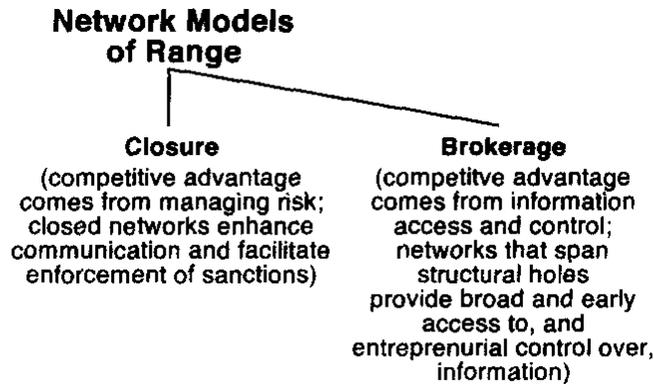


Figure I: Two network concepts affecting the flow of information (Adopted from Burt, 2000:347)

2.2.1. The network closure as social capital

Networks with many and strong connections are considered rich in social capital (Carlsson and Sandström, 2008; Portes, 1998). This is due to the network closure facilitating reciprocity and creation of norms, which are, when existing and effective, form of social capital (Coleman, 1988). Monitoring could be such norm, especially self-monitoring, since it would motivate individuals to act for the benefit of the collectivity, with community interests put forward before their own (Coleman, 1990). Another form of social norms could be conflict resolution within local community, i.e. the acceptance of turning to local mediator that could solve conflicts rapidly and with low costs (Ostrom, 2008).

The network closure also improves communication between individuals in terms of quality of information received and it facilitates sanctions which, when combined with effective norms, enable people to trust each other more (Coleman in Burt, 2000:351-352). Strong relations amongst contacts can enable more reliable communications channels and protect individuals from exploitation due to the connected individuals being able to act together against those violating norms of conduct (Burt, 2000:352-53). Coleman (1990) further argues that network closure is more likely to develop between weaker actors, which enables them to strengthen their position vis-à-vis more powerful counterparts (Coleman, 1990).

Further, the network closure is important for trustworthiness as well, allowing proliferation of obligations. In a closed network, generating collective sanctions, ensuring trust can be applied (Coleman, 1990; Coleman, 1988). Trust makes lives predictable and creates a sense of community, enabling cooperative environment (Folke et al., 2005; Carlsson and Sandström, 2008).

However, strong intracommunity ties give a sense of identity and common purpose to individuals but without intercommunity ties crossing social divisions, such as sectarian divisions present in the Lebanese society, these strong ties could be used for pursuit of

narrow interests and inhibit cooperation with others (Woolcock and Narayan, 2000; Bodin et al., 2006:2).

2.2.2. Structural holes as social capital

The structural holes concept defines social capital as “the information and control advantage of being the broker in relations between people otherwise disconnected in social structure” (Burt, 1997a:340). The concept represents the opportunities to broker, i.e. participate in and control of the flows of information and control the form of projects that bring actors from the opposite sides of the holes together (Burt, 1997a; Burt, 1992; Burt, 2000). Intercommunity, religion based ties can represent the concept of structural holes in my research, concerned with the importance of connections between different sets of farmers (Carlsson and Sandström, 2008). The structural holes are essentially gaps between non-redundant contacts, with contacts being redundant in two ways: as cohesive contacts, which are strongly connected to each other, having same information, or structurally equivalent contacts, linking an actor to the same third parties, hence same source of information (Burt, 1997a:340-341; Burt, 2000:353; Burt, 1992). Non-redundant contacts are those that are more additive in the sense of the resources they possess (Burt, 2000). However, structural holes between cluster of actors do not mean that actors in the clusters are unaware of each other but rather that they just circulate in different flows of information (Burt, 1997a:341).

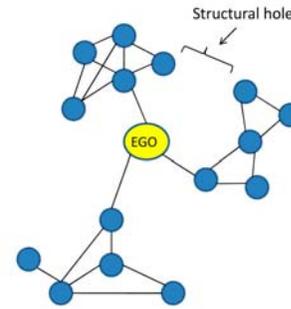


Figure II: Structural holes (DeJordy and Halgin, 2008)

2.2.3. Network closure and structural holes combined

Even though these two concepts seem contradictory, Burt suggested their synthesis. He claims (2000) that brokerage across structural holes represents the source of the added value but that network closure, on the other hand, can be critical for the realization of the value of these new resources. Dense networks lower the risks in regard with transaction, trust and cost, affecting the performance (Carlsson and Sandström, 2008:25; Burt, 2000; Burt, 2001). Optimally, social networks involved in NRM should consist of cohesive sub-networks connected with brokers, diversifying resources and creating more democratic decision-making environment.

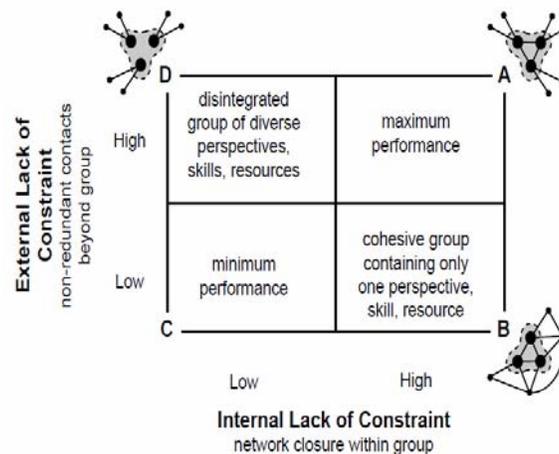


Figure III: Group performance across structural holes and network closure (Adopted from Burt, 2001)

2.3. Key individuals or central actors

The social capital creates preconditions for cooperation but key or central individuals, who can trigger this potential, are essential (Sandström and Rova, 2010; Lin, 1999). Leadership is needed due to its potential to shape changes and reorganization by introducing innovation (Folke et al., 2005:451). In Blat, identification of these central individuals is required due to trying to educate and influence them first, before influencing whole community with their help (Borgatti, 2006). Further, the ability to effectively transfer knowledge can be essential for the transfer of good practices and organisational survival (Reagans and McEvily, 2003).

These potential leaders could help build trust, manage conflicts, link actors and / or groups and initiate partnership between disconnected entities, compile and diffuse knowledge and mobilize support for common goals. On the other side, their absence could lead to inertia of self-organizing processes. However, key individuals must be trustworthy since they have to influence others and it is easier to influence those who are trusting (Folke et al., 2005:451).

The capacity building workshops abroad were needed due to the field visits and hands-on system of the workshops, enabling farmers to get familiar with organisation and management of the WUA⁵, getting introduced to the advanced irrigation systems⁶, getting exposed to the advantages of the WUA facilitating farming activities⁷ and getting familiar with the work of the farmers' local groups focusing on the rural development⁸.

⁵ Visit to the »Consorzio per la bonifica Della Capitanata«, consortium comprising of 9 WUAs

⁶ Visit to the »Cappacciotti« dam on the »Ofanto« river, getting familiar with the on-demand irrigation system using acqua-card technology

⁷ Visit to the «La Cooperativa Vinicola Olearia Ortofrutticola» exposing Lebanese farmers to the advantages of group work (WUA) in facilitation of activities and income raising

⁸ Visit to the «Terre del Primitivo», local action group helping farmers with rural development and improvement of their capacities in different aspects (Gharib, 2011)

3. METHODOLOGY

3.1. Research design

3.1.1. Mixed methods research strategy

The intent of this research is investigation of the social network structure of the farmers in the village of Blat, South Lebanon. These structural characteristics reflect the extent of network social capital in the context of the establishment of the WUA in the village and future irrigation water management. The research design used is mixed quantitative and qualitative case study with main methods used being in-person questionnaire interviewing. The type of study is an action research, aiming to explore social network structure and propose actions for the facilitation of the establishment of the WUA.

3.1.2. Epistemological and ontological stance

The research design and methods chosen are in line with epistemological and ontological positions of interpretivism and constructionism, implying that social world is different from natural world and should be studied in a different way and that social phenomena and categories are constantly produced and revised by social actors (Bryman, 2008). Trying to interpret the functioning of the farmers' social network I will combine quantitative data collection with questionnaires and qualitative data collection with key informant interviews, personal observations and documentation reviews. Exploratory social network analysis (SNA) will enable me to reveal farmer's network and its structural characteristics. This structure will then be interpreted in line with the social capital theory, from the network perspective. Further, central positions of the farmers will be interpreted from the network perspective as well.

3.1.3. Case study research design

For my research design I chose the case study design which entails detailed study of a single case and can be used for qualitative or quantitative research (Bryman, 2008). Yin (2003:13) defines case study as an empirical enquiry investigating a contemporary phenomena within its real-life context. He (2003:1) further claims that the case study is usually used when researcher has little control of the event under study. The case study method allows researcher to "retain the holistic and meaningful characteristics of real-life events" (Yin, 2003:2).

The research design and methods chosen are also in line with epistemological and ontological positions – interpretivism and constructionism (Bryman, 2008). Furthermore, case study research design employed in this study is holistic single case study design due to the study of the general characteristics of the farmers' social network structures in the village of Blat (Yin, 2003:39). In addition, nature of the case is revelatory due to the observation and analysis of the phenomena not being investigated previously in the South Lebanon or in the village of Blat (Yin, 2003:42). Moreover, social network analysis is a type of analysis that is suitable for the case study research design due to the need of contacting limited number but as much of the actors as possible and not leaving out potentially influential actors, ending up with distorted structure of the social network.

3.1.4. Case study selection – Village of Blat

When selecting a case and / or units of analysis measures must be taken in order to ensure that both address the issues and / or questions of interest (Yin, 2003). After the documentation review and interviews with some project partners⁹, I realized that project villages would establish their own WUA and then merge into a federation at the higher level due to distinct natural and social preconditions in each of the villages.¹⁰

My options came down to the choice of the most suitable village. Number of identified farmers in each village varied between 8 and 51. Interviewing farmers in the village with the highest number of farmers was unfeasible due to time-consuming in-person interviews and my financial constraints, so I selected village Blat with second highest number of farmers (UNDP Lebanon, 2010b). I further supported my selection with the Blat being the biggest village and having the biggest average size of the agricultural land plots, majority of the farmers owning the land, land being predominantly cultivated between 75 - 100% and most of the farmers not irrigating the land (UNDP Lebanon, 2010b).

3.1.5. Case study selection – network boundary

For the network boundary specification realist approach, treating network as a social fact experienced by the farmers composing it, was used (Laumann et al., 1983:20-21). The farmers had opportunities to cooperate with each other through Agricultural Cooperative (UNDP Lebanon, 2010a), thus farmers being aware of each other as distinct social entity. Moreover, identification of individuals for the network boundary specification was done with combination of positional and reputational approach. The former approach is based on the selection of actors according to their attribute, in this case full time or part time farmers and owning or renting the land. However, due to the information gained during the data collection, selection of farmers was supplemented with the reputational approach, delimiting participants based on gathered information (Laumann et al., 1983:22-24). Some of the farmers on my initial list were not fulfilling the farming and land rights conditions for their inclusion, thus they were omitted.

Draft Law of the irrigation Water User's Association defines that members of the WUA can be owners of the land (AFIAL, 2010) but there are few problems with the land rights in Lebanon. Due to the lack of official data regarding the land tenure, I decided to focus only on the farmers present, instead of on all owners. However, farmers had to be owners as well and this is the case with the study (UNDP Lebanon, 2010b). This reduction of the network is necessary since it is impossible to identify all of the owners, who are either completely unknown or are abroad and unreachable¹¹. Another rather interesting problem is that in Lebanon deceased individuals can still be *de iure* owners. After their death land has to be divided amongst inheritors, which can be very costly, and often the land is just not divided¹².

⁹ Karaa, Gharib, 2010

¹⁰ Gharib, 2010

¹¹ Bahsoun, 2010

¹² Bahsoun, 2010

3.2. Study area

The area of focus is village Blat located in the province (mohafaza) of Nabatiyeh and in the district (qada) of Marjeyoun, South Lebanon (Cammet and Issar, 2010:392; UNDP Lebanon, 2010b). The village is in the area under the mandate of the UNIFIL¹³ since the 1978 (United Nations, 2011) and was one of the villages affected in the 2006 July war between Israel and Lebanon (Irani, 2008; Norton, 2007).

The area of the village is 8 km² and the population is estimated at 5500, with 750 all year residents (UNDP Lebanon, 2010b). Predominant religious affiliation is Moslem Shi'i (Cammet and Issar, 2010; Verdeil et al., 2007) but other religions¹⁴ are present as well. Prevailing crops in the village consist of field crops and olive trees due to the lack of irrigation water, since field crops and olives can be productive even without irrigation (UNDP Lebanon, 2010b).



Figure IV – Village Blat (Savanović, 2011)¹⁵

¹³ United Nations Interim Forces in Lebanon

¹⁴ Orthodox, Roman Catholic, Protestant

¹⁵ Data source: Bing Maps, 2011; SDATL project (CDR, IAURIF and Dar al Handash, 2010)

3.3. Data collection

3.3.1. Sampling

Prior to data collection I assumed that I would be able to collect data on all farmers due to their small number, thus collecting full network data. The latter is preferred due to its complete picture of the relations and more accurate measurement of many structural concepts¹⁶. However, full data collection can in some cases be impossible even if all of the actors are known. Data can only be collected to a certain degree and it can be made manageable by limiting the number of alters actors can report on (Hanneman and Riddle, 2005:7).

This unfeasibility was also the case of my study. Even though I had the information about the farmers in the village, interviewing all of them turned out to be impossible due to the practical reasons (Bryman, 2008), namely: some of the farmers were either unwilling or unable¹⁷ to participate, whereas with others I was unable to make an appointment because one was living elsewhere or due to inability of finding the others in the village¹⁸. All these constraints left me no choice but to omit them from my network and instead of collecting the full network data I collected ego-network data, i.e. the farmers reporting on their contacts (Marsden, 1990; Straits, 2000; Wasserman and Faust, 2009).

Nevertheless, I managed to interview ten out of sixteen farmers but three of the non-respondents ended up in the network as well, being reported on by others. Thus I managed to obtain full or partial data for 13 farmers. Non-respondents that ended up in the network were the ones I could not get the hold off them. On the other hand, omitted farmers were two unwilling¹⁹ to and one unable to participate. The latter was 92 years old farmer, unable to follow the conversation. Implications of the missing farmers for the interpretation of the results will be elaborated on in the data quality part.

3.3.2. Methods used

I employed multiple methods consisting of in-person questionnaires, interviews with key informants, observations and project documentation review (Silverman, 2005; Creswell, 2007). This enabled me to draw data from different contexts and to triangulate information collected and subsequently improve the reliability of the research. However, caution had to be taken with the multiple methods which could impede the in-depth analysis (Silverman, 2005). For this reason my predominant focus was on in-person questionnaires. However, since I spent some time in the field I supplemented my questionnaire data with informal conversations and semi-structured interviews with key informants and my personal observations.

¹⁶ Centrality measures

¹⁷ One farmer was 92 years old and was unable to follow the interview

¹⁸ My data collection coincided with the olive picking season and farmers were in their fields throughout the day; some of them never answered the phone and when I visited their homes they were not present

¹⁹ One, who was very old, did not expect anything good from the project, whereas the other only had olive trees and he thought that irrigation would spoil his oil

3.3.3. Questionnaires

Questionnaires are the most commonly used social network data collection method and are most useful when actors are people and when relations studied are the ones actors can report on (Wasserman and Faust, 2009). The questionnaires were prepared in the form of name generators, i.e. survey questions asking respondents about their alters, and name interpreters, i.e. survey questions eliciting data on reported alters and relationship with them (Burt, 1984; Burt, 1997b; Marsden, 1990:439; Marsden, 2005:11). Furthermore, three question formats were used: free recall, fixed choice and rating of the ties (Wasserman and Faust, 2009:45-48).

Free recall design is used when there is less definable network and the farmers themselves generated the list of names of the alters, revealing their ego-networks (Lin, 1999:38; Wasserman and Faust, 2009:45-48).

Additionally, the farmers were restricted to finite number of alters they could nominate, hence the fixed choice format (Wasserman and Faust, 2009:45-48). I decided to use this format for two reasons. Firstly, according to Burt (1984:314) up to eight alters are usually cited, averaging three. However, five alters fixed choice was chosen in order to improve measurement precision comparing to the three fixed choice option (Burt, 1984). And secondly, data provision for the alters, especially when more name generators are used, can be tedious task and due to respondents' potential boredom and inattentiveness it is wise to limit the number of alters they can report on (White and Cotts Watkins, 2000; Marsden, 2005; Bell et al., 2007).

In addition, data about the tie characteristics was collected as well, using tie indicators²⁰ for tie strength and tie predictors²¹ for identification of the alters' role (Marsden and Campbell, 1984). Farmers' ratings of the strength of their ties is considered as rating format (Wasserman and Faust, 2009:45-48). In addition, farmers provided me with socioeconomic, demographic and other data (see Appendix I)²².

Before entering the field questionnaire was tested for its ambiguities and to measure time needed for the questionnaire to be answered, which was used in the informed consent (Kvale and Brinkmann, 2009; Kvale, 1996; Bryman, 2008). I conducted the questionnaires in person with the help of the interpreter. Interviews lasted between 30 and 90 minutes, averaging 45 minutes.

With in-person interviews I was able to control the unexpected outcomes which in my case appeared in the minor reformulations of some questions, increasing the validity of the research. Furthermore, I was able to discuss some issues in depth and take observation notes. In addition, I was also able to control that the interviewees were actual farmers (Bryman, 2008).

²⁰ Tie indicators were used to measure emotional closeness, frequency of communication and duration of acquaintanceship amongst farmers and their alters

²¹ Tie predictors revealed the roles of the alters in terms of being kin, friend, neighbour etc.

²² Inclusion of institutions and NGOs into the questionnaire was discussed with Ms. Nassif and it consists of locally active NGOs, organizations perceived as potentially influential by project implementers and project partners; trust and confidence questions were adopted from WVS and contextualized

3.3.4. Observations – Field notes

I also collected data through informal conversations and my personal observations in the form of the field notes. While collecting my data I spent 13 days in the field, living at my interpreter's home and spending time with his family and his friends. This enabled me to write down day-to-day events, overheard conversation and notes about conversations with my interpreter (DeWalt and DeWalt, 2002).

Furthermore, through informal conversation with my interpreter I would deepen my knowledge about the collected data. On average we would spend around six hours per interviewing day trying to interview farmers and we would engage in all sorts of conversations. I would predominantly write down analytic notes interpreting already collected data and impressions (DeWalt and DeWalt, 2002).

3.3.5. Interviews

I conducted couple of interviews with key informants which provided me with information useful for my questionnaire preparation and case selection. While conducting the interviews I was using the digital voice recorder, enabling me to focus on conversation more, reducing the distraction and increasing the free flow of the conversation (Kvale and Brinkmann, 2009). Since interviews were in the form of the semi-structured interviews, additional questions could be asked when better apprehension of the topic was gained (Bryman, 2008).

3.3.6. Document Reviews

During my research I came across various documents, i.e. surveys, project proposals, stakeholder analyses and legislation drafts. All these documents were very useful at the beginning of my research, providing me with the insight in the nature of the project and the social reality in the field. Furthermore, stakeholder analyses and surveys amongst the farmers helped me select the case and units of the analysis.

However, precaution was needed since documents could be biased and misleading (Bryman, 2008). Specific problems with the documentation in Lebanon arise in regard with the statistical data due to the absence of such data, e.g. last census being conducted in 1932 (Makdisi, 2007; Norton, 2007), or collected data being of poor quality due to the careless data collection²³. Nevertheless, uncovering the errors or distortions can be done by triangulating the information (Bryman, 2008).

3.4. Ethical considerations

Ethical issues regarding the access to the farmers and gaining their participation in the research were addressed as follows. Firstly, informed consent was written so that in case the farmers wanted to have one, it was available. Secondly, purpose of research, methods used, time needed for answering the questionnaire and options for withdrawal and not answering the questions were presented. Thirdly, confidentiality issues, i.e. access to data

²³ Karaa, 2010

and conversion of the names mentioned into “farmer #” and “alter #”, were explained as well (Bryman, 2008; Kvale and Brinkmann, 2009; Kvale, 1996; Scheyvens et al., 2003).

3.5. Limitations of the study

There are two issues I would like to bring up as limitations of this study. Firstly, my interviews were conducted in Arabic. Some of the farmers were very talkative but I was unable to grasp the whole conversations. However, interpreter would explain to me certain parts of the conversations but only those which he perceived could interest me, whereas I could find more things interesting for my research and take more field notes.

Secondly and more importantly, my initial plan was to identify central farmers in the networks and conduct semi-structured interviews with them. I wanted to investigate if they are motivated for the participation in the capacity building and if they are willing to be facilitators of the WUA establishment. After all, SNA calculations must be supplemented with the social factors as well and motivation plays important part in cooperation. However, due to my problems with visa I had to leave Lebanon earlier than planned and was unable to conduct the interviews.

3.6. Data quality

3.6.1. Accuracy of interaction reports

Accuracy refers to respondents recalling their interactions and due to the recall data collection method used, accuracy of the reports can be a concern (Wasserman and Faust, 2009; Calloway et al., 1993), especially if average age of respondents is 62, like in this study (Freeman and Romney, 1987:333). Level of forgetting alters in the free recall data collection differs across groups and relationships but it is inversely connected with tie strength (Marsden, 2005:14; Brewer, 2000; Brewer and Webster, 1999; Kogovšek, 2006). When using recall data collection method, probing for additional alters can reduce the level of forgetting (Marsden, 2005:14; Brewer, 2000)

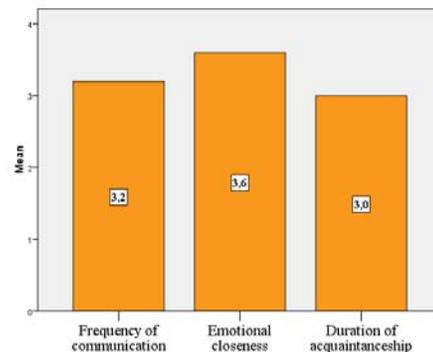


Figure V – Tie strength²⁴

and in case of not reporting on all possible alters, farmers were probed if there was anybody else that they forgot about.

Further, remembering persons can importantly depend on their social relations, with social closeness affecting the recall of persons (Bond et al., 1985:44; Brewer, 1995; Fiske, 1995; Bondonio, 1998:325; Mouton Srygley et al., 1955; Freeman and Romney, 1987). Accuracy also increases when reporting prolonged interactions, as opposed to sporadic

²⁴ Maximum values are 4 (daily), 4 (especially close) and 3 (more than 6 years) for frequency, closeness and duration, respectively

ones (Calloway et al., 1993; Freeman and Romney, 1987; Carpentier and Ducharme, 2007). Farmers' communication with their family members and their engagement in agriculture, regardless of the level of the farming activity, could be perceived as routines, i.e. "prolonged interaction".

Moreover, relationship between individuals is more important factor of remembrance than similar attributes, such as age, gender, race, personality or physique. However, the latter can further strengthen the remembering (Bond et al., 1985; Fiske, 1995). Reports on alters in regard with their role revealed that most of the farmers' contacts were either kin, friend, neighbour or the latter both, which increases the accuracy of the farmers' reports. In addition, reported ties were predominantly strong in terms of emotional closeness, rather frequent and prolonged.

Regarding respondents' reports on alters' attributes, it has been established that many alter characteristics can be reported on with reasonable accuracy (Marsden, 2005) and accuracy rates are extremely high when respondents report on their close friends' characteristic (Burt, 1984; Marsden, 1993). In this study respondents were asked to provide information about alters' gender, location, occupation and religious affiliation.

3.6.2. Validity

Name generators try to reveal certain type of social ties and usually it is assumed that respondents share researchers understanding of the question (Marsden, 2005:15). Validity of measurements was addressed by posing questions using simple wording (DeJordy and Halgin, 2008). Further, questions were tested for their ambiguities and altered before going to the field and some minor reformulations were done during the first interviews and at the end of the first interviewing day.

Name generator for the support network matters was adopted from the GSS survey (Burt, 1984). The validity of this name generator can be affected by "context effect" – respondents constructing context based "important matters" definition. This was avoided by placing the question at the beginning of the questionnaire, limiting respondent aforementioned construction (Bailey and Marsden, 1999:306). Moreover, when question is posed this way respondents decide what is important to them and not what research thinks could be important to respondents, enabling him to avoid his personal values affect the research (Bryman, 2008).

Name generator trying to reveal knowledge network was adopted from Bodin and Crona (2008) but was contextualised with the UNDP agricultural engineer's help, achieving face validity (Bryman, 2008:152). Moreover, validity was further increased with my interpreter also being agricultural engineer and in case of ambiguities in the field he was able to intervene with his knowledge and probe further.

Regarding the questions about conflict resolution mechanism and monitoring I think that they are rather straightforward and cannot imagine that there would be any problems understanding them (see Appendix I).

In addition, name generators measuring intimacy and activity at the same time further increase construct validity (Burt, 1997b; Burt, 1997 in Marsden, 2005:13). This was

achieved with the use of tie strength indicators²⁵ and tie predictors²⁶ for each of the networks. And lastly, validity (and accuracy) also increases in smaller ego networks (Kogovšek and Ferligoj, 2005:221; Bell et al., 2007), hence fixed-choice format having positive sides as well. Smaller networks also consist of stronger ties which can be advantageous for my study due to farmers' average age potentially affecting their recall ability (Freeman and Romney, 1987:333).

3.6.3. Reliability

Reliability refers to ability of obtaining same data with repeated measurement on the same unit (Kogovšek and Ferligoj, 2005; Bryman, 2008; Wasserman and Faust, 2009). The ordinal scales were used in the questionnaires due to their higher reliability as opposed to binary reports, reporting only on presence or absence of the ties. Further, reliability also increases with reports on stronger and more frequent ties (Ferligoj and Hlebec, 1999; Kogovšek, 2006; Marsden, 2005; Calloway et al., 1993). Moreover, according to Ferligoj and Hlebec (1999:125) fixed choice data collection does not affect reliability much in cases when respondents know their contacts well. And finally, according to Marsden (1993:401), data on three to five alters generates acceptably reliable measures of network density and composition²⁷.

3.6.4. Measurement error

Measurement error is a misclassification of relations that are either recorded but do not exist or are not recorded but do exist in the true network structure (Holland and Leinhardt, 1973; Brewer, 2000). However, Brewer (2000:41-42) argues that findings support that most, if not all, of the recalled ties are genuine.

Collected data, or observed network structure, is composed of true network structure and error (Holland and Leinhardt, 1973:86). There are two implications of the measurement error for the research: level of measurement error in observed ties and its implications for the interpretation of the network (Iacobucci et al., 1999).

In this study measurement error is attributable to the lack of accurate data on the number of farmers, unwillingness or inability of some farmers to participate, inability to make appointments with farmers due to geographic distance, inability to find them in the village and fixed choice data collection format.

The problem with the fixed choice format is a network distortion due to the possible difference in the number of the reported ties and it can be twofold: farmers could have more ties than fixed-choice allows them to report on or they could have less ties and would report non-existing ones in order to fulfil the requirement (Holland and Leinhardt, 1973). Regarding the second case, I do not see problems since not all farmers reported all five ties and when probed they would stick to their reports. Whereas for the first case it is

²⁵ Emotional closeness, duration of acquaintanceship, frequency of communication

²⁶ Kin, friend etc categories

²⁷ Central tendency of an attribute distribution across alters (Marsden, 1993)

not possible, without posterior test, to establish which ties farmers chose and if there are any non-reported ties that would be more significant, i.e. with other farmers.

Measurement error attributable to unwillingness or inability of the farmers to participate and inability to meet them was alleviated to a certain degree with some farmers ending up in the network anyway, being reported on by others. This way network actually consists of both, respondents and non-respondents. Instead of removing the non-respondents, I used the process of network reconstruction with which farmers' identification of ties was accorded to non-respondents as well (Robins et al., 2004:259-260). Reconstruction is further supported by the way name generator were formulated with "discussion" and "exchange" terms used, implying reciprocity of action.

The error could be further alleviated by the fact that one farmer unwilling to participate and one unable to participate were very old and I do not regard them as being very active socially, hence possibly being rather peripheral in the network. Further, one of them is Christian and their network consists mostly of the within-group ties, generating small number of ties. Regarding third completely missing farmer, indirect signs, i.e. not being mentioned by any other farmer, indicate that he could be rather peripheral in the network as well, thus omitting him not having significant implications on the results (Brewer, 2000:41).

However, there was nothing I could do to prevent or minimize the measurement error attributable to the lack of accurate data on farmers' number, i.e. ambiguity regarding one farmer being the land owner or not²⁸.

These measurement errors will mostly affect global network measures (centralization), which are more sensitive to errors due to the consideration of direct and indirect ties (Zemljič and Hlebec, 2005). However, network is rather small with direct or two step ties reaching almost entire network from the most central actors' perspective. However, networks are unstable entities that can change rapidly (Maines, 1993:27). Due to some of the farmers' old age they could be deceased by now and others could have sold their land²⁹, thus changing my network significantly.

3.6.5. Triangulation

Triangulation will help increase credibility of the research by employing multiple sources of data, i.e. primary data collected with questionnaires and key respondent interviews and secondary resources, consisting of various documents obtained from the hosting and partner organizations, internet resources, scientific articles and my observations (Bryman, 2008; Creswell, 2007).

4. ANALYTICAL FRAMEWORK

Assessment of the structural aspects of the farmers' social networks was done with the social network analysis (SNA). SNA can be used as diagnostic tool when promoting

²⁸ UNDP data stating she was a farmer but when I approached her she told me she did not own any land

²⁹ Few farmers told me that they were approached by individuals that wanted to buy their land

cooperation and knowledge sharing (Cross et al., 2002). Religion-based groups were defined in order to investigate if religion plays any role in structuring communication networks. Further, tie strengths indicators based on frequency³⁰ of communication, farmers' closeness and duration of their acquaintanceship and tie predictors, defining alters' roles (kin, friend, etc.) were used as well (Marsden and Campbell, 1984). Tie strength indicators were further aggregated into one strength measure³¹. Collected data was entered into the SPSS in accordance with Burt's (1984) suggestion of aggregation of the data into hypothetical and generalized "sixth" alter, averaging the data. This way attributes could be used for the analysis of the respondents interpersonal environment (Burt, 1984:329). Software used for the social network analysis was UCINET (Borgatti et al., 2002) and Key Player 2. The latter was also used for the graphic representations.

4.1. Communal social capital

The assessment of the of the communal social capital was done with two networks: social support network and knowledge network. Further, normative aspect of social capital was assessed separately with conflict resolution and monitoring networks. The linkages between actors occur within different contexts simultaneously and measuring these linkages with more networks is referred to as multiplexity (Hamill, 2006:22). In case of ties from support network and knowledge network being complementary, new combined network would be created and new tie strength formed in order to capture the essence of both networks.

The social support network was used to reveal the strongest and most intimate relations between farmers (Bodin and Crona, 2008:2768), generating emotional and problem solving support (Van der Gaag and Snijders, 2002).

Knowledge network was explored in order to unveil knowledge diffusion channels, needed for dissemination of new knowledge gained with capacity building. Efficient diffusion of the knowledge could be essential for the WUA establishment and its future viability (Cross et al., 2002). In addition, common understanding of farmers' current agricultural situation and new technical and managerial knowledge could further be essential in enabling collective action in NRM (Ostrom, 1990 in Bodin and Crona, 2008:2768).

The conflict resolution network was explored to reveal presence of the local conflict solving mechanism and procedures. These mechanism can enable "rapid access to low-cost local arenas to resolve conflicts" (Ostrom, 2008:100).

And lastly, monitoring network was explored to investigate the farmers' willingness to monitor and report rule breaking. Monitoring and reporting represent compliance with the community norms, thus being a component of normative part of the social capital (Bodin and Crona, 2008).

³⁰ Frequency of the communication refers to communication pattern during the farming season, otherwise would not be meaningful since agricultural issues are not discussed often otherwise

³¹ Values of each indicator were doubled in case of network reconstruction and in case of actual reciprocity values were summed; possible aggregated tie values vary between 6 and 22

Table I: Types of networks under study

Network name	Type of network
Social support network	Discussion of important matters
Knowledge network	Agricultural knowledge exchange
Conflict resolution network	Individuals that could play important role in conflict resolutions
Monitoring network	Individuals / institutions for reporting a rule breaking

The network measures used for calculations are related to the communal cohesiveness, the degree of fragmentation and the brokerage across the network. The cohesiveness of the community as a whole and its potential sub-groups will be measured by network density of the farmers' ties. Level of fragmentation will be revealed by the number of components, i.e. isolated sub-groups, present in the network. Bridging and bonding social capital will be assessed by the number of / ratio of relations within and between subgroups, defined on religious basis (Hanneman and Riddle, 2005). Further, structural holes measures will show us which farmers are brokering across the network the most.

Table II: Network measures of social capital

Network Measure	Description / definition	Relation to social capital
<i>Density</i>	Density of binary network represents the proportion of all possible ties that are present; for valued network it represents the sum of the ties divided by the number of possible ties (De Nooy et al., 2005; Hanneman and Riddle, 2005; Borgatti et al., 1998);	Measures reveal the extent of network cohesiveness and can be used as the measures of the network closure (Coleman, 1988; Sandström and Rova, 2010). Higher community degree, i.e. denser networks, form more cohesive communities, thus have higher capability of collective action (Granovetter, 1973; De Nooy et al., 2005). Cohesive subgroups also generate solidarity and shared norms (De Nooy et al., 2005) since individuals are most strongly influenced by their primary groups (Frank, 1996)
<i>Degree</i>	The degree represents number of ties each vertex has (De Nooy et al., 2005; Iacobucci, 2009)	
<i>Average degree</i>	Measure for the structural cohesion of the network, representing sum of vertices degree divided by the number of vertices (De Nooy et al., 2005; Iacobucci, 2009)	
<i>No. of components</i>	Components are sub-networks that are connected within and disconnected between. They can consist of either individuals or more interconnected actors (Hanneman and Riddle, 2005; Scott, 2000; Iacobucci, 2009)	

<i>E-I Index</i>	Measure of group embedding, comparing the within / between group ties (Hanneman and Riddle, 2005; Krackhardt and Stern, 1988);	Within and between group ties represent concepts of bonding and bridging social capital, respectively (Pretty and Smith, 2004; Woolcock, 2001; Woolcock and Narayan, 2000)
<i>Effective size</i>	Number of alters ego is directly connected with, without redundant ³² contacts (Borgatti et al., 1998; Burt, 1992)	Structural holes reveal the individuals that represent brokers, connecting otherwise disconnected parts of the network influencing the network flows (Burt, 1992; Burt, 2000)

4.2. Key individuals

This study is focusing on the key individuals due to the reason that farmers will be chosen and sent for the capacity building abroad and care should be given to the choice of the best possible candidates for their new knowledge dissemination and potential influence on other farmers afterwards. Individuals' structural position can affect information circulation in the network (Prell et al., 2009:4). Key individuals will be identified according to their centrality scores. A range of the centrality measures is available, each having specific relation to social influence (Bodin and Crona, 2008:2769). The key individuals will be identified by the multiple measures, namely: degree centrality (Wasserman and Faust, 2009; Hanneman and Riddle, 2005:148-152), betweenness centrality (Freeman, 1978/79; Freeman, 1977) and closeness centrality (Hanneman and Riddle, 2005:153-162).

Individuals with high degree centrality are potentially important for mobilization of the networks and can use their direct links for information diffusion and potentially initiate cooperation (Prell et al., 2009).

Freeman argues (1977:40) that use of betweenness centrality is natural in communication networks, where communication control by individuals is relevant. Further, betweenness measures are useful in the networks that are not completely connected, which is the case in this study (Freeman, 1977:35). In addition, betweenness central actors are important for long-term NRM, bringing together disconnected parts of the network and introducing diversity and new ideas (Prell et al., 2009:4).

Closeness centrality measures are also very useful for communicating information to others, with short communication paths being potentially efficient in problem solving situations (Wasserman and Faust, 2009:184; Iacobucci, 2009).

However, aforementioned measures are concerned with actors being individually most central but they can point out individuals that can be quite different from a set of nodes most central as an ensemble (Borgatti, 2006:24). Borgatti (2006:21) claims that in the context of managerial change initiative, identification of central actors or informal leaders

³² cohesive redundancy (having contacts with the same information); structural redundancy (having same source of information) (Burt, 2000)

to influence them first, can be beneficial in order to easier diffuse new practices (Borgatti, 2006:22). Influencing and educating more farmers at the same time could be beneficial for their NRM.

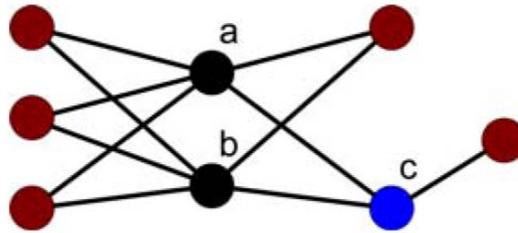


Figure VI: Two most central nodes (a and b) reach less nodes than different set of nodes (a and c) (Adopted from Borgatti, 2006:24)

After the centrality calculations will be made, each farmer will be assigned a rank according to the values calculated for various centrality measures and subsequently overall ranking will be assigned to them as well. This way identification of key individuals will not be based only on one measure, hence alleviating measurement error.

Table III: Network measures of social capital

Measures		Description / Definition
Degree centrality	Freeman's approach	Number of ties an actor has (De Nooy et al., 2005:63-64); more ties represent a possibility of directly affecting more actors (Hanneman and Riddle, 2005:150)
Betweenness Centrality	Freeman's betweenness node	Individual is central to the extent that he/she lies on the geodesic between other actors (Freeman, 1977:35); It is sum of the proportions of time that actor is between other actors for sending info (Hanneman and Riddle, 2005:163)
	Flow centrality	Flow centrality is measured by the proportion of the entire flow between two actors, i.e. all of the pathways between actors, occurring on paths of which a given actor is a part. It measures how actors are involved in all of the flow between all other pairs of actor (Hanneman and Riddle, 2005:166).
Closeness centrality	Freeman's geodesics path	How close an actor is to all others in the network – actor is central if can quickly interact with others (Wasserman and Faust, 2009:183); “Farness” is sum of the all geodesics from (or to) ego from all other nodes; it can be reciprocated in “nearness” or closeness (Hanneman and Riddle, 2005:154-155)
	Reach	Proportion of others that actor can reach in various number of steps (Hanneman and Riddle, 2005)
KPP-Pos³³	Distance-weighted reach ³⁴	Measure is defined as “the sum of the reciprocals of distances from the kp-set ³⁵ S to all nodes, where distance from the set to a node is defined as the minimum distance” (Borgatti, 2006:29)

³³ KPP-Pos stands for Key Player Problem-Positive

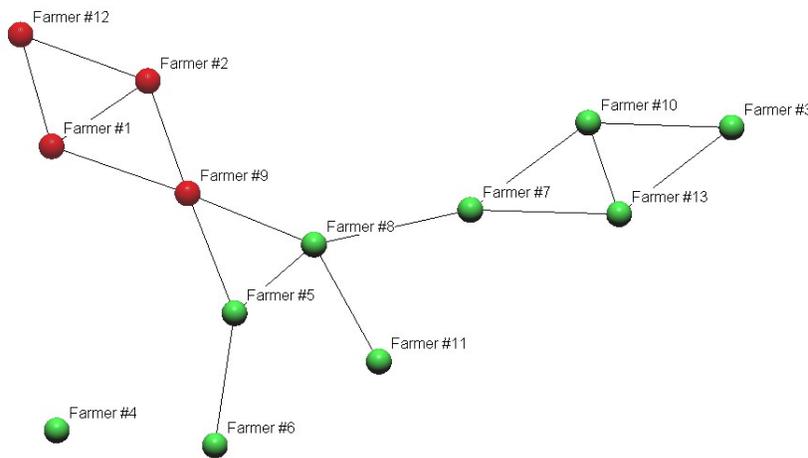
³⁴ Normalized values vary between 0 and 1; value one meaning that every outside node has direct link with at least one member of kp-set (Borgatti, 2006)

³⁵ Kp-set represents the most central set of nodes (Borgatti, 2006)

5. RESULTS

5.1. Socio-economic and demographic characteristics

The analysis reveals that half of the farmers, who are all males, are full time farmers with the average age of 62. The youngest farmer has 40 years, whereas the oldest has 87 years. Regarding religious affiliation, four farmers are Christians and nine are Moslems, which roughly reflect the overall religious proportions in the southern Lebanon and in the village of Blat³⁶ (Cammet and Issar, 2010:405; Verdeil et al., 2007). Christian farmers are more heterogeneous regarding their religion with two of them being Orthodox, one Roman Catholic and one Protestant, whereas Moslem farmers are all Shi'i.



Sociogram I: Farmers' religion - Christians (red), Moslems (green)

In terms of their education, almost three quarters of the farmers have either primary or complementary level of education. One farmer has no formal education and one has university level or higher.

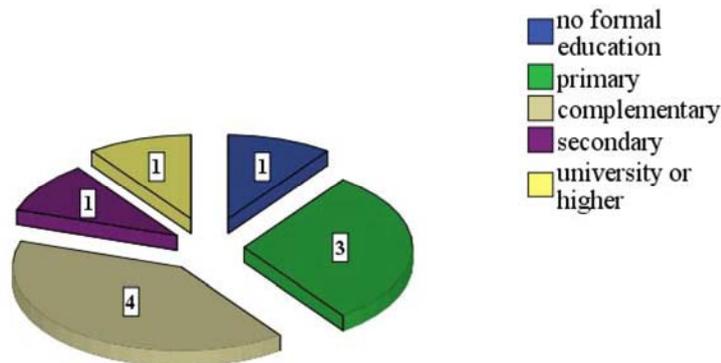


Figure VII: Education levels attained

³⁶ More than 70% of the population are Shi'i

The farmers' household monthly income levels indicate that half of the farmers' income is below 1 000 000 LBP, i.e. roughly average wage³⁷, of which four farmers' income is below minimum wage³⁸.

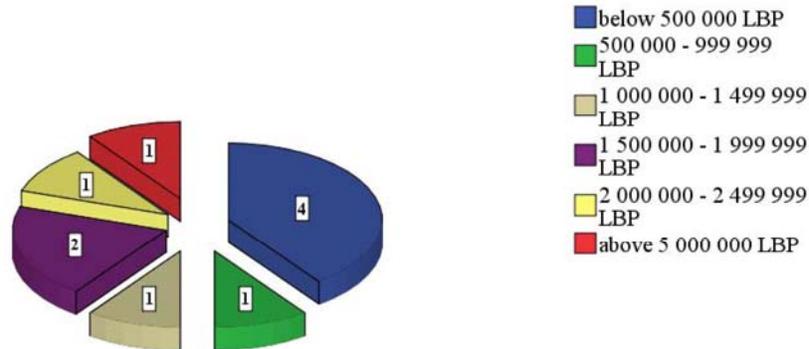


Figure VIII: Farmers' household monthly incomes

5.2. Communal trust and cooperation in the past

The data indicates that farmers do not trust people on general, strangers and other farmers in the village. Seven farmers reported that they did not have much trust or did not trust other farmers at all.

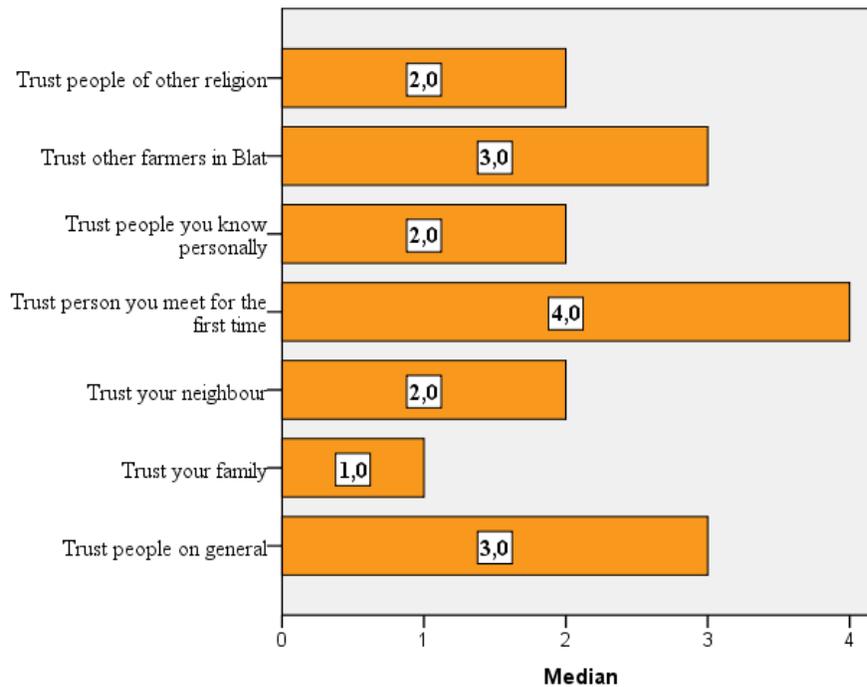


Figure IX – Farmers' trust³⁹

³⁷ Average wage in Lebanon is 600\$ (Nassif, 2011)

³⁸ 500 000 LBP represent minimum wage in Lebanon; exchange rate LBP/EUR is 2000 LBP per 1 EUR

³⁹ Values vary between 1 (complete trust) and 4 (no trust at all)

It is similar story with the confidence in institutions. Farmers predominantly have no confidence in them, with the mayor being an exception. All but one farmer have at least some confidence in mayor. What is interesting is that people were not familiar with UNDP and AFIAL's⁴⁰, i.e. main project implementers, work. The lack of the confidence in the institutions could be attributable to the area being neglected in the past by governmental institutions (Volk, 2009) and low quality and control over the works executed.

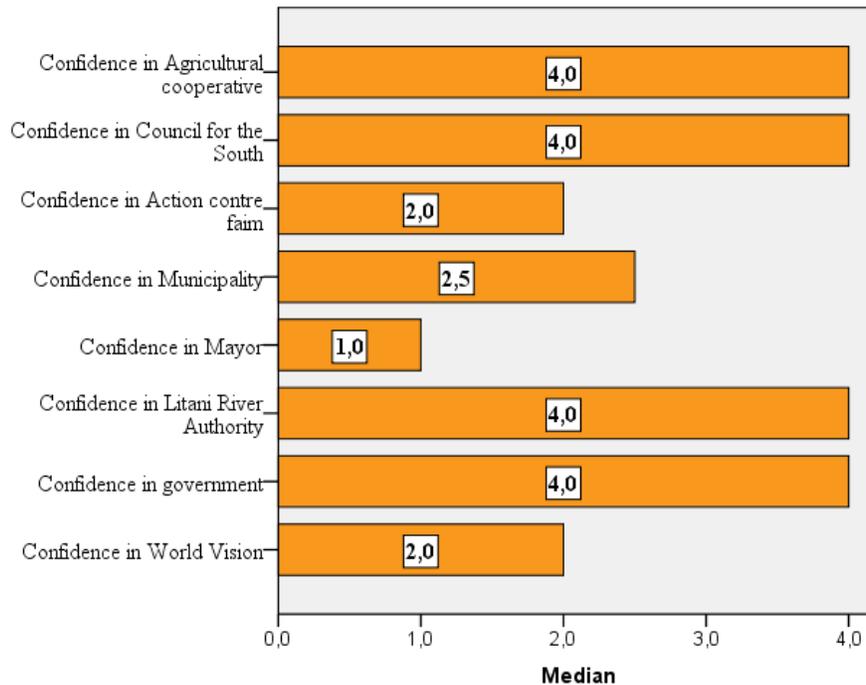


Figure X: Farmers confidence in institutions and NGOs⁴¹

Regarding cooperation, only two farmers got involved in cooperation in the past but only with their family. Further, two of them said that they would never cooperate with farmers from Blat. The lack of past cooperation is rather worrying fact and it reveals that interpersonal relationship skills could be missing⁴² (Petri, 2010).

5.3. Communal social capital

5.3.1. Support network

The analysis of this network reveals that farmers have 43 outgoing ties, averaging 4.3 ties per farmer. However, all but one farmer discuss important matters within their close families⁴³. Farmer #5 reported he discussed important matters with his friend as well. Other farmers prefer discussing important matters with their families even if they are

⁴⁰ Only one farmer was familiar with UNDP's work and none with AFIAL's

⁴¹ Values vary between 1 (complete confidence) and 4 (none at all)

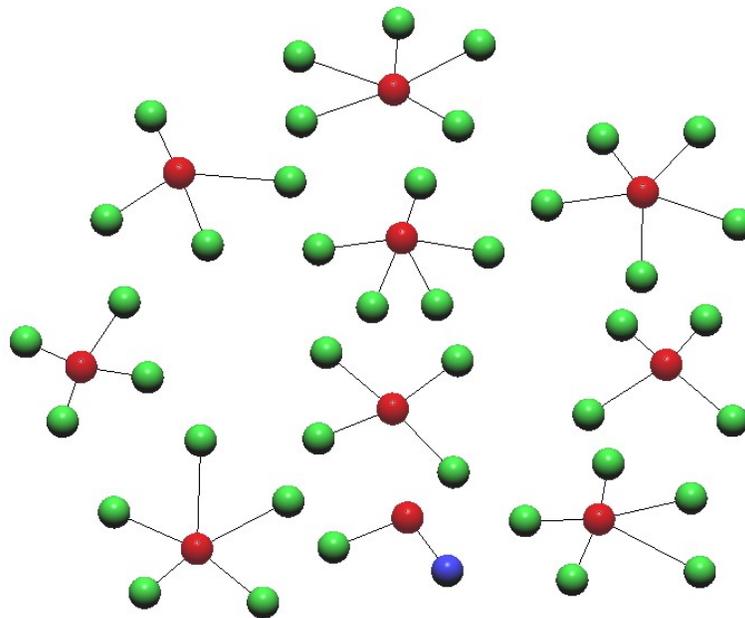
⁴² Mutual respect, trust, effective communication (Petri, 2010)

⁴³ Spouses, siblings, parents, children

elsewhere in Lebanon or even abroad. My assumption that there would be more non-kin ties, preferably with other farmers, was incorrect. What is even more surprising, farmers are close friends, even neighbours in the case of Christian farmers, and I expected that “close friends” would inhere discussion of important matters. The proportion of the kin ties (97,7%) indicates strong familiar closures (Hanneman and Riddle, 2005:125-128; Krackhardt and Stern, 1988).

Table IV: Support network characteristics

	Support network
No. of farmers' outgoing ties	43
Average No. of farmers' outgoing ties	4.3
Proportion of kin-ties	97.7%



Sociogram II: Kin and Non-kin ties - interviewed farmers (red), kin (green), non-kin (blue)

5.3.2. Knowledge network

The analysis of the ties reveals that 82 ties within the whole network were resent, with an average degree of 2.47, indicating rather small number of direct contacts. Further, network density indicates that only 7.5% of all possible ties are present. My assumption that there would be religion based components was incorrect but there is one component consisting of only one farmer and his contacts. However, extracted network of only ties between farmers has higher density, i.e. 20,5% of all ties present and an average degree of 2,43 ties per farmer.

Estimations of religiously based bonding and bridging ties indicate that bonding ties represent 90.2% of all ties present. The situation is similar even when we analyse these religious groups separately: Christian farmers' internal ties represent 83.3% of their ties,

whereas proportion of internal ties amongst Moslem farmers is even higher, 93.1%. This tendency for group closures is referred to as homophily (McPherson et al., 2001).

Value of the E-I index⁴⁴ of -0.81 further indicates that there is strong tendency towards the closure of the religious subgroups (Hanneman and Riddle, 2005) and it indicates stronger group closure tendency amongst Moslem farmers but it is rather misleading and attributable to their higher number and spatial segregation of Christians, who are all neighbours.

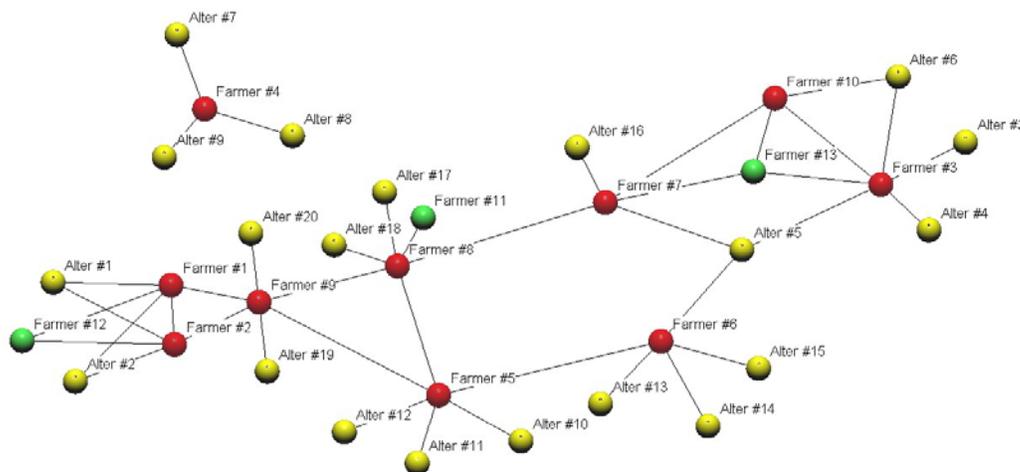
Homophily test for the extracted network supports my claim: magnitude of Christians' within group ties is 4.33 times higher than expected as opposed to 1.3 times higher occurrence of these ties amongst Moslems (Hanneman and Riddle, 2005). Thus, indicating that homophily amongst Christian farmers is much stronger.

Table V: Knowledge network characteristics

	Size	No. ties	Network density	Average degree	Internal ties	E-I index
Whole knowledge network	33	82	0.077	2.47	90.2%	-0.81
Extracted knowledge network	13	32	0.205	2.46	87.5%	-0,75

Table VI: Whole knowledge network characteristics for religion based sub-groups

	Size	Network density	Internal ties	E-I index
Christians	8	0.36	83.3%	-0.667
Moslems	25	0.09	93.1%	-0.862



Sociogram III: Interviewed farmers (red), other farmers (green), others (yellow)

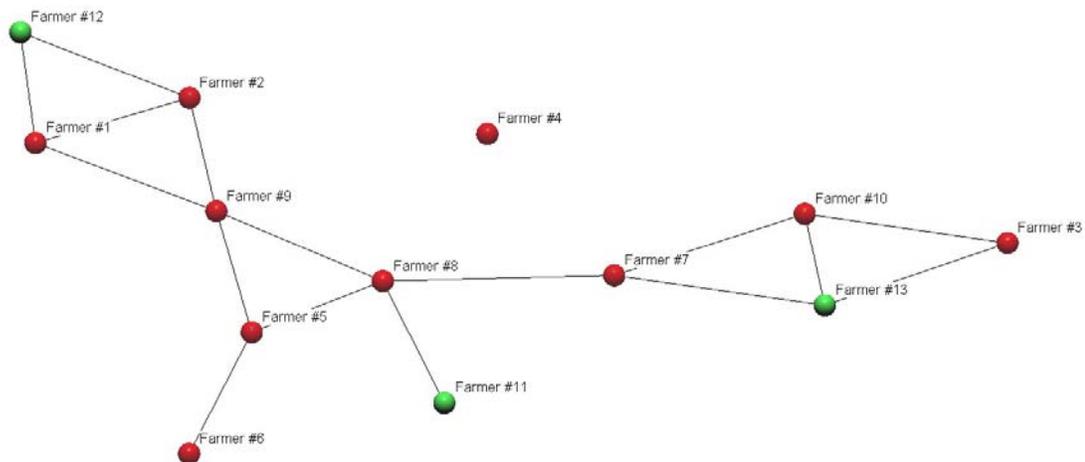
⁴⁴ Sig. $p < 0.05$ means that distribution of ties is not random

Table VII: Extracted knowledge network characteristics

	Size	Density	Proportion of internal ties	E-I index ⁴⁵
Whole extracted network	13	0,205	87,5%	-0,750
Christians	4	0.833	83.3%	-0.667
Moslems	9	0.250	90%	-0.800

Table VIII: Extracted knowledge network - Homophily test⁴⁶

	Observed No. of ties	Expected No. of ties	Observed / expected difference magnitude
Christian farmers	10	2.31	4.33
Moslem farmers	18	13.85	1.3



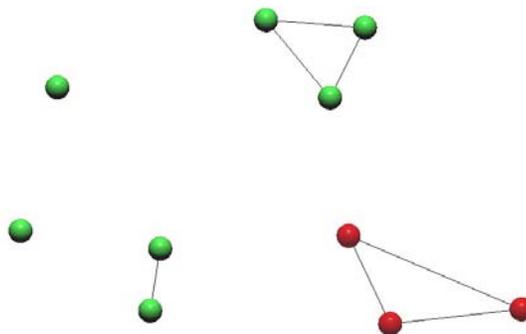
Sociogram IV: Extracted farmers' knowledge network - interviewed farmers (red), other farmers (green)

Apart from having religiously segregated farmers and one disconnected farmer, there are many structural holes bridged by farmers. Only five farmers do not represent brokers between other farmers. The sociogram below represents a network in case of disappearance of three most central farmers who also brokered the most⁴⁷, bringing together what would otherwise be disconnected parts of the network. Without them network would have been fragmented into five components, hindering potential cooperation.

⁴⁵ Sig. $P < 0,05$

⁴⁶ Sig. $p < 0.0025$, indicating that distribution of ties is not random

⁴⁷ Farmer #7, #8 and #9



Sociogram V: Network without farmers bridging the structural holes – Christian farmers (red), Moslem farmers (green)

5.3.3. Conflict resolution

Only two farmers reported they had or still have conflicts regarding their farming activities. Non-existence of conflicts is positive circumstance since it could hinder cooperation amongst farmers. However, farmers' reports about seeking mediation within the village were rather surprising: only two of them mentioned individuals to which they would turn to for help. My assumption about the "hakim", a wise villager farmers could turn to, was incorrect or there is no recognized village authority amongst the farmers, who, after all, represent minority of the villagers. One farmer reported he would turn to mayor and president of the municipality, whereas the other mentioned two individuals, who are according to his words old, wise and with the knowledge about the land affairs⁴⁸.

Interestingly, they were both of another religious affiliation (shi'a), which is an example of bridging the religious divide in the terms of potential conflict resolution. All other farmers would try to solve conflicts through court. This fact is rather negative finding since going to the court could be costly, time consuming and potentially disabling the functioning of the WUA.

Table IX: Conflict resolution citations

Person / institution	Number of citing
Mayor	1
President of municipality	1
H.K.R.	1
H.K.	1
Court / by law	8

5.3.4. Monitoring

Four farmers reported they would report rule violations, citing the mayor, president of the municipality and potentially responsible person as individuals to whom they would turn

⁴⁸ Farmer #9, 2010

to. On the other hand, six farmers would not report a rule breaking stating that they would not report it if it would not hurt them, that they were not interested in the people of the area, that there were influential individuals who could break the rules and get away with it and that monitoring should be done by those in charge.

Table X: Reporting on a rule breaking

	No. of farmers
Would report a rule breaking	4
Would not report a rule breaking	6

Table XI: Citations for the reporting on a rule breaking

Person	Number of citing
Mayor	2
President of municipality	1
Responsible person	1

5.4. Key or central individuals

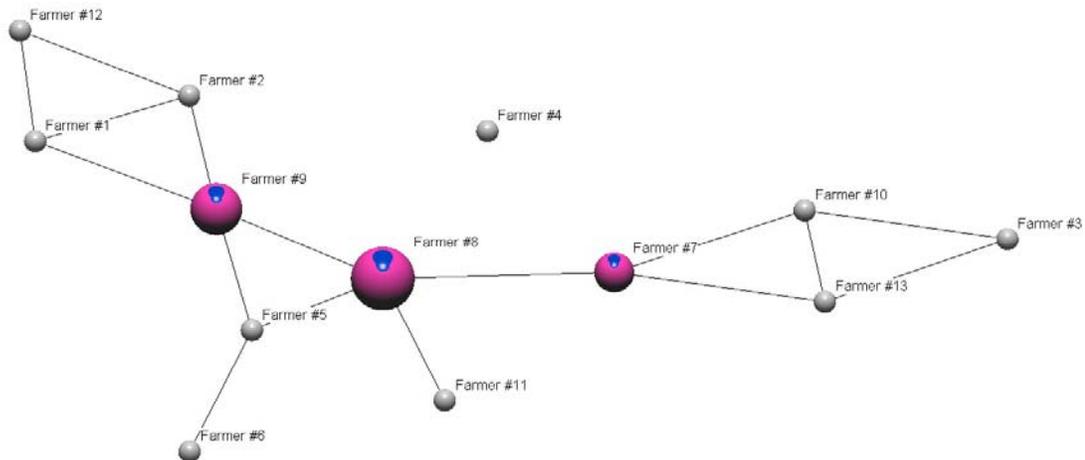
Identification of the most central farmers was performed only on the reduced farmers' knowledge network due to the high number of pendants, i.e. alters with only one tie (Borgatti, 1994), being irrelevant as knowledge diffusion factors but affecting the centrality measures and due to only farmers being potential WUA members.

The most central farmers were identified according to their scores on various centrality measures. In the table below three most central farmers are presented, scoring first three rank orders on all measures. They combine six direct ties to other farmers, reaching 60% of them or 66,7% of all farmers, excluding the isolated one. If we account for their contacts' ties as well, they are no more than two steps away from all other farmers but the isolated one, accounting for 92,9% of all ties present.

Two of the most central farmers are Moslems and one is Christian, with the former having same education, i.e. incomplete primary, both being full time farmers and younger than the Christian farmer, who is retired, with higher education and a part time farmer.

Table XII: Key individuals in the farmers' knowledge network

Overall rank	Farmer	Farming activity	Age	Religion	Education
1	Farmer #8	Full time	57	Shi'a	Incomplete primary
2	Farmer #9	Part time	67	Orthodox	Incomplete complementary
3	Farmer #7	Full time	62	Shi'a	Incomplete primary



Sociogram VI: The most central farmers

6. DISCUSSION

The discussion consists of two sections, answering all three main research questions. First I discuss the assessment of the social capital and then I proceed with the discussion of the potential leadership. The social capital part of discussion, and its implications for the NRM, is further broken down into two more parts. Firstly, the network closure and structural holes concepts are used for the assessment of the cohesiveness and brokerage potential of the network. Then I discuss normative aspects of the social capital, i.e. conflict resolution and monitoring norms. In the second part of my discussion I argue for the selection of the most central farmers, i.e. most suitable for the capacity building abroad and potential leaders in the community. My arguments are based on network centrality calculations, supplemented with the socio-economic and demographic factors.

6.1. Communal social capital

6.1.1. Support network

The social support can be distinguished in terms of emotional and practical support, with the former aiming at attitudes and cognitive processes, whereas the latter helping individual's performance directly. It can further be perceived either as daily support or support in times of crises (Veiel, 1985). The social support networks encompass strongest and most intimate ties (Bodin and Crona, 2008), potentially influencing changes of norms, generating trust amongst farmers, thus creating sense of the community.

Having confidants within close family is normal and usual situation (McPherson et al., 2001:420; Bodin and Crona, 2008) but it appears more pronounced in my research. The support network is non-existent in terms of contacts outside farmers' closest family members⁴⁹, with only one farmer bridging the non-kin ties. This fact contradicts my assumption that farmers could be each other's confidants as well, especially since they

⁴⁹ Parents, siblings, spouses and their children

are close and long time friends, some even neighbours⁵⁰. Nevertheless, network is completely fragmented into familiar nuclei, with strong bonding social capital between family members but almost non-existent bridging social capital between farmers, or anybody else for that matter.

These results represent an example of why multiplexity approach should be used in SNA. Problem is inherent in the fact that social network consists of various contexts and just measuring it at one level is not sufficient (Marin and Hampton, 2007:168) with multiplexity enabling to grasp nuances in relationships.

Nevertheless, Veiel (1985) claims that frequency of communication and emotional closeness can also be measures of social support, meaning that close and lengthy relationships amongst farmers could alleviate lack of non-kin ties in farmers' support network. These strong ties could be important as farmers' socio-emotional and conflict solving potential (Hasen, 1999:83). Burt (1984:325) claims that duration of friendships affects individual's reliance on others' judgments when making important decisions, indicating potential influence amongst farmers due to their emotional closeness. Strong emotional attachment further provides assistance or support in times of distress (Reagans and McEvily, 2003:244). Farmers' close friendships could be beneficial for NRM through the facilitation of collaboration and conflict resolution.

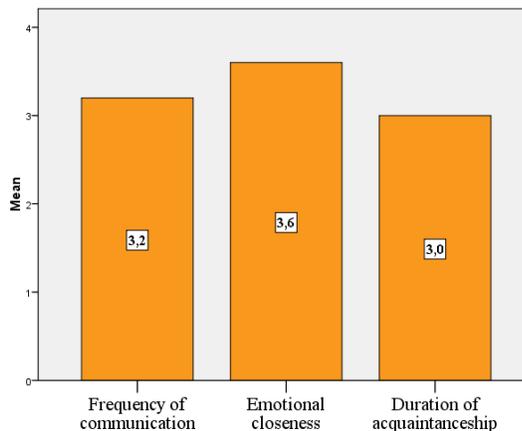


Figure XI: Ties strength⁵¹

6.1.2. Knowledge network

Burt (2001; 2000), Reagans and Zuckerman (2001) and Reagans and McEvily (2003) demonstrated that the theoretical concepts of the structural holes and the network closure can complement each other. Burt (2001) argues that concepts combined can be associated with performance: the network closure lowers the risk associated with trust and transaction costs and the structural holes provide added value with brokering opportunities. However, he further claims that network closure can be critical for the realization of the added value accessed through structural holes (Burt, 2001). Apart from

⁵⁰ All farmers are close, long time friends, with Christian farmers being neighbours as well

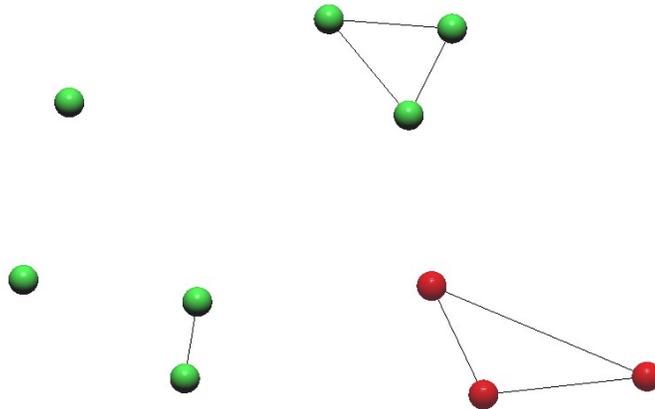
⁵¹ Maximum values are 4 (daily), 4 (especially close) and 3 (more than 6 years) for frequency, closeness and duration, respectively

only accessing new resources, the bridging social capital enables brokers to bring otherwise disconnected parts of the network together and to control the knowledge diffusion (Burt, 1997a; Burt, 1992; Carlsson and Sandström, 2008).

The network closure with its cohesiveness has positive implications for NRM and knowledge diffusion. Coleman (1988) argues that cohesive networks facilitate reciprocity and creation of norms. Of special importance for NRM are the norms of monitoring and conflicts resolution. Cohesiveness, through formation of trust, further affects motivation to invest time, energy and effort in knowledge sharing and also eases it (Reagans and McEvily, 2003).

My assumptions that network could be fragmented due to distrust amongst farmers and sectarianism were rather incorrect. Results indicate that all but one farmer form one network component, having positive implications for the communal social capital, i.e. low network fragmentation strengthens communal social capital by knitting the community together (Bodin and Crona, 2008). However, disconnection of one farmer could represent negative side of the social capital, if he is excluded by others (Portes, 1998). Nevertheless, even though there is no religion based fragmentation, my sectarian division assumption is supported to a certain degree: network structure reveals segregation of the Christian farmers.

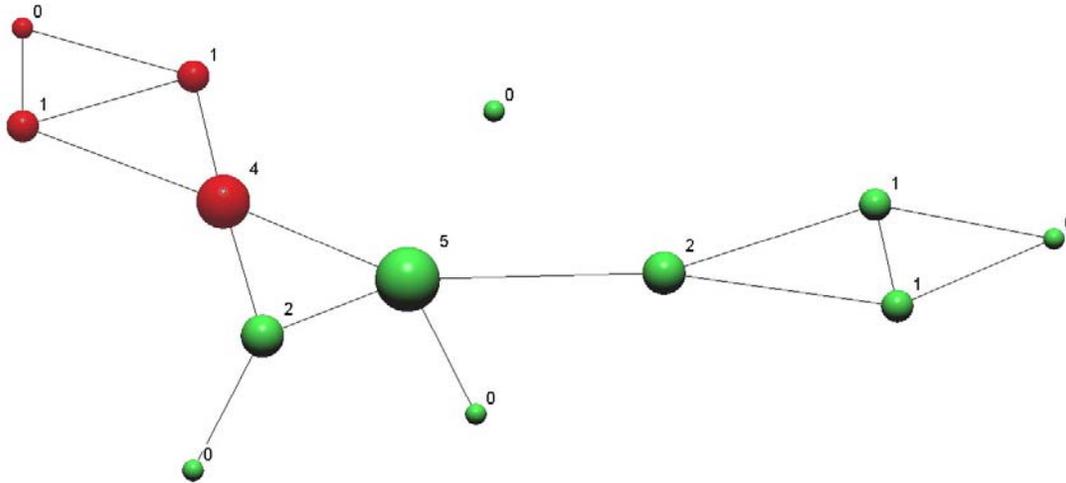
Low levels of network fragmentation are a consequence of the bridging social capital, which is present in two ways. Firstly, bridging religious divide and secondly, bringing together what would otherwise be disconnected farmers.



Sociogram VII: Network without three most central farmers bridging the structural holes – Christian farmers (red), Moslem farmers (green)

Bridging social capital is rather strong in terms of the number of the farmers being brokers⁵², with the most central farmer also brokering the most.

⁵² 5 farmers are not brokers in the network



Sociogram VIII: Farmers' brokerage roles in terms of the number of pairs they brokered between

The brokerage can have positive implications for NRM and knowledge diffusion. Many structural holes in the network mean that diverse perspectives and skills, thus creativity and innovation are present (Reagans and McEvily, 2003; Burt, 2001). The brokers could communicate the knowledge to most of the farmers and to different religious groups. The most central Farmer #8 reaches all but three farmers within two steps. The two step reach is important due to having only one intermediary between farmers. The brokerage is further supplemented with strong ties, i.e. intermediaries are close and long time friends, Christian farmers are even neighbours. Emotional closeness can have positive implications for trust in farmers' judgement ability and integrity (Coleman, 1990) making the influence, knowledge transfer and even easier. Farmers' reports indicate that, even though they do not trust or cooperate with other farmers on general, they trust their friends, neighbours and acquaintances, which are predominant ties in the network.

Presence of diverse perspectives and skills is due to farmers' distinct human capital and connections beyond the network. Rather strong bridging social capital creates positive basis for long term NRM management with diversification of resources and perspectives, thus potentially creating more democratic environment within the WUA. The brokers, subject to various perspectives, are also more likely to develop cooperative skills and recognise the importance of discussion (Reagans and McEvily, 2003). Within the WUA farmers will elect their president and steering committee⁵³, thus democratic environment could benefit from their diversity. Further, decisions will be agreed upon by majority of farmers' votes⁵⁴. The network is further democratically diverse in a sense that two small cohesive sub-networks cannot achieve majority of votes and thus cannot outvote other farmers.

Regarding cohesiveness, knowledge network is not very cohesive⁵⁵ but there are significant differences in cohesiveness levels between Christian and Moslem farmers and

⁵³ Three to six members steering committee will consist of WUA president, vice-president, secretary, treasurer; in case of only three members in the committee then vice-president assumes the secretary tasks as well (AFIAL, 2010)

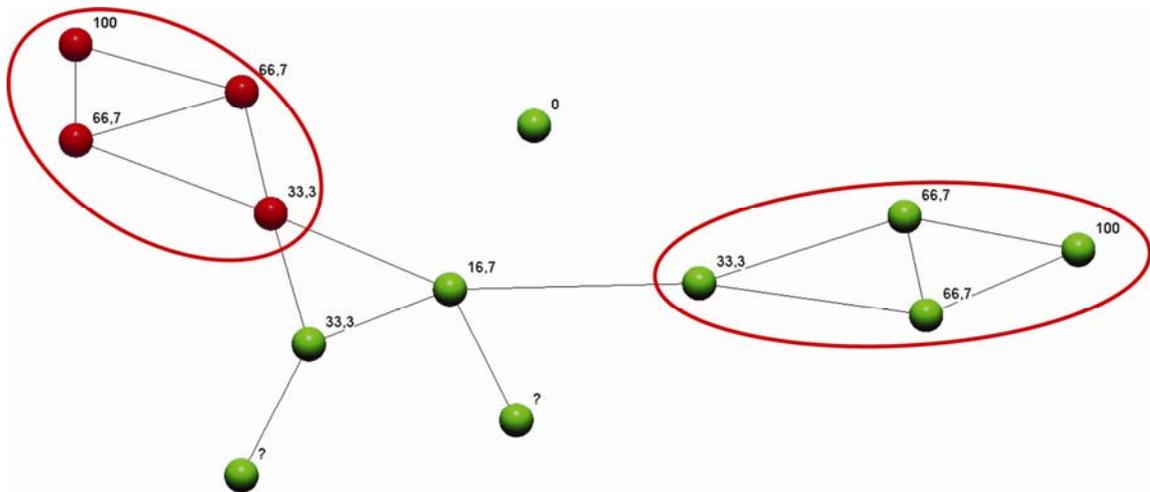
⁵⁴ Either 50% or 2/3 of votes

⁵⁵ Only 20,5% of all possible ties are present

within Moslems' sub-network as well. The Christian farmers form one very cohesive⁵⁶ sub-network, i.e. bonding social capital is very strong, whereas Moslem farmers' sub-network is less cohesive⁵⁷. However, Moslems' sub-network can be further broken down into two parts, with one part having the same cohesiveness characteristics as their Christian counterparts' sub-network (see sociogram below).

Cohesiveness levels indicate religion based homophily, at least amongst Christian farmers. Friendship and confiding homophily is common in religiously heterogeneous societies and I expected it in sectarian Lebanon. Furthermore, more frequent contacts between similar people localize network flows and have implications for influence and knowledge dissemination with formation of trust (McPherson et al., 2001; Reagans and McEvily, 2003). The most basic factor for homophily is geographic location due to the sheer physical closeness and increased frequency of communication (McPherson et al., 2001:429) but in the case of Christian farmers their small number is also relevant⁵⁸.

On the other hand, Moslem farmers' number also affects their cohesiveness levels but in an inverse way: higher number lowers their interaction opportunities and increases cost of maintaining the relations.



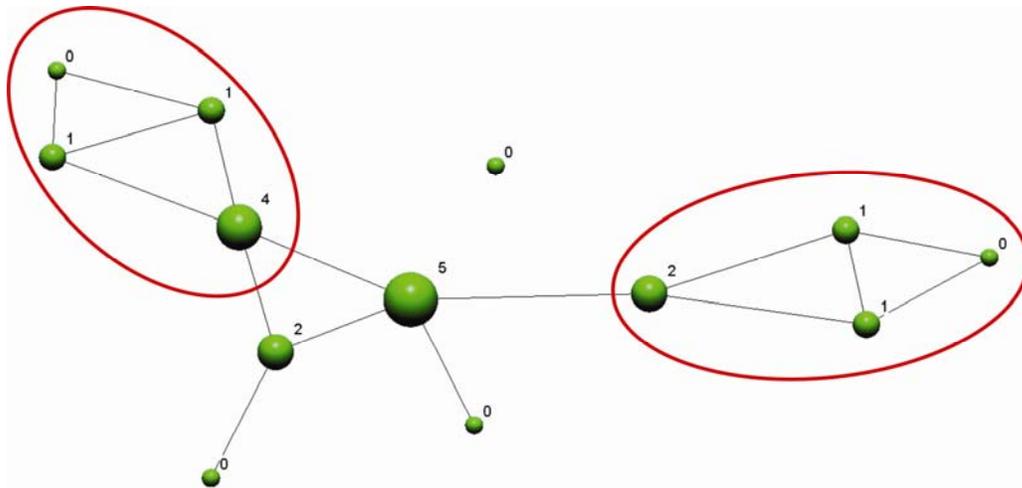
Sociogram IX: Ego network densities (% of ties present) indicating cohesive sub-networks - Christians (red), Moslems (green)

Implications for the NRM and knowledge diffusion are inherent in cohesive networks as well. Dense networks ensure quick knowledge diffusion between farmers due to willingness to devote effort to help others, hence strengthen cooperative behaviour (Reagans and McEvily, 2003). Three most central farmers have two step contacts, i.e. close friend contacts, with all but the isolated farmer, having positive implications for the overall trust and influence on each other, potentially facilitating cooperation and WUA establishment.

⁵⁶ 83,3% of the possible ties are present in Christian farmers' sub-network

⁵⁷ 25% of possible ties are present

⁵⁸ Lower costs of maintaining their ties



Sociogram X: Network closure and structural holes concepts brought together

When linking the network structure to network closure and structural holes concepts we see that knowledge network has good basis for success in the future, combining the positive aspects of both concepts. And it is in spite of first impression that cooperation could be hard due to low levels of trust amongst farmers.

6.1.3. Monitoring

In my study I perceive monitoring as a normative aspect of the social capital with beneficial implication for the NRM. When monitoring norms are present, especially self-monitoring, they motivate individuals to put community interests before their own and to act for the benefit of the collectivity (Coleman, 1990). Monitoring is also important in NRM since it generates farmers' compliance with the rules, enforces agreements and, if needed, identifies and sanctions the rule breakers (Ostrom, 1990). If sanctions are absent or cannot be enforced then motivation for monitoring can decline and affect NRM.

The analysis of the monitoring network reveals that there are no monitoring institutions in place in the farmers' community. What is more, monitoring norms are predominantly not present⁵⁹. Ballet et al (2007) argue that social capital's implications for the NRM are dependent on the values and norms in which social capital is embedded in. Potential lack of monitoring norms amongst farmers could also be perceived as communal norms detrimental for the long-term NRM.

However, when taking another look at this lack of monitoring norms it is not as worrying as it seems: I expect farmers to monitor equitable water distribution since it would affect their farming activities in cases of cheating. Further, distrust amongst farmers could be the additional motivation for monitoring, especially for full time farmers, economically dependent on agriculture and paying for the irrigation water (AFIAL, 2010). Situations with farmers investing time and effort to monitor NRM, have been proven to exist in many real world settings (Ostrom, 1990:94).

⁵⁹ Six farmers reported that they would not report a rule breaking for various reasons

The monitoring of equitable water distribution can be done either by internal or external monitor. The latter is the option farmers have by the law but I will argue for the internal monitor due to Ostrom's (1990:94) claims that monitoring by farmers themselves would create robust WUA. She further argues that "quasi voluntary compliance"⁶⁰ explains actors' investment in monitoring activities: they are willing to comply with the rules if they perceive that others will comply as well and that common objective is achieved. This contingent behaviour is perceived as an alternative to external coercion. However, deterrence from rule breaking has to be achieved somehow in order to assure quasi voluntary compliers that they are not being "suckers" (Levi, 1988 in Ostrom, 1990), thus monitoring is needed.

The internal monitor would also be accountable to and monitored by other farmers with few implications for his tasks. In case of doing the job well, monitor could gain prestige within the community. The community could also place additional incentives for proper monitoring by setting their own rules, e.g. he could keep proportion of the fines imposed⁶¹. Continuous monitoring of each other and monitor as well would enable farmers to preserve the rule-compliance in cases of occasional infractions. Their community would also benefit from gaining the information in regard the rule infractions and would be able to adjust their strategic decisions, thus increase adaptive capacity (Ostrom, 1990:96-97).

The internal monitor would be aware of the situation in the field and could easier understand when farmers' distress would lead to rule infraction and impose graduated sanctions, strengthening the confidence in the "rules of the game" and enable farmers to make up for their mistakes (Ostrom, 1990).

However, lowering costs of and increased efficiency of monitoring is dependent on the set of rules in place and it is beneficial for the farmers that legislation⁶² will allow them to modify the rules according to the *in situ* reality in terms of appropriation rules (Ostrom, 1990:95-96; Bodin et al., 2006) and natural conditions, especially regarding annual and seasonal fluctuations of water availability⁶³ (Makdisi, 2007). Future rise of the temperatures is expected in the Middle East, changing climate patterns, potentially reducing precipitation and triggering desertification, hence affecting the availability of already scarce water resources⁶⁴ (Bou-Zeid and El-Fadel, 2002) and potentially affecting the rules infraction. By devising their own rules, in line with their social norms and structures, farmers could build communal managerial resilience⁶⁵, i.e. social adaptation with positive effect, and strengthen adaptive capacity and management in the context of potential climate change (Tompkins and Adger, 2004).

⁶⁰ "quasi voluntary compliance" is quasi voluntary due to noncompliers being subject to coercion in case of being caught (Ostrom, 1994)

⁶¹ WUA will be responsible for the monitor's salary (AFIAL, 2010)

⁶² "Associations may make additions within their own status or rules further to those decided in this code..." (Afial, 2010: Article 19)

⁶³ During my stay in Lebanon rainy season was late for more than two months

⁶⁴ Projections for Lebanon indicate decrease in renewable water resources from 766-1287 m³/capita/y in 1997 to 262-809 m³/capita/y in 2025; countries with 1000m³/capita/y or less are considered water poor (Bou-Zeid & El-Fadel, 2002:347)

⁶⁵ Resilient communities have the ability to buffer disturbances, self-organize, learn and adapt (Tompkins and Adger, 2004)

6.1.4. Conflict resolution mechanisms

Another aspect of social capital norms is acceptance of the conflict resolution at the local level. Farmers' will have an opportunity to establish the mediation and arbitration centre within the WUA (AFIAL, 2010) for the resolution of conflicts, thus creating low-cost and immediate conflict solving environment (Ostrom, 1990; 2008). It has to be kept in mind that NRM conflicts are normal processes in societies and that for their successful resolution constructive communication is needed (Goebel et al., 2005). If conflicts are not addressed they can undermine livelihoods (FAO, 2000). Additionally, monitoring can eventually reveal rule infractors and in order to maintain compliance with the rules and ensure enduring NRM, conflict resolution mechanisms are needed (Ostrom, 1990). Even more so due to conflict resolution being integral part of NRM and being intertwined with the monitoring and sanctioning. If one of these components is missing then others are affected as well, thus hindering the whole NRM process (Ostrom, 1990). Further, conflict resolution mechanism also affect motivation of individuals for establishment of the NRM institutions (Carlsson and Berkes, 2005).

Conflicts related to agriculture or any other issues are not prevalent amongst farmers⁶⁶, thus they do not represent a big threat for the future cooperation. However, most of the farmers do not perceive any authority as a potential mediator in their disputes.⁶⁷ They would rather resolve conflicts with non-consensual methods, i.e. by legal recourse instead of seeking for mutually acceptable solutions. The latter could have negative implications for the poor⁶⁸ and marginalized farmers due to the costs, political obstacles and discrimination. What is more, it also promotes winner-loser situations (FAO, 2000).

Surprisingly to me, project implementers did not envision any conflict resolution training as a part of capacity building, even though they were aware of few potential conflict generating factors, such as the sectarianism, i.e. politics intertwined with religion changing relations amongst farmers for the worse, distrust among farmers, non-cooperation in the past and influential individuals, powerful enough to break the rules and take over the institutions⁶⁹ established for the benefit of the communities (UNDP Lebanon, 2010a).

Nevertheless, when imposing establishment of the mediation centre onto farmers (AFIAL, 2010), then conflict resolution training should be enabled for them. Goebels et al (2005) argue that for the long run NRM conflict resolution skills⁷⁰, enabling farmers to improve their consensus building and manage conflicts, are needed.

Even though farmers do not recognize any village authority that could be potential mediator, mayor emerged as very trusted party⁷¹, who could be considered as an option for a mediator in WUA. Another positive aspect is a small size of the farmers' network, with its two step reach and close relationships that could have positive effects on conflict

⁶⁶ Two farmers reported conflicts; further, farmer #10 does not talk to Farmer #5 and #8

⁶⁷ Eight farmers would resolve conflicts through court only

⁶⁸ Four farmers' monthly household income is lower than minimum wage

⁶⁹ Agricultural Cooperatives in project villages were taken over, serving narrow interest now

⁷⁰ Effective communication, confidence-building, respectful listening (Goebel et al, 2005)

⁷¹ Only one farmer reported having no confidence at all in the mayor

resolutions. Intermediaries could be potential mediators between their contacts in disputes, being their close and long time friends, thus being trusted parties, which is vital for conflict resolutions (Goebel et al., 2005). For example, Farmer #8 can reach all but three farmers in two steps or less.

6.2. Central farmers – potential leaders

The central farmers are essential for triggering the cooperation potential inherent in social capital (Sandström and Rova, 2010; Lin, 1999). They are needed due to their potential to shape changes and reorganization by introducing innovation (Folke et al., 2005:451), i.e. facilitate the establishment of WUA. Further, identification of these central individuals is required due to trying to educate and influence them first, before influencing whole community with their help (Borgatti, 2006).

These potential leaders could also help build trust, manage conflicts, link actors and / or groups and initiate partnership between disconnected entities, compile and diffuse knowledge and mobilize support for common goals. On the other side, lack of these individuals could lead to inertia of self-organizing processes. However, they must be trustworthy since they have to influence others and it is easier to influence those who are trusting (Folke et al., 2005:451).

The most central farmers in the knowledge network were identified according to their scores on multiple centrality criteria and three⁷² of them stand out on all of the criteria. They combine 6 direct ties to other farmers, mostly meaning they are long-time close friends, and if reported contacts' direct ties are counted in they reach all but the isolated farmer. However, just being central in the network does not automatically make farmers motivated for certain tasks. Motivation is important factor and can be influenced by the farmers' socio-economic situation, affecting their vested interest in improvement of the agricultural conditions.

I will present my arguments for two scenarios: for the selection of one and two farmers, respectively. I will address two scenarios due to initial intentions of the project implementers of sending up to two farmers abroad for the capacity building⁷³.

The selection of farmers was implemented in January 2011 and I sent a report, with calculations and arguments for the selection of the most suitable farmer(s) to project manager. Their project documentation did not consist of any official selection criteria but it was done based on the (a) full time involvement in farming, (b) years of agricultural experience, (c) friendship with other farmers and (d) land size. I agree that first three criteria are relevant due to (a) farmers chosen being dependent on the agriculture, (b) agricultural experiences having positive impact on the farming knowledge and technical aspect of the capacity building and (c) friendship with others influencing communication and trust. However, I disagree that (d) land size should be important factor. Diffusion of knowledge and potential influence is dependent on the structural position farmers occupy

⁷² Farmers #8, #7 and #9, in order of their centrality rankings

⁷³ Gharib, 2010

in the network and not on the size of their land.

6.2.1. One farmer scenario

Based on the aforementioned selection criteria Farmer #5 was selected, also due to the size of his land, whereas I was arguing for the Farmer #8. When taking a look at other criteria used for the selection it is evident that both are full time farmers and of the same age, i.e. 56 and 57 years old, and could be argued that they possess similar agricultural experiences and knowledge.

However, I argue that the selection of the Farmer #5 was not the best choice for various reasons. Firstly, he is less central in the knowledge network than Farmer #8 and reaches less farmers directly or in two steps⁷⁴. Secondly, and more importantly is his distrust in other farmers, reporting he had no trust in other farmers in the village. Thirdly, he is not keen on resolving conflicts at the local level and would only resolve it in court. Fourthly, he is rather indifferent regarding monitoring, since he would not report any rule breaking. Lack of monitoring and conflict resolution norms does not make him a role model for the others. Fifthly, he also reported that he would never cooperate with the farmers in Blat. Lack of trust and willingness to cooperate could be perceived as indirect indicators of his friendship with other farmers and it appears to be questionable. However, I have not conducted a research on friendships network amongst farmers but it would have been beneficial to have it, especially if I had known earlier what the selection criteria were. And finally, his agricultural knowledge communication network exists only partially in the village of Blat, with half of his contacts being outside the village⁷⁵.

This being said, I argue that Farmer #8 should have been chosen. Firstly, he is by far the most central individual in the network not only in terms of religious divide but also bringing the network together the most in general terms as well⁷⁶. Secondly, he is one of the few farmers that still have some trust in other farmers. Thirdly, he is willing to report rule-breaking to potential responsible, meaning that he is willing to accept authority imposed by the WUA and that the norms of monitoring are present, making him a role model for the others. However, he would also resolve conflicts only by court as well.

6.2.2. Two farmer scenario

My opinion is that two farmer scenario is even better solution⁷⁷. Benefits of this option are as follows: (a) two farmers can reach more of the others directly and in two steps; (b) heterogeneity of farmers in terms of different religious affiliation could be achieved, which is important in sectarian community; (c) more farmers can disseminate knowledge better and influence others more; (d) higher redundancy levels, i.e. performing capacity in cases of loss of the actors could be achieved (Bodin et al., 2006).

⁷⁴ Farmer #5 reaches seven other farmers within two steps, whereas Farmer #8 reaches nine farmers

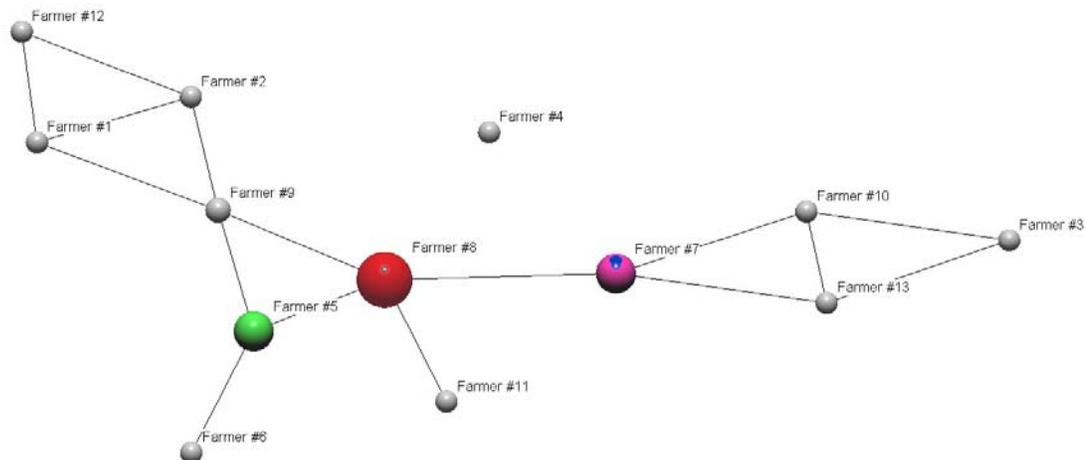
⁷⁵ Three out of his six ties were outside the village Blat

⁷⁶ Without Farmer #8 in the network it would have been fragmented into 4 network components and even more importantly one component of 4 farmers appears; on the other hand in case of disappearance of Farmer #5 only one disconnected farmer appears in the network structure

⁷⁷ Gharib, 2010

The knowledge network centrality calculations⁷⁸ indicate that for this scenario Farmer #9 and Farmer #7 are the most suitable since they reach all farmers but the isolated farmer in two steps. Nevertheless, calculations should be supported with social data since it also reflects socio-economic reality and the presence of conflict resolution and monitoring norms. I argue that in this case Farmers #7 and #8 make better choice. They reach one farmer less within two steps but regardless of that they are firstly, full time farmers economically dependant on agriculture, with income and education levels being low, thus hindering their employment opportunities outside the agricultural sectors. This could affect their vested interest in improving agricultural conditions, making them more motivated for cooperation. Full time farming is also relevant in terms of the possession of the agricultural knowledge and experiences needed for technical capacity building abroad and it is in line with selection criteria used by project implementers. Secondly, Farmer #9 is retired teacher, receiving state pension and being independent of the agricultural income. And thirdly, they are both younger than the Farmer #9. However, regarding their monitoring and conflict resolution norms then both of them would seek for conflict resolution only through court and only Farmer #8 would report rule breaking.

However, proposed selection of farmers does not satisfy religious heterogeneity criteria but Farmer #8 is bridging the religious divide and alleviates this problem. Further, only farmer that is not reached by proposed Farmers #7 and #8 is one of the Christian farmers who is strongly embedded in their segregated community and thus can be influenced by, e.g. Farmer #9, which is a direct contact of Farmer #8.



Sociogram XI: Selected farmer (green), proposed farmers (red, fuchsia)

⁷⁸ KPP-Pos problem

7. CONCLUSION

This case study shows that SNA can be useful diagnostic tool for the analysis of the social structures, helping policy-makers with its findings. The biggest advantage of the SNA is that it can reveal rather surprising central actors that should be influenced first when introducing changes into communities. SNA also represents bottom up approach with the stakeholders identifying influential actors in their communities instead of the project implementers deciding on them.

Assessment of the network social capital with the support and knowledge network revealed both positive and negative issues, potentially facilitating or hindering NRM. Firstly, support network is non-existent in terms of ties outside farmers' families, which was surprising due to farmers being close and long time friends. Nevertheless, lack of these ties is alleviated with their close and long time friendships and in some cases with geographical closeness, i.e. being neighbours. Emotional closeness can have similar supportive effects as the ties expected in support network (Veiel, 1985). Secondly, knowledge network reflects the characteristics of both the network closure and the structural holes concepts with dense sub-networks and many brokers, most importantly bridging the religious divide and keeping the network together as a whole, with only one farmer being isolated. These characteristic could have positive implications for the diffusion of the new knowledge amongst farmers, facilitating the establishment of the WUA and strengthening democratic environment, important for the viability of the WUA with diversified perspectives and resources amongst farmers. However, if isolated farmer is isolated due to being excluded by the others than this would represent an example of negative consequence of the social capital – exclusion of others.

The normative aspects of social capital, on the other hand, are rather worrying. The monitoring and especially conflict resolution norms are predominantly non-existent. However, (non)presence of monitoring norms is ambiguous, since it can be perceived either as lack of monitoring norms or as negative norms being present, i.e. norm of non-monitoring. However, I expect farmers to be willing to monitor actual equitable water distribution, especially full time farmers, dependent on the agriculture. The conflict resolution norms, on the other hand, are even less present and this could hinder the NRM. It is surprising that the project was designed without the conflict resolution training component, even more so since it is one of the essential parts of the NRM and without the conflict resolution skills it is harder to “identify, pre-empt or address conflicts” (FAO, 2000:12).

Identification of the most central farmers indicated that my potential candidate(s) differ from project implementers' selection. Further, I also argue for the selection of two farmers for the capacity building instead of just one. However, since only one farmer was selected I argue that Farmer #8 represents better choice than the selected Farmer #5 due to being by far the most central farmer and having developed monitoring norms, making him better role model for the others. What could be hard to overcome, and could be an issue with the actual selection of the farmer, is acceptance that social influence is not necessarily based on the size of the land owned but that it could be inherent in the structural position farmers occupy. One of the project implementers' arguments for the selection of the Farmer #5 was the size of his land. However, influence is also dependent

on motivation, meaning that SNA indicators should be supplemented with social indicators, i.e. socio-economic and demographic data, and followed up with the interviews with the most central farmers, exploring their perceptions on their structural position.

This study also confirmed that when studying social networks multiplexity approach should be used. The interactions between farmers are complex and occur in many contexts simultaneously and more networks could grasp the nuances in farmers' connectedness better. The study would benefit from inclusion of at least the friendship network due to friendship being one of the actual farmer selection criteria.

And finally, the study would further benefit from using the directed network approach instead of undirected, i.e. construction of the symmetrised ties. Not all relations mentioned by the farmers are necessarily reciprocated and directed networks would collect more accurate data regarding the connections and brokerage roles in the community, hence improving the centrality and the influence assessments. However, full network data collection is needed for this kind of study, which was unfeasible in my case.

Word count: 15 041

APPENDIX I – QUESTIONNAIRE

Actor No.: _____

<p>A1) Name: _____</p> <p>A2) Age: _____</p> <p>A3) Gender. 1 male 2 female</p> <p>A4) Education: 1. No formal education 2. Incomplete primary 3. Complete primary 4. Incomplete complementary 5. Complete complementary (brever) 6. Incomplete secondary 7. Complete secondary (baccalaureat) 8. Some university level – no degree 9. University level – degree 10. Higher</p> <p>A5) Religious affiliation: _____</p>	<p>A6) Farming activity: 1. Full time 2. Part time</p> <p>A7) If you are part time farmer, what is your occupation: _____</p> <p>A8) Monthly household income (LBP) 1. < 500 000 2. 500 000 – 999 999 3. 1 000 000 – 1 499 999 4. 1 500 000 – 1 999 999 5. 2 000 000 – 2 499 999 6. 2 500 000 - 2 999 999 7. 3 000 000 - 3 499 999 8. 3 500 000 – 3 999 999 9. 4 000 000 – 4 499 999 10. 4 500 000 – 4 999 999 11. > 5 000 0000 12. no answer</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Q1 With whom can you discuss important matters, a person outside your home? Anything important to you. List five names below. Please just tell me their first name or initials.

Name 1: _____

Name 2: _____

Name 3: _____

Name 4: _____

Name 5: _____

I would like to find out more about the persons you mentioned

Name 1_____
Name 2_____
Name 3_____
Name 4_____
Name 5

Could you tell me if they are:

1 male	1	1	1	1	1
2 female	2	2	2	2	2

On average, how often do you communicate with each person?

1 Less often	1	1	1	1	1
2 Monthly	2	2	2	2	2
3 Weekly	3	3	3	3	3
4 Daily	4	4	4	4	4
9 Don't know	9	9	9	9	9

How close are you with each person?

1 distant	1	1	1	1	1
2 less than close	2	2	2	2	2
3 close	3	3	3	3	3
4 especially close	4	4	4	4	4

Could you tell me how long do you know each person:

1 less than 3 y	1	1	1	1	1
2 3 to 6 y	2	2	2	2	2
3 more than 6y	3	3	3	3	3
4 don't know	4	4	4	4	4

Could you tell me where do they live?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Blat	1	1	1	1	1
2 Elsewhere	2	2	2	2	2

Could you tell me about their occupation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me how each person you mentioned is connected with you

1 spouse	1	1	1	1	1
2 parent	2	2	2	2	2
3 sibling	3	3	3	3	3
4 child	4	4	4	4	4
5 other family	5	5	5	5	5
6 co-worker	6	6	6	6	6
7 co-member	7	7	7	7	7
8 neighbour	8	8	8	8	8
9 friend	9	9	9	9	9
10 other	10	10	10	10	10
99 Don't know	99	99	99	99	99

Could you tell me what is their religious affiliation?

1 Shi'ite	1	1	1	1	1
2 Sunni	2	2	2	2	2
3 Maronite	3	3	3	3	3
4 Druze	4	4	4	4	4

5 Orthodox	5	5	5	5	5
6 Catholic	6	6	6	6	6
7 Other	7	7	7	7	7
9 Don't know	9	9	9	9	9
99 No answer	99	99	99	99	99

Q2 Do you exchange information, useful for you to carry out your farming activities, with anyone? For example information about farming techniques, plant protection, access to water, irrigation techniques, farming extensions etc.? If yes, please name them below, just their first names or their initials.

Name 1: _____

Name 2: _____

Name 3: _____

Name 4: _____

Name 5: _____

I would like to find out more about the persons you mentioned

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
Could you tell me if they are:					
1 male	1	1	1	1	1
2 female	2	2	2	2	2
On average, how often do you communicate with each person?					
1 Less often	1	1	1	1	1
2 Monthly	2	2	2	2	2
3 Weekly	3	3	3	3	3
4 Daily	4	4	4	4	4
9 Don't know	9	9	9	9	9
How close are you with each person?					
1 distant	1	1	1	1	1
2 less than close	2	2	2	2	2
3 close	3	3	3	3	3
4 especially close	4	4	4	4	4
Could you tell me how long do you know each person:					
1 less than 3 y	1	1	1	1	1
2 3 to 6 y	2	2	2	2	2
3 more than 6y	3	3	3	3	3
4 don't know	4	4	4	4	4

Could you tell me where do they live?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Blat	1	1	1	1	1
2 Elsewhere	2	2	2	2	2

Could you tell me what is their occupation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me how each person you mentioned is connected to you

1 spouse	1	1	1	1	1
2 parent	2	2	2	2	2
3 sibling	3	3	3	3	3
4 child	4	4	4	4	4
5 other family	5	5	5	5	5
6 co-worker	6	6	6	6	6
7 co-member	7	7	7	7	7
8 neighbour	8	8	8	8	8
9 friend	9	9	9	9	9
10 other	10	10	10	10	10
99 Don't know	99	99	99	99	99

Could you tell me what is their religious affiliation?

1 Shi'ite	1	1	1	1	1
2 Sunni	2	2	2	2	2
3 Maronite	3	3	3	3	3
4 Druze	4	4	4	4	4
5 Orthodox	5	5	5	5	5
6 Catholic	6	6	6	6	6
7 Other	7	7	7	7	7
9 Don't know	9	9	9	9	9
99 No answer	99	99	99	99	99

Q3 Have you ever encountered a dispute related to your farming activity with anyone? If yes, please tell me with whom and why. Just their first names or initials

Name 1: _____ Cause: _____

Name 2: _____ Cause: _____

Name 3: _____ Cause: _____

Name 4: _____ Cause: _____

Name 5: _____ Cause: _____

I would like to find out more about the persons you mentioned

<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
---------------	---------------	---------------	---------------	---------------

Could you tell me if they are:

1 male	1	1	1	1	1
2 female	2	2	2	2	2

On average, how often do you communicate with each person?

1 Less often	1	1	1	1	1
2 Monthly	2	2	2	2	2
3 Weekly	3	3	3	3	3
4 Daily	4	4	4	4	4
9 Don't know	9	9	9	9	9

How close are you with each person?

1 especially close	1	1	1	1	1
2 close	2	2	2	2	2
3 less than close	3	3	3	3	3
4 distant	4	4	4	4	4

Could you tell me how long do you know each person:

1 less than 3 y	1	1	1	1	1
2 3 to 6 y	2	2	2	2	2
3 more than 6y	3	3	3	3	3
4 don't know	4	4	4	4	4

Could you tell me where do they live?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Blat	1	1	1	1	1
2 Elsewhere	2	2	2	2	2

Could you tell me about their occupation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me how each person you mentioned is connected to you

1 spouse	1	1	1	1	1
2 parent	2	2	2	2	2
3 sibling	3	3	3	3	3
4 child	4	4	4	4	4
5 other family	5	5	5	5	5
6 co-worker	6	6	6	6	6
7 co-member	7	7	7	7	7
8 neighbour	8	8	8	8	8
9 friend	9	9	9	9	9
10 other	10	10	10	10	10
99 Don't know	99	99	99	99	99

Could you tell me about their religious affiliation?

1 Shi'ite	1	1	1	1	1
2 Sunni	2	2	2	2	2
3 Maronite	3	3	3	3	3

4 Druze	4	4	4	4	4
5 Orthodox	5	5	5	5	5
6 Catholic	6	6	6	6	6
7 Other	7	7	7	7	7
9 Don't know	9	9	9	9	9
99 No answer	99	99	99	99	99

Q4 If you encountered a dispute with someone and you could not resolve it yourself, who would you turn to for conflict resolutions?

Name 1: _____

Name 2: _____

Name 3: _____

Name 4: _____

Name 5: _____

I would like to find out more about the persons you mentioned

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
Could you tell if they are:					
1 male	1	1	1	1	1
2 female	2	2	2	2	2
On average, how often do you communicate with each person?					
1 Less often	1	1	1	1	1
2 Monthly	2	2	2	2	2
3 Weekly	3	3	3	3	3
4 Daily	4	4	4	4	4
9 Don't know	9	9	9	9	9
How close are you with each person?					
1 distant	1	1	1	1	1
2 less than close	2	2	2	2	2
3 close	3	3	3	3	3
4 especially close	4	4	4	4	4
Could you tell me how long do you know each person:					
1 less than 3 y	1	1	1	1	1
2 3 to 6 y	2	2	2	2	2
3 more than 6y	3	3	3	3	3
4 don't know	4	4	4	4	4

Could you tell me where do they live?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Blat	1	1	1	1	1

2 Elsewhere 2 2 2 2

Could you tell me what is their occupation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me how each person you mentioned is connected to you

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 spouse	1	1	1	1	1
2 parent	2	2	2	2	2
3 sibling	3	3	3	3	3
4 child	4	4	4	4	4
5 other family	5	5	5	5	5
6 co-worker	6	6	6	6	6
7 co-member	7	7	7	7	7
8 neighbour	8	8	8	8	8
9 friend	9	9	9	9	9
10 other	10	10	10	10	10
99 Don't know	99	99	99	99	99

Could you tell me their religious affiliation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Shi'ite	1	1	1	1	1
2 Sunni	2	2	2	2	2
3 Maronite	3	3	3	3	3
4 Druze	4	4	4	4	4
5 Othodox	5	5	5	5	5
6 Catholic	6	6	6	6	6
7 Other	7	7	7	7	7
9 Don't know	9	9	9	9	9
99 No answer	99	99	99	99	99

Q5 If you see someone breaking the rule / law within the area of your farming activities, for example digging an illegal well, breaking the water tour rule etc., would you tell someone about it? If yes, please name the persons below. If no, please specify why.

Name 1: _____ No report: _____

Name 2: _____ No report: _____

Name 3: _____ No report: _____

Name 4: _____ No report: _____

Name 5: _____ No report: _____

I would like to find out more about the persons you mentioned

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me if they are:

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 male	1	1	1	1	1
2 female	2	2	2	2	2

On average, how often do you communicate with each person?

1 Less often	1	1	1	1	1
2 Monthly	2	2	2	2	2
3 Weekly	3	3	3	3	3
4 Daily	4	4	4	4	4
9 Don't know	9	9	9	9	9

How close are you with each person?

1 distant	1	1	1	1	1
2 less than close	2	2	2	2	2
3 close	3	3	3	3	3
4 especially close	4	4	4	4	4

Could you tell me how long do you know each person:

1 less than 3 y	1	1	1	1	1
2 3 to 6 y	2	2	2	2	2
3 more than 6y	3	3	3	3	3
4 don't know	4	4	4	4	4

Could you tell me where do they live?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
1 Blat	1	1	1	1	1
2 Elsewhere	2	2	2	2	2

Could you tell me what is their occupation?

	<u>Name 1</u>	<u>Name 2</u>	<u>Name 3</u>	<u>Name 4</u>	<u>Name 5</u>
--	---------------	---------------	---------------	---------------	---------------

Could you tell me how each person you mentioned is connected to you, all the ways person is connected with you

1 spouse	1	1	1	1	1
2 parent	2	2	2	2	2
3 sibling	3	3	3	3	3
4 child	4	4	4	4	4
5 other family	5	5	5	5	5
6 co-worker	6	6	6	6	6
7 co-member	7	7	7	7	7
8 neighbour	8	8	8	8	8
9 friend	9	9	9	9	9
10 other	10	10	10	10	10
99 Don't know	99	99	99	99	99

Could you tell me their religious affiliation?

1 Shi'ite	1	1	1	1	1
2 Sunni	2	2	2	2	2
3 Maronite	3	3	3	3	3
4 Druze	4	4	4	4	4
5 Othodox	5	5	5	5	5
6 Catholic	6	6	6	6	6

7 Other	7	7	7	7	7
9 Don't know	9	9	9	9	9
99 No answer	99	99	99	99	99

Q6 I want to ask you how much you trust following groups of people.

	Trust completely	Trust Somewhat	Not very much	No trust at all	Don't know	No answer
People on general	1	2	4	5	9	99
Your family	1	2	4	5	9	99
Your neighbour	1	2	4	5	9	99
People you meet for the first time	1	2	4	5	9	99
People you know personally	1	2	4	5	9	99
Farmers in Blat	1	2	4	5	9	99
People of another religion	1	2	4	5	9	99

Q7 Could you tell me how much confidence you have in the following organizations / institutions?

	A great deal	Quite a lot	Not very much	None at all	Don't know	No answer
UNDP	1	2	3	4	9	99
LRA	1	2	3	4	9	99
AFIAL	1	2	3	4	9	99
NGO – Arc En Ciel	1	2	3	4	9	99
NGO – World Vision	1	2	3	4	9	99
NGO – Action Contre le Faim	1	2	3	4	9	99
Government	1	2	3	4	9	99
Mayor	1	2	3	4	9	99

Municipality	1	2	3	4	9	99
Council for the South (Majles Loubnan Al Janoubi)⁷⁹	1	2	3	4	9	99
Agricultural cooperative	1	2	3	4	9	99

Q8 I want to ask you if you ever cooperated, might cooperate or would never cooperate with the following:

	Have done	Might do	Would never do	Don't know	No answer
Your family	1	2	3	9	99
Your neighbour	1	2	3	9	99
People you know personally	1	2	3	9	99
Farmers in Blat	1	2	3	9	99
Agricultural cooperative	1	2	3	9	99

⁷⁹ Council for the South is development organization, part of the Amal political party, one of two Shi'i political parties; the other is Hezbollah

People of another religion	1	2	3	9	99
Municipality	1	2	3	9	99
Mayor	1	2	3	9	99
NGO – World Vision	1	2	3	9	99
NGO – Arc En Ciel	1	2	3	9	99
NGO – Action Contre le Faim	1	2	3	9	99
Council of the south (Majles Loubnan Al janoubi)	1	2	3	9	99
AFIAL	1	2	3	9	99

APPENDIX II – SOCIAL CAPITAL CALCULATIONS

Density – whole network binary

	Density	No. of Ties
Knowledge network (binary)	0.0777	82.0000

Density – extracted network

	Density	No. of Ties
Farmers (binary)	0.2051	32.0000

E-I INDEX – Knowledge network

```
Adjacency dataset:      info network_binary
Attribute:              "partition_religion_matrix" col 1
# of Permutations:     5000
Random seed:           1097
```

Warning: Row Attribute vector has been recoded.
Here is a translation table:

```
Old Code      New Code
=====
      1      =>    1
      2      =>    2
```

Density matrix

```
          1      2
          1      2
-----
1 1  0.357 0.020
2 2  0.020 0.090
```

82 ties.

Whole Network Results

```
          1      2      3      4
          Freq      Pct Possible      Density
-----
1 Internal      74.000      0.902  656.000      0.113
2 External      8.000      0.098  400.000      0.020
3      E-I     -66.000     -0.805 -256.000     -0.242
```

Max possible external ties: 400.000

Max possible internal ties: 656.000

E-I Index: -0.805

Expected value for E-I index is: -0.242

Max possible E-I given density & group sizes: 1.000

Min possible E-I given density & group sizes: -1.000

Re-scaled E-I index: -0.805

Permutation Test

Number of iterations = 5000

```
          1      2      3      4      5      6      7
          Obs      Min      Avg      Max      SD P >= Ob P <= Ob
-----
1 Internal      0.902      0.317      0.623      0.878      0.081      0.000      1.000
2 External      0.098      0.122      0.377      0.683      0.081      1.000      0.000
3      E-I     -0.805     -0.756     -0.246      0.366      0.163      1.000      0.000
```

E-I Index is significant (p < 0.05)

```

Group level E-I Index
      1      2      3      4
      Intern Extern Total E-I
      -----
1 1  20.000  4.000 24.000 -0.667
2 2  54.000  4.000 58.000 -0.862

```

```

Individual Level E-I Index
      1      2      3      4
      Intern Extern Total E-I
      -----
1  Farmer #1  5.000  0.000  5.000 -1.000
2  Farmer #2  5.000  0.000  5.000 -1.000
3  Farmer #3  6.000  0.000  6.000 -1.000
4  Farmer #4  3.000  0.000  3.000 -1.000
5  Farmer #5  4.000  2.000  6.000 -0.333
6  Farmer #6  5.000  0.000  5.000 -1.000
7  Farmer #7  5.000  0.000  5.000 -1.000
8  Farmer #8  5.000  1.000  6.000 -0.667
9  Farmer #9  3.000  3.000  6.000  0.000
10 Farmer #10  4.000  0.000  4.000 -1.000
11 Farmer #11  1.000  0.000  1.000 -1.000
12  Alter #1  2.000  0.000  2.000 -1.000
13 Farmer #12  2.000  0.000  2.000 -1.000
14  Alter #2  2.000  0.000  2.000 -1.000
15  Alter #3  1.000  0.000  1.000 -1.000
16  Alter #4  1.000  0.000  1.000 -1.000
17  Alter #5  3.000  0.000  3.000 -1.000
18 Farmer #13  3.000  0.000  3.000 -1.000
19  Alter #6  2.000  0.000  2.000 -1.000
20  Alter #7  1.000  0.000  1.000 -1.000
21  Alter #8  1.000  0.000  1.000 -1.000
22  Alter #9  1.000  0.000  1.000 -1.000
23  Alter #10  0.000  1.000  1.000  1.000
24  Alter #11  1.000  0.000  1.000 -1.000
25  Alter #12  1.000  0.000  1.000 -1.000
26  Alter #13  1.000  0.000  1.000 -1.000
27  Alter #14  1.000  0.000  1.000 -1.000
28  Alter #15  1.000  0.000  1.000 -1.000
29  Alter #16  1.000  0.000  1.000 -1.000
30  Alter #17  1.000  0.000  1.000 -1.000
31  Alter #18  1.000  0.000  1.000 -1.000
32  Alter #19  0.000  1.000  1.000  1.000
33  Alter #20  1.000  0.000  1.000 -1.000

```

E-I INDEX – Extracted knowledge network

```

Adjacency dataset:          farmers_binary
Attribute:                  "partition_religion_extracted_matrix" col 1
# of Permutations:         5000
Random seed:                24950

```

Warning: Row Attribute vector has been recoded.

Here is a translation table:

```

Old Code      New Code
=====
1             =>    1
2             =>    2

```

Density matrix

```

      1      2
      1      2
-----
1 1  0.833 0.056
2 2  0.056 0.250

```

32 ties.

Whole Network Results

```

      1      2      3      4
      Freq    Pct Possibl Density
-----
1 Internal  28.000  0.875  84.000  0.333
2 External   4.000  0.125  72.000  0.056
3      E-I -24.000 -0.750 -12.000 -0.077

```

Max possible external ties: 72.000

Max possible internal ties: 84.000

E-I Index: -0.750

Expected value for E-I index is: -0.077

Max possible E-I given density & group sizes: 1.000

Min possible E-I given density & group sizes: -1.000

Re-scaled E-I index: -0.750

Permutation Test

Number of iterations = 5000

```

      1      2      3      4      5      6      7
      Obs    Min    Avg    Max    SD P >= Ob P <= Ob
-----
1 Internal  0.875  0.313  0.540  0.938  0.110  0.006  0.998
2 External  0.125  0.063  0.460  0.688  0.110  0.998  0.006
3      E-I -0.750 -0.875 -0.079  0.375  0.219  0.998  0.006

```

E-I Index is significant (p < 0.05)

Group level E-I Index

```

      1      2      3      4
      Intern Extern Total    E-I
-----
1 1  10.000  2.000 12.000 -0.667
2 2  18.000  2.000 20.000 -0.800

```

Individual Level E-I Index

```

      1      2      3      4
      Intern Extern Total    E-I
-----
1 Farmer #1  3.000  0.000  3.000 -1.000
2 Farmer #2  3.000  0.000  3.000 -1.000
3 Farmer #3  2.000  0.000  2.000 -1.000

```

```

4 Farmer #4 0.000 0.000 0.000 0.000
5 Farmer #5 2.000 1.000 3.000 -0.333
6 Farmer #6 1.000 0.000 1.000 -1.000
7 Farmer #7 3.000 0.000 3.000 -1.000
8 Farmer #8 3.000 1.000 4.000 -0.500
9 Farmer #9 2.000 2.000 4.000 0.000
10 Farmer #10 3.000 0.000 3.000 -1.000
11 Farmer #11 1.000 0.000 1.000 -1.000
12 Farmer #12 2.000 0.000 2.000 -1.000
13 Farmer #13 3.000 0.000 3.000 -1.000

```

Homophily test

```

Network dataset: farmers_binary
Attribute: "partition_religion_extracted_matrix" COL 1
# of Permutations: 10000
Random seed: 24157

```

Input data is undirected (symmetric).
Warning: Attribute vector has been recoded.

Here is a translation table:

Old Code		New Code	Frequency
=====		=====	=====
1	=>	1	4
2	=>	2	9

Number of ties: 30.000

Cross-classified Frequencies

	1	2	
	1	2	
	--	--	
1 1	10	2	
2 2	2	18	

Expected Values Under Model of Independence

	1	2	
	1	2	
	-----	-----	
1 1	2.31	13.85	
2 2	13.85	13.85	

Observed/Expected

	1	2	
	1	2	
	-----	-----	
1 1	4.33	0.14	
2 2	0.14	1.30	

Odds ratio = 45.000

Average permutation frequency table

	1	2
	-----	-----
1	2.46	7.38
2	7.38	14.77

Observed chisquare value = 37.022

Significance = 0.002500

Number of iterations = 10000

Structural holes

Input dataset: farmers_binary
 Method: Ego Network -- connections 2 links beyond ego are ignored

Structural Hole Measures

		1	2	3	4	5	6	7	8	9
		Degree	EffSize	Efficienc	Constrain	Hierarchy	Ego Betwe	Ln(Constr	Indirects	Density
1	Farmer #1	3.000	1.667	0.556	0.840	0.074	1.000	-0.175	0.556	0.667
2	Farmer #2	3.000	1.667	0.556	0.840	0.074	1.000	-0.175	0.556	0.667
3	Farmer #3	2.000	1.000	0.500	1.125	0.000	0.000	0.118	0.500	1.000
4	Farmer #4	0.000	1.000				0.000		0.000	1.000
5	Farmer #5	3.000	2.333	0.778	0.611	0.052	4.000	-0.492	0.333	0.333
6	Farmer #6	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.333
7	Farmer #7	3.000	2.333	0.778	0.611	0.052	4.000	-0.492	0.333	0.333
8	Farmer #8	4.000	3.500	0.875	0.406	0.055	10.000	-0.901	0.250	0.167
9	Farmer #9	4.000	3.000	0.750	0.563	0.000	8.000	-0.575	0.500	0.333
10	Farmer #10	3.000	1.667	0.556	0.840	0.074	1.000	-0.175	0.556	0.667
11	Farmer #11	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.667
12	Farmer #12	2.000	1.000	0.500	1.125	0.000	0.000	0.118	0.500	1.000
13	Farmer #13	3.000	1.667	0.556	0.840	0.074	1.000	-0.175	0.556	0.667

Dyadic Redundancy

	1	2	3	4	5	6	7	8	9	10	11	12	13
Farmer #1	1.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
Farmer #2	0.67	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
Farmer #3	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
Farmer #4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Farmer #5	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.00
Farmer #6	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Farmer #7	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.33	0.00	0.00	0.33
Farmer #8	0.00	0.00	0.00	0.00	0.25	0.00	0.00	1.00	0.25	0.00	0.00	0.00	0.00
Farmer #9	0.25	0.25	0.00	0.00	0.25	0.00	0.00	0.25	1.00	0.00	0.00	0.00	0.00
Farmer #10	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00	1.00	0.00	0.00	0.67
Farmer #11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00

Farmer #12	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Farmer #13	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.67	0.00	0.00	1.00

Dyadic Constraint

		1	2	3	4	5	6	7	8	9	10	11	12	13
	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm
		----	----	----	----	----	----	----	----	----	----	----	----	----
1	Farmer #1	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.20	0.00
2	Farmer #2	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.20	0.00
3	Farmer #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.56
4	Farmer #4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Farmer #5	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.25	0.25	0.00	0.00	0.00	0.00
6	Farmer #6	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Farmer #7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.25	0.00	0.00	0.25
8	Farmer #8	0.00	0.00	0.00	0.00	0.14	0.00	0.06	0.00	0.14	0.00	0.06	0.00	0.00
9	Farmer #9	0.14	0.14	0.00	0.00	0.14	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00
10	Farmer #10	0.00	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.44
11	Farmer #11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12	Farmer #12	0.56	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Farmer #13	0.00	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.44	0.00	0.00	0.00

Ego networks

Input dataset: farmers_binary

Density Measures

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Size	Ties	Pairs	Densit	AvgDis	Diamet	nWeakC	pWeakC	2StepR	ReachE	Broker	nBroke	EgoBet	nEgoBe
1	Farmer #1	3.00	4.00	6.00	66.67	1.33	2.00	1.00	33.33	41.67	55.56	1.00	0.33	0.50	16.67
2	Farmer #2	3.00	4.00	6.00	66.67	1.33	2.00	1.00	33.33	41.67	55.56	1.00	0.33	0.50	16.67
3	Farmer #3	2.00	2.00	2.00	100.00	1.00	1.00	1.00	50.00	25.00	50.00	0.00	0.00	0.00	0.00
4	Farmer #4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Farmer #5	3.00	2.00	6.00	33.33			2.00	66.67	58.33	77.78	2.00	0.67	2.00	66.67
6	Farmer #6	1.00	0.00	0.00		0.00	0.00	1.00	100.00	25.00	100.00	0.00		0.00	
7	Farmer #7	3.00	2.00	6.00	33.33			2.00	66.67	58.33	70.00	2.00	0.67	2.00	66.67
8	Farmer #8	4.00	2.00	12.00	16.67			3.00	75.00	75.00	81.82	5.00	0.83	5.00	83.33
9	Farmer #9	4.00	4.00	12.00	33.33			2.00	50.00	66.67	61.54	4.00	0.67	4.00	66.67
10	Farmer #10	3.00	4.00	6.00	66.67	1.33	2.00	1.00	33.33	33.33	50.00	1.00	0.33	0.50	16.67
11	Farmer #11	1.00	0.00	0.00		0.00	0.00	1.00	100.00	33.33	100.00	0.00		0.00	
12	Farmer #12	2.00	2.00	2.00	100.00	1.00	1.00	1.00	50.00	25.00	50.00	0.00	0.00	0.00	0.00
13	Farmer #13	3.00	4.00	6.00	66.67	1.33	2.00	1.00	33.33	33.33	50.00	1.00	0.33	0.50	16.67

1. Size. Size of ego network.
2. Ties. Number of directed ties.
3. Pairs. Number of ordered pairs.
4. Density. Ties divided by Pairs.
5. AvgDist. Average geodesic distance.
6. Diameter. Longest distance in egonet.
7. nWeakComp. Number of weak components.
8. pWeakComp. NWeakComp divided by Size.
9. 2StepReach. # of nodes within 2 links of ego.
10. ReachEffic. 2StepReach divided Size.
11. Broker. # of pairs not directly connected.
12. Normalized Broker. Broker divided by number of pairs.
13. Ego Betweenness. Betweenness of ego in own network.
14. Normalized Ego Betweenness. Betweenness of ego in own network.

APPENDIX III – CENTRALITY CALCULATION**Freeman's degree centrality measure – binary network**

Diagonal valid? NO
 Model: SYMMETRIC
 Input dataset: farmers_binary

	1	2	3
	Degree	NrmDegree	Share
	-----	-----	-----
8 Farmer #8	4.000	33.333	0.125
9 Farmer #9	4.000	33.333	0.125
1 Farmer #1	3.000	25.000	0.094
10 Farmer #10	3.000	25.000	0.094
5 Farmer #5	3.000	25.000	0.094
7 Farmer #7	3.000	25.000	0.094
2 Farmer #2	3.000	25.000	0.094
13 Farmer #13	3.000	25.000	0.094
12 Farmer #12	2.000	16.667	0.063
3 Farmer #3	2.000	16.667	0.063
11 Farmer #11	1.000	8.333	0.031
6 Farmer #6	1.000	8.333	0.031
4 Farmer #4	0.000	0.000	0.000

DESCRIPTIVE STATISTICS

	1	2	3
	Degree	NrmDegree	Share
	-----	-----	-----
1 Mean	2.462	20.513	0.077
2 Std Dev	1.151	9.594	0.036
3 Sum	32.000	266.667	1.000
4 Variance	1.325	92.045	0.001
5 SSQ	96.000	6666.667	0.094
6 MCSSQ	17.231	1196.581	0.017
7 Euc Norm	9.798	81.650	0.306
8 Minimum	0.000	0.000	0.000
9 Maximum	4.000	33.333	0.125
10 N of Obs	13.000	13.000	13.000

Network Centralization = 15.15%

Blau Heterogeneity = 9.38%. Normalized (IQV) = 1.82%

Freeman's degree centrality measure – valued network

Diagonal valid? NO
 Model: SYMMETRIC
 Input dataset: farmers_valued

	1	2	3
	Degree	NrmDegree	Share
	-----	-----	-----
9 Farmer #9	74.000	28.030	0.131
8 Farmer #8	66.000	25.000	0.117
2 Farmer #2	58.000	21.970	0.103
7 Farmer #7	56.000	21.212	0.099

13 Farmer #13	54.000	20.455	0.096
5 Farmer #5	54.000	20.455	0.096
1 Farmer #1	52.000	19.697	0.092
10 Farmer #10	44.000	16.667	0.078
12 Farmer #12	36.000	13.636	0.064
3 Farmer #3	34.000	12.879	0.060
6 Farmer #6	20.000	7.576	0.035
11 Farmer #11	16.000	6.061	0.028
4 Farmer #4	0.000	0.000	0.000

DESCRIPTIVE STATISTICS

	1	2	3
	Degree	NrmDegree	Share
	-----	-----	-----
1 Mean	43.385	16.434	0.077
2 Std Dev	20.462	7.751	0.036
3 Sum	564.000	213.636	1.000
4 Variance	418.698	60.075	0.001
5 SSQ	29912.000	4291.782	0.094
6 MCSSQ	5443.077	780.974	0.017
7 Euc Norm	172.951	65.512	0.307
8 Minimum	0.000	0.000	0.000
9 Maximum	74.000	28.030	0.131
10 N of Obs	13.000	13.000	13.000

Network Centralization = 13.71%

Blau Heterogeneity = 9.40%. Normalized (IQV) = 1.85%

Freeman's closeness centrality (geodesics)

nput dataset: farmers_valued_without isolate
 Method: Geodesic paths only (Freeman Closeness)

WARNING: Data matrix dichotomized such that $X_{ij} > 0$ was recoded to 1

Closeness Centrality Measures

	1	2
	Farness	nCloseness
	-----	-----
7 Farmer #8	20.000	55.000
8 Farmer #9	22.000	50.000
6 Farmer #7	24.000	45.833
4 Farmer #5	24.000	45.833
2 Farmer #2	29.000	37.931
1 Farmer #1	29.000	37.931
10 Farmer #11	30.000	36.667
9 Farmer #10	31.000	35.484
12 Farmer #13	31.000	35.484
5 Farmer #6	34.000	32.353
11 Farmer #12	38.000	28.947
3 Farmer #3	40.000	27.500

Statistics

	1	2
	Farness	nCloseness
	-----	-----

1	Mean	29.333	39.080
2	Std Dev	5.878	8.064
3	Sum	352.000	468.963
4	Variance	34.556	65.021
5	SSQ	10740.000	19107.482
6	MCSSQ	414.667	780.256
7	Euc Norm	103.634	138.230
8	Minimum	20.000	27.500
9	Maximum	40.000	55.000
10	N of Obs	12.000	12.000

Network Centralization = 36.47%

Reach centrality

Input dataset: farmers_valued
 WARNING: Data matrix dichotomized such that $X_{ij} > 0$ was recoded to 1

Reach-Based Centrality Measures

		1	2
		dwReach	NormdwRea
		-----	-----
8	Farmer #8	8.167	0.628
9	Farmer #9	7.917	0.609
5	Farmer #5	7.250	0.558
7	Farmer #7	7.250	0.558
1	Farmer #1	6.700	0.515
2	Farmer #2	6.700	0.515
10	Farmer #10	6.450	0.496
13	Farmer #13	6.450	0.496
11	Farmer #11	5.667	0.436
12	Farmer #12	5.483	0.422
3	Farmer #3	5.350	0.412
6	Farmer #6	5.283	0.406
4	Farmer #4	1.000	0.077

Statistics

		1	2
		dwReac	Normdw
		-----	-----
1	Mean	6.13	0.47
2	Std Dev	1.73	0.13
3	Sum	79.67	6.13
4	Variance	3.00	0.02
5	SSQ	527.19	3.12
6	MCSSQ	38.98	0.23
7	Euc Norm	22.96	1.77
8	Minimum	1.00	0.08
9	Maximum	8.17	0.63
10	N of Obs	13.00	13.00

Node-by-Distance Proportion of Nodes Reached Matrix

		1	2	3	4	5	6	7	8	9	10	11	12
		d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12
1	Farmer #1	0.25	0.42	0.67	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2	Farmer #2	0.25	0.42	0.67	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
3	Farmer #3	0.17	0.25	0.33	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92
4	Farmer #4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Farmer #5	0.25	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
6	Farmer #6	0.08	0.25	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
7	Farmer #7	0.25	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
8	Farmer #8	0.33	0.75	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
9	Farmer #9	0.33	0.67	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
10	Farmer #10	0.25	0.33	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
11	Farmer #11	0.08	0.33	0.75	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
12	Farmer #12	0.17	0.25	0.42	0.67	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92
13	Farmer #13	0.25	0.33	0.58	0.83	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92

Freeman's betweenness centrality

Input dataset: farmers_valued
 Important note: this routine binarizes but does NOT symmetrize.
 Un-normalized centralization: 332.000

		1	2
		Betweenness	nBetweenness
		-----	-----
8	Farmer #8	34.000	51.515
7	Farmer #7	24.000	36.364
9	Farmer #9	24.000	36.364
5	Farmer #5	10.000	15.152
10	Farmer #10	4.500	6.818
1	Farmer #1	4.500	6.818
2	Farmer #2	4.500	6.818
13	Farmer #13	4.500	6.818
6	Farmer #6	0.000	0.000
3	Farmer #3	0.000	0.000
11	Farmer #11	0.000	0.000
12	Farmer #12	0.000	0.000
4	Farmer #4	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		Betweenness	nBetweenness
		-----	-----
1	Mean	8.462	12.821
2	Std Dev	10.948	16.588
3	Sum	110.000	166.667
4	Variance	119.864	275.170
5	SSQ	2489.000	5713.958
6	MCSSQ	1558.231	3577.206
7	Euc Norm	49.890	75.591
8	Minimum	0.000	0.000
9	Maximum	34.000	51.515
10	N of Obs	13.000	13.000

Network Centralization Index = 41.92%

Flow Betweenness

Input dataset: farmers_valued
 Dataset is symmetric.

		1	2
		FlowBet	nFlowBet
		-----	-----
1	Farmer #1	6.019	4.560
2	Farmer #2	7.875	5.966
3	Farmer #3	1.345	1.019
4	Farmer #4	0.000	0.000
5	Farmer #5	23.765	18.004
6	Farmer #6	0.000	0.000
7	Farmer #7	49.497	37.498
8	Farmer #8	72.565	54.973
9	Farmer #9	50.262	38.077
10	Farmer #10	2.529	1.916

11 Farmer #11	0.000	0.000
12 Farmer #12	0.721	0.546
13 Farmer #13	7.588	5.749

Network Centralization Index = 45.529%

DESCRIPTIVE STATISTICS FOR EACH MEASURE

	1	2
	FlowBet	nFlowBet
1 Mean	17.090	12.947
2 Std Dev	23.492	17.797
3 Sum	222.167	168.308
4 Variance	551.881	316.736
5 SSQ	10971.229	6296.620
6 MCSSQ	7174.452	4117.569
7 Euc Norm	104.744	79.351
8 Minimum	0.000	0.000
9 Maximum	72.565	54.973
10 N of Obs	13.000	13.000

KPP-Pos (Key player 2, <http://www.analytictech.com/products.htm>, 18.3.2011)

Diffuse 2 nodes

Dichotomize

Number of steps: 2

Initial nodes

Farmer #8

Farmer #9

Percentage of nodes reached 92,308%: "Farmer #10" "Farmer #9"

Percentage of nodes reached 92,308%: "Farmer #13" "Farmer #9"

Percentage of nodes reached 92,308%: "Farmer #3" "Farmer #9"

Percentage of nodes reached 92,308%: "Farmer #7" "Farmer #9"

Group size 2 Fitness Delta 92,308

Diffuse 1 nodes

Dichotomize

Number of steps: 2

Initial nodes

Farmer #8

Percentage of nodes reached 76,923%: "Farmer #8"

Group size 1 Fitness Delta 76,923

KEY INDIVIDUALS – Ranks assigned according to the scores on centrality measures

	C_D^{80}	C_{Dv}^{81}	C_{Cg}^{82}	C_{Cr}^{83}	C_{BF}^{84}	C_{Bf}^{85}	KPP - Pos
Farmer #8	1	2	1	1	1	1	1 (KP group size 1)
Farmer #9	1	1	2	2	2	2	1 (KP group size 2)
Farmer #7	2	4	3	3	2	3	1 (KP group size 2)
Farmer #5	2	5	3	3	3	4	/
Farmer #2	2	3	4	4	4	5	/
Farmer #13	2	5	6	5	4	6	1 (KP group size 2)
Farmer #1	2	6	4	4	4	7	/
Farmer #10	2	7	6	5	4	6	/
Farmer #3	3	9	9	8	5	9	1 (KP group size 2)
Farmer #12	3	8	8	7	5	10	/
Farmer #11	4	11	5	6	5	11	/
Farmer #6	4	10	7	9	5	11	/
Farmer #4	5	12	/	10	5	11	/

APPENDIX IV – NETWORK AND PARTITION FILES⁸⁶

Support network

*Vertices 53

1 "Farmer #1"	0.8303	0.5179
2 "Farmer #2"	0.2249	0.6692
3 "Farmer #3"	0.7483	0.2579
4 "Farmer #4"	0.6464	0.7978
5 "Farmer #5"	0.8257	0.7448
6 "Farmer #6"	0.4103	0.8151
7 "Farmer #7"	0.5720	0.4051
8 "Farmer #8"	0.1506	0.4715
9 "Farmer #9"	0.3169	0.3587
10 "Farmer #10"	0.4900	0.1716
11 "Alter #1"	0.7897	0.4529

⁸⁰ Degree centrality - binary

⁸¹ Degree centrality - valued

⁸² Closeness centrality – Freeman's geodesics

⁸³ Closeness centrality – reach centrality

⁸⁴ Betweenness centrality – Freeman's betweenness

⁸⁵ Betweenness centrality – flow centrality

⁸⁶ Pajek .net, .clu files

12	"Alter #2"	0.9000	0.5577
13	"Alter #3"	0.7536	0.5537
14	"Alter #4"	0.8172	0.6015
15	"Alter #5"	0.8885	0.4516
16	"Alter #6"	0.2678	0.6015
17	"Alter #7"	0.3138	0.6718
18	"Alter #8"	0.1835	0.7461
19	"Alter #9"	0.1475	0.6493
20	"Alter #10"	0.2548	0.7501
21	"Alter #11"	0.7352	0.3295
22	"Alter #12"	0.8057	0.2167
23	"Alter #13"	0.7123	0.1849
24	"Alter #14"	0.8341	0.3123
25	"Alter #15"	0.5851	0.7368
26	"Alter #16"	0.7307	0.8177
27	"Alter #17"	0.6709	0.7235
28	"Alter #18"	0.6525	0.8761
29	"Alter #19"	0.5759	0.8456
30	"Alter #20"	0.8885	0.6983
31	"Alter #21"	0.8011	0.8204
32	"Alter #22"	0.4877	0.8310
33	"Alter #23"	0.3713	0.8828
34	"Alter #24"	0.4303	0.7355
35	"Alter #25"	0.4471	0.9000
36	"Alter #26"	0.3222	0.8217
37	"Alter #27"	0.6464	0.4410
38	"Alter #28"	0.5605	0.4980
39	"Alter #29"	0.6134	0.3229
40	"Alter #30"	0.4900	0.3839
41	"Alter #31"	0.1061	0.5325
42	"Alter #32"	0.1766	0.3733
43	"Alter #33"	0.2195	0.4847
44	"Alter #34"	0.1000	0.4078
45	"Alter #35"	0.2364	0.3322
46	"Alter #36"	0.2770	0.2645
47	"Alter #37"	0.3582	0.2884
48	"Alter #38"	0.3467	0.4330
49	"Alter #39"	0.5751	0.1597
50	"Alter #40"	0.4027	0.1836
51	"Alter #41"	0.4188	0.1186
52	"Alter #42"	0.5092	0.2433
53	"Alter #43"	0.5130	0.1000
*Edges			
1	11		
1	12		
1	13		
1	14		
1	15		
2	16		
2	17		
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2	19		
2	20		
3	21		
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 10 53

Extracted knowledge network – binary

*Vertices 13

1 "Farmer #1"	0.7652	0.2862	0.5000
2 "Farmer #2"	0.6756	0.1429	0.5000
3 "Farmer #3"	0.0564	0.6822	0.5000
4 "Farmer #4"	0.2526	0.3194	0.5000
5 "Farmer #5"	0.6196	0.6214	0.5000
6 "Farmer #6"	0.7286	0.8129	0.5000
7 "Farmer #7"	0.3450	0.6729	0.5000
8 "Farmer #8"	0.4784	0.5024	0.5000
9 "Farmer #9"	0.6205	0.3861	0.5000
10 "Farmer #10"	0.1916	0.5694	0.5000
11 "Farmer #11"	0.3995	0.2605	0.5000
12 "Farmer #12"	0.8166	0.0528	0.5000
13 "Farmer #13"	0.1994	0.7645	0.5000

*Edges

1 2
 1 9
 1 12
 2 9
 2 12
 3 10
 3 13
 5 6
 5 8

5 9
 7 8
 7 10
 7 13
 8 9
 8 11
 10 13

Extracted knowledge network – valued

*Vertices 13

1 "Farmer #1"	0.2343	0.2332	0.5000
2 "Farmer #2"	0.3822	0.2224	0.5000
3 "Farmer #3"	0.7931	0.9475	0.5000
4 "Farmer #4"	0.5278	0.3555	0.5000
5 "Farmer #5"	0.2200	0.5427	0.5000
6 "Farmer #6"	0.0567	0.5876	0.5000
7 "Farmer #7"	0.6280	0.6878	0.5000
8 "Farmer #8"	0.4147	0.5998	0.5000
9 "Farmer #9"	0.3404	0.4022	0.5000
10 "Farmer #10"	0.7518	0.5899	0.5000
11 "Farmer #11"	0.3013	0.8208	0.5000
12 "Farmer #12"	0.3302	0.0525	0.5000
13 "Farmer #13"	0.6680	0.8691	0.5000

*Edges

1 2 18
 1 9 18
 1 12 16
 2 9 20
 2 12 20
 3 10 12
 3 13 22
 5 6 20
 5 8 16
 5 9 18
 7 8 16
 7 10 20
 7 13 20
 8 9 18
 8 11 16
 10 13 12

Knowledge network – valued

*Vertices 33

1 "Farmer #1"	0.1000	0.5000	0.5000
2 "Farmer #2"	0.1068	0.4265	0.5000
3 "Farmer #3"	0.1270	0.3555	0.5000
4 "Farmer #4"	0.1599	0.2894	0.5000
5 "Farmer #5"	0.2044	0.2305	0.5000
6 "Farmer #6"	0.2589	0.1808	0.5000
7 "Farmer #7"	0.3217	0.1419	0.5000
8 "Farmer #8"	0.3905	0.1153	0.5000
9 "Farmer #9"	0.4631	0.1017	0.5000
10 "Farmer #10"	0.5369	0.1017	0.5000
11 "Farmer #11"	0.6095	0.1153	0.5000

12	"Alter #1"	0.6783	0.1419	0.5000
13	"Farmer #12"	0.7411	0.1808	0.5000
14	"Alter #2"	0.7956	0.2305	0.5000
15	"Alter #3"	0.8401	0.2894	0.5000
16	"Alter #4"	0.8730	0.3555	0.5000
17	"Alter #5"	0.8932	0.4265	0.5000
18	"Farmer #13"	0.9000	0.5000	0.5000
19	"Alter #6"	0.8932	0.5735	0.5000
20	"Alter #7"	0.8730	0.6445	0.5000
21	"Alter #8"	0.8401	0.7106	0.5000
22	"Alter #9"	0.7956	0.7695	0.5000
23	"Alter #10"	0.7411	0.8192	0.5000
24	"Alter #11"	0.6783	0.8581	0.5000
25	"Alter #12"	0.6095	0.8847	0.5000
26	"Alter #13"	0.5369	0.8983	0.5000
27	"Alter #14"	0.4631	0.8983	0.5000
28	"Alter #15"	0.3905	0.8847	0.5000
29	"Alter #16"	0.3217	0.8581	0.5000
30	"Alter #17"	0.2044	0.7695	0.5000
31	"Alter #18"	0.1599	0.7106	0.5000
32	"Alter #19"	0.1270	0.6445	0.5000
33	"Alter #20"	0.1068	0.5735	0.5000

*Edges

1 2 18
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1 12 18
1 13 16
1 14 14
2 9 20
2 12 22
2 13 20
2 14 20
3 10 12
3 15 20
3 16 22
3 17 22
3 18 22
3 19 20
4 20 22
4 21 22
4 22 20
5 6 20
5 8 16
5 9 18
5 23 22
5 24 22
5 25 22
6 17 20
6 26 20
6 27 20
6 28 20
7 8 16
7 10 20
7 17 20
7 18 20
7 29 20
8 9 18

8 11 16
 8 30 16
 8 31 16
 9 32 18
 9 33 18
 10 18 12
 10 19 12

Knowledge network – binary

*Vertices 33

1 "Farmer #1"	0.1000	0.5000	0.5000
2 "Farmer #2"	0.1068	0.4265	0.5000
3 "Farmer #3"	0.1270	0.3555	0.5000
4 "Farmer #4"	0.1599	0.2894	0.5000
5 "Farmer #5"	0.2044	0.2305	0.5000
6 "Farmer #6"	0.2589	0.1808	0.5000
7 "Farmer #7"	0.3217	0.1419	0.5000
8 "Farmer #8"	0.3905	0.1153	0.5000
9 "Farmer #9"	0.4631	0.1017	0.5000
10 "Farmer #10"	0.5369	0.1017	0.5000
11 "Farmer #11"	0.6095	0.1153	0.5000
12 "Alter #1"	0.6783	0.1419	0.5000
13 "Farmer #12"	0.7411	0.1808	0.5000
14 "Alter #2"	0.7956	0.2305	0.5000
15 "Alter #3"	0.8401	0.2894	0.5000
16 "Alter #4"	0.8730	0.3555	0.5000
17 "Alter #5"	0.8932	0.4265	0.5000
18 "Farmer #13"	0.9000	0.5000	0.5000
19 "Alter #6"	0.8932	0.5735	0.5000
20 "Alter #7"	0.8730	0.6445	0.5000
21 "Alter #8"	0.8401	0.7106	0.5000
22 "Alter #9"	0.7956	0.7695	0.5000
23 "Alter #10"	0.7411	0.8192	0.5000
24 "Alter #11"	0.6783	0.8581	0.5000
25 "Alter #12"	0.6095	0.8847	0.5000
26 "Alter #13"	0.5369	0.8983	0.5000
27 "Alter #14"	0.4631	0.8983	0.5000
28 "Alter #15"	0.3905	0.8847	0.5000
29 "Alter #16"	0.3217	0.8581	0.5000
30 "Alter #17"	0.2044	0.7695	0.5000
31 "Alter #18"	0.1599	0.7106	0.5000
32 "Alter #19"	0.1270	0.6445	0.5000
33 "Alter #20"	0.1068	0.5735	0.5000

*Edges

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APPENDIX V – INTERVIEWS AND KEY INFORMANTS

	Interview date	Gender	Age	Farming activity	Occupation	Religion
Farmer #1	3.11.2010	Male	68	Part time	Retired (plumber)	Roman Catholic
Farmer #2	3.11.2010	Male	72	Part time	Retired (officer)	Protestant
Farmer #3	4.11.2010	Male	48	Part time	Teacher	Shi'ah
Farmer #4	4.11.2010	Male	73	Full time	/	Shi'ah
Farmer #5	5.11.2010	Male	56	Full time	/	Shi'ah
Farmer #6	5.11.2010	Male	87	Part time	Retired (businessman)	Shi'ah
Farmer #7	5.11.2010	Male	62	Full time	/	Shi'ah
Farmer #8	9. / 10.11.2010	Male	57	Full time	/	Shi'ah
Farmer #9	9.11.2010	Male	67	Part time	Retired (teacher)	Orthodox
Farmer #10	9. / 11.11.2010	Male	52	Full time	/	Shi'ah

Key informants:

Kamal Karaa, head of the Litani River Authority (LRA)
 Nicolas Gharib, UNDP project manager
 Marie H el ene Nassif, UNDP site engineer
 Mohamad Bahsoun, AFIAL site engineer

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