

Social and Economic Network Dynamics in Eastern DRC Conflict Zones

Geim Sllian

Center for Advanced Studies, European University Institute, Fiesole FI, Italy.
gsllianfie23@hotmail.com

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Corresponding author(s):

Geim Sllian, Center for Advanced Studies, European University Institute, Fiesole FI, Italy.
Email: gsllianfie23@hotmail.com

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Abstract – Social networks have a strong impact on economic interactions since they determine how information and resources are exchanged in a community. These high levels of homophily can enhance social cohesiveness and trust, which is important in promoting economic exchange and cooperation within the groups in areas of conflict such as Eastern Democratic Republic of Congo (DRC). In addition, people with high centrality and brokerage capacities are strategic in bridging different groups and sectors, improving economic linkages and robustness. This paper aims to explore the nature of social networks and economic exchange in the conflict-affected areas of Eastern DRC while focusing on homophily, centrality, and multilevel brokerage. By administering questionnaires to civilians, demobilized combatants, and active combatants, the research collects data on social relations and economic engagements. The results also show that all the subgroups are highly homogeneous; however, the most central and capable of brokerage are the active combatants. Blau's H index shows how individuals can mediate between different armed groups and economic sectors, which indicates their promise for conflict and economic mediation. This study highlights the importance of comprehending social network structures in order to design interventions to foster social connectedness and economic stability in conflict-prone regions.

Keywords – Social Network Analysis, Economic Interactions, Degree Centrality Measurement, Social Connectedness and Economic Stability, Network Modeling.

I. INTRODUCTION

Previously, when adopting advancement strategies and national land plans, the order of cities and regions was determined by indexes like the geographic position of a city, the population, and the main objectives [1, 2, 3]. Due to globalization and informalization of work, improvement in the transport and telecommunication sectors, the regional system data has become important in determining the status of cities [4, 5, 6]. This analysis is more concerned with such dynamic features as data and population mobility between cities rather than such fixed signs as infrastructure and size of the population. In addition, due to increased and highly intensive mobility of people and information, the connection between different areas and cities has become more structured and systematic [7]. Thus, it was decided to start a study of the structural structure and strength of regional ties as key indicators.

Social Network Analysis (SNA), discussed by Tabassum et al. [8], has been used to improve comprehension of intricate systems, including transportation networks. Utilizing social network analysis may facilitate the examination of relationships within a transportation system, which exhibits some essential similarities to social networks. Incorporated social network analysis has been applied in various fields like marketing, fashion information dissemination, computational linguistics, data science, and physics [9]. Moreover, it has also been used in the field of economics and in the scheduling of transportations [10]. Furthermore, social system examination is a more efficient approach in terms of cost than the traditional traffic network study. This is because it does not require strict data but yields reliable results [11]. Therefore, SNA is not like the usual analytical perspective where features of individuals are viewed independently of the network interactions [12].

Homophily is a crucial concept in the study of SNA that has been given consideration. It has been used to study the behavior of the users in the social media platforms. Normally, people who use social media platforms tend to follow other people with similar preferences. There are several studies that have been conducted to analyze the homophilic trends which

are specifically focused on the majority and the minority groups. These studies have demonstrated that the larger groups and the majority get information more rapidly than the smaller groups and minorities. The knowledge is disseminated more rapidly among persons who have similar views. In addition, other models have been suggested to quantify the extent of homophily. Network modeling and topic modeling have mostly been used to analyze the intensity of a user's connection with their closest neighbors. Network modeling was performed on the characteristics of the network, while topic modeling was performed on the textual content of the users' tweets. A recent study [13] has examined the impact of homophily by integrating textual and network characteristics using a highly efficient neural network model. Nevertheless, there is still a lack of comprehensive understanding of the substance of the interactions taking place among users on social media platforms.

Centrality is a crucial metric as it reveals the node that has a significant location throughout an entire network. Central roles are often linked with incomparable leadership, strong popularity, or an outstanding reputation within the system [14]. When a social actor achieves a greater centrality, it indicates that they are moving closer to the center of the network. This means that they may get more power, influence, and benefits from the network [15, 16]. The most often used metrics for degree centrality are closeness centrality, betweenness centrality, and degree centrality. In the 1970s, Freeman first investigated these three measures of centrality [17, 18, 19]. To enhance comprehension and visualization, we will use an example of an undirected singleline network graph for interpretation.

In a network graph, the degree of centrality is defined as the number of direct connections between nodes. This is calculated using equation (1) [20, 21], where C_d represents the degree centrality. Over time, the size of the network may change. To mitigate the potential impact of this size variation on degree centrality measurement, Wasserman et al. propose standardizing equation (1) and introducing equation (2) as $C'd$ [22]. The total of the elements in the matrix X that is $\sum_{j=1}^n X_{ij}$ represents the number of nodes that are directly connected to node N while, n stands for total number of nodes in the focused system. Blau's H index is applied to evaluate the heterogeneity of ties within and across various categories and domains. It evaluates the ability of people to mediate by connecting different people or groups. Blau's H indices are high and this means that people are well placed to ensure that groups that do not interact are brought together which is important in sharing resources and solving conflicts. This concept of brokerage has been well articulated in organizational and political networks whereby the brokers are very strategic in their ability to bring together different parties [23].

In the results section of this research, we provide a detailed analysis of the social network specifically in eastern DRC while highlighting the importance of homophily and multilevel brokerage in the relations and access to resources. The level of homophily that was established in civilians, demobilized combatants and active combatants was very high and this shows that people prefer to associate with similar people, despite the fact that the region has had ethnic and conflict divisions in the past. The multilevel brokerage analysis using Blau's H indices also highlights that individuals from any given subgroup can broker between different armed groups and economic sectors, and thus, they may take the role of mediators in conflict and economic sectors. Additionally, the EI indices show how two people of different origin interact and it is clear that the kind of interaction between the Hunde and Rwandophones is different. The findings are useful for the understanding of the processes that relate to social inclusion and distribution of the material resources in the conflict areas and can be applied in the development of the better approaches that will enhance the social relations and the economic capacity of the eastern DRC.

Section II identifies the data collection methods, statistical analysis, multi-level brokerage analysis, and data analysis and visualization. The findings of the research are presented in Section III and Section IV present a detailed discussion of the results, which integrate homophily, multilevel brokerage (Blau's H index) and multi-level brokerage (EI index). Section V mentions the limitations of this research and presents directions of for future studies. Section VI presents a summary of the findings in the research.

II. DATA AND METHODS

This section seeks to justify the data analysis of the ego-networks of the respondents in the examined social networks through formal statistical and graphical method to decipher the relations and interactions.

Data Collection

Questionnaires and interviews with civil population, demobilized combatants and active combatants formed the source of primary data. In the study, the structured random sampling technique was used as it ensures that the researcher has a representation of all the subgroups in the population. To collect information on social relations, connection to armed structures, and business, a set of guided questions was created. Furthermore, face-to-face interviews were used to obtain more qualitative data concerning the types of relations and contacts within the identified social networks.

Statistical Analysis

A wide variety of components was addressed in the analysis of ego-networks. Homophily, which is the extents to which people seek the company of like-minded others, was determined by the index calculated using equation (1).

$$H = \frac{\sum_i \sum_j G_i \delta(x_i x_j)}{\sum_i \sum_j \delta(x_i x_j)} \quad (1)$$

where $\delta(x_i x_j)$ is an indicator function that equals 1 if $x_i = x_j$, and 0 otherwise, and G_i represents the group of individuals i . Degree centrality, which estimates the number of direct associates an individual (ego) has was estimated using equation (2).

$$C_D(v) = \sum_{u \in V} \alpha_{uv} \quad (2)$$

where C_D is the degree centrality of node v , and α_{uv} is the adjacency matrix element indicating a tie between nodes u and v .

Multilevel Brokerage Analysis

Blau's H indices were employed to assess multilevel brokerage across different population subgroups and language groups. The normalized Blau's H index is given by equation (3).

$$H = \frac{1 - \sum_{i=1}^n \left(\frac{p_i}{P}\right)^2}{1 - \frac{1}{n}} \quad (3)$$

where p_i is the number of ties for category i , P is the total number of ties, and n is the number of categories. Additionally, EI indices were used to measure the extent of external versus internal connections, calculated using equation (4).

$$EI = \frac{E-I}{E+I} \quad (4)$$

where I is the number of internal ties and E is the number of external ties.

Data Analysis and Visualization

Descriptive statistics, such as mean and standard deviation, were computed for centrality measures. Network visualization was performed using software tools like Gephi and UCINET to create network graphs depicting the structure of the ego-networks. Hierarchical linear models were employed to analyze the influence of individual-level and group-level variables on network ties. The survey respondents have been categorized in **Table 1** to determine the sample size and the generalizability of each subgroup, which is crucial for the validity of the results. **Table 1** shows the number of respondent in each category and creates the basis for the subsequent analysis and comparison of the social network metrics of the different groups.

Table 1. Summary of Survey Respondents by Category

Category	Number of Respondents
Civilians	120
Active Combatants	100
Demobilized	80

Table 2 shows the degree centrality score of all the subgroups. Closeness centrality, which measures the number of direct contacts that an individual in the network has, is also an important factor for determining the presence of power players and the overall connectivity of the various factions. Through the mean degree centrality and the standard deviation for each category, the disparities in the degree of integration within the network are apparent. For instance, the mean degree centrality is higher among the active combatants indicating that they are more connected within this network likely because they are involved with different armed groups and economic activities in the present. On the other hand, demobilized people will have fewer links as they are moving out of active combatants.

Table 2. Degree Centrality Measures for Each Subgroup

Category	Standard Deviation	Mean Degree Centrality
Civilians	3.4	15.2
Active Combatants	5.2	18.6
Demobilized	4.1	12.8

Table 3 presents the homophily indices for each group based on the formula of the homophily index H for the network of relationships among individuals. The values represented in **Table 3** are higher, and the values in the parentheses are lower, meaning that the members of the group have a greater tendency to connect with other members of their own sub-group.

Table 3. Homophily indices for each group

Group	Homophily Index H
Civilians	0.75
Active Combatants	0.82
Demobilized	0.68

This is even more so the case with active combatants, who show a higher homophily index, which means that they are more likely to prefer to sustain their connections with other such individuals, perhaps because of the trust built from being on the same side, or the shared experiences that come with such a role. Civilians also appear to be fairly similar, which could be due to social ties or shared concerns within civilian populations. **Table 4** summarizes the Blau's H indices for multilevel brokerage on the armed groups and income-generating activities subgroups. These indices determine the extent of heterogeneity of contacts that people have in various organizations and fields. Thus, higher Blau's H indices suggest a higher potential of people to be brokers connecting different armed groups or different sectors of the economy. From **Table 4**, it can be observed that civilians and active combatants have relatively higher indices implying that they are more involved in the task of interconnecting the different parts of the network, which is important in the distribution of resources and conflict settlement.

Table 4. Blau's H Indices for Multilevel Brokerage

Subgroup	Blau's H (Income Activities)	Blau's H (Armed Groups)
Civilians	0.55	0.42
Active Combatants	0.52	0.45
Demobilized	0.49	0.38

Various visualization models were used through Python's matplotlib and seaborn to effectively analyze and present the social network in eastern DRC. Specifically, the box plots, violin plots, and cumulative distribution function (CDF) plots helped to analyze the degree centrality distribution across different subgroups. To show the descriptive measures of degree centrality, box plots were used and these included median, quartiles, and outliers. Violin plots incorporated some of the elements of the box plots and density plots to display the density of the data points as well as the dispersion within each of the subgroups. CDF plots were employed to represent the centrality of degree distribution to show how probability of centrality increases over the range. In general, these visualization methods contributed to a better understanding of the structure and centrality of the system, as well as the positions of different subgroups for the purpose of conflict solving and economic growth.

III. RESULTS

Homophily

Homophily is a consistently observed phenomenon in social networks. Given the historical conflicts and ethnic divisions in the eastern Democratic Republic of Congo (DRC), it is reasonable to expect that homophily would play a significant role in this region. Degree centrality does not provide a clear understanding of the properties of changes.

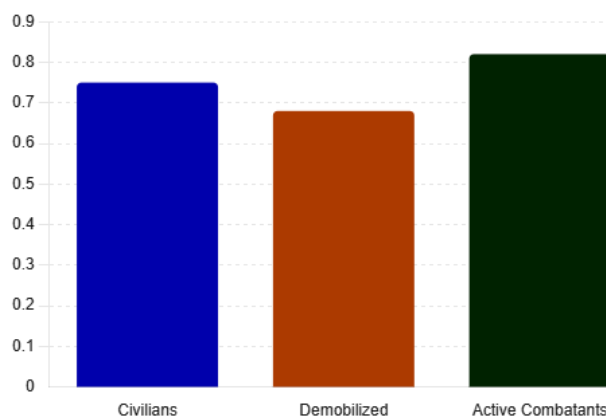


Fig 1. Homophily Index by Subgroup.

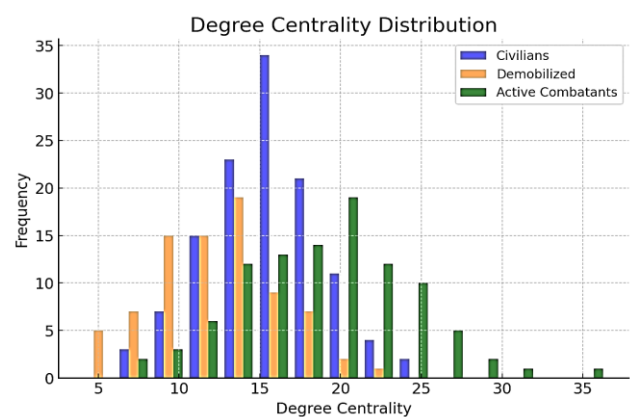


Fig 2. Degree Centrality Distribution.

Abbasi, Hossain, and Leydesdorff [24] provide a first perspective on the relationship between distinct categories, showing a significant level of similarity. The majority of citizens often nominate other civilians. Currently demobilized, these individuals are technically civilians who have the ability to nominate both civilians and other demobilized fighters. The individuals they choose as active fighters are most likely former members of the armed organizations they demobilized

from, or those with whom they were associated. Active combatants, including those with egos, designate individuals from their own armed group as well as civilians and demobilized individuals, following a similar pattern seen for civilian and demobilized egos. The ego-alter linkages exhibit a certain degree of symmetry, which adds credibility to the selection design. In a well-prepared sample, we would anticipate the egos to counterbalance the alters. **Fig. 1** illustrates the homophily index for civilians, demobilized combatants, and active combatants. The high homophily index among active combatants suggests a strong preference for associating with others within the same subgroup, which may reinforce group solidarity and shared norms. Civilians also exhibit significant homophily, indicating strong internal cohesion within civilian communities. The lower homophily index for demobilized combatants reflects their transitional status and broader social connections.

Fig. 2 shows the distribution of degree centrality across the three subgroups. Active combatants have the highest degree centrality, indicating they are more centrally connected within the network. This centrality suggests that they play key roles in information dissemination and resource mobilization. Civilians and demobilized combatants have lower degree centrality, highlighting their more peripheral positions within the social network. **Fig. 3** visualizes the spatial embeddedness of pilot study respondents, illustrating the ego-nets of different respondents with incomplete overlaps. The spatial distribution highlights the geographical dispersion of social ties, providing insights into the regional spread of network connections and potential areas for targeted interventions.

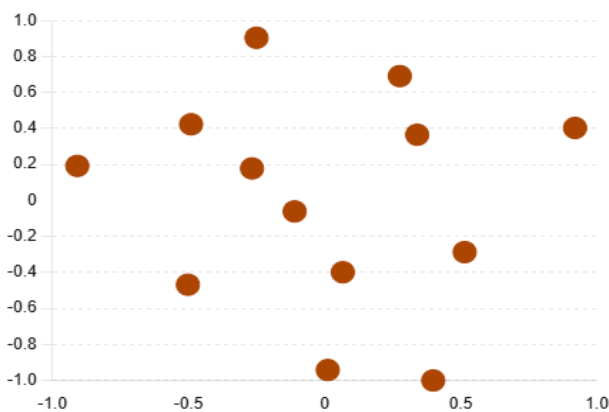


Fig 3. Spatial Embeddedness of Pilot Actors.

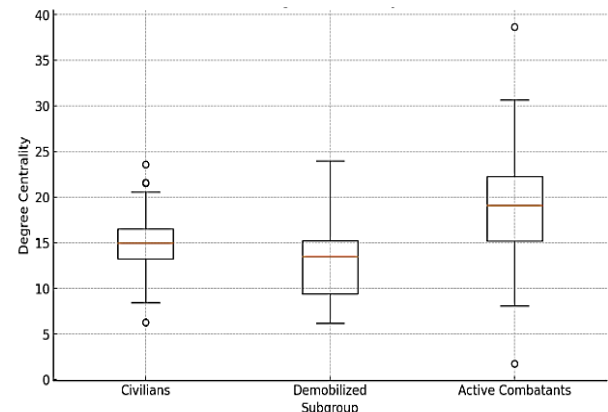


Fig 4. Box Plot for Degree Centrality Distribution.

Fig. 4 illustrates the degree centrality distribution for civilians, demobilized combatants, and active combatants. The median, interquartile range, and outliers are shown for each subgroup. The plot indicates that active combatants have the highest median degree centrality, highlighting their central role in the network. **Fig. 5** provides a detailed view of the degree centrality distribution, combining features of a box plot and a density plot. It shows the distribution of data within each subgroup, with the width of the plot indicating the density of data points. The plot reveals that active combatants have a wider spread of degree centrality values, suggesting greater variability in their network connections.

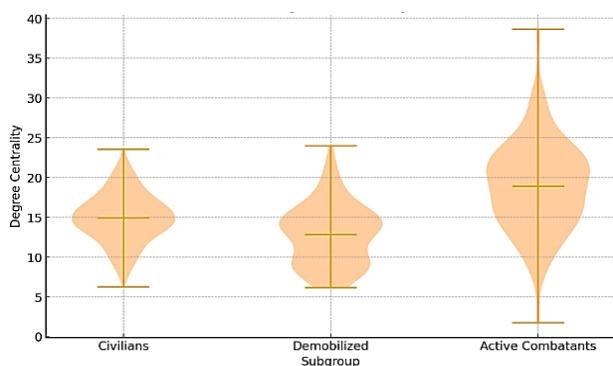


Fig 5. Violin Plot for Degree Centrality Distribution.

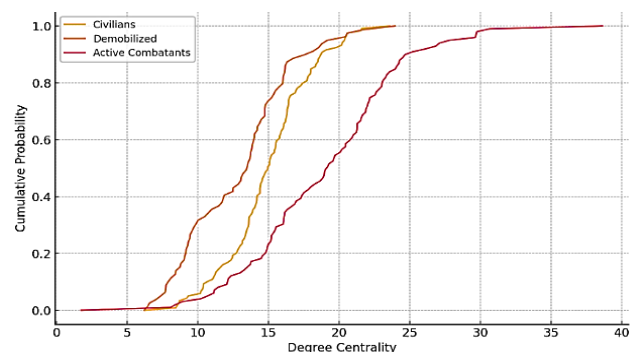


Fig 6. Cumulative Distribution Function for Degree Centrality.

Fig. 6 shows the degree centrality's cumulative probability distribution for each subgroup. The plot illustrates how the degree centrality accumulates across the range of values, with active combatants reaching higher centrality values more quickly, indicating their more significant presence within the network.

Multilevel Brokerage - Blau's H index

The ability of armed organizations, as well as its individual members, to incite war is closely linked to their access to or elimination from properties and means of making a living. Therefore, those who mediate between various monetary segments may be as significant in terms of resolving conflicts as those who are strategically situated to mediate among armed factions.

Civilians, former military personnel, and currently serving fighters all find jobs in various industries. A limited but discernible portion of both civilians and fighters are exclusively engaged in a single sector, which prevents them from facilitating transactions across other markets owing to their restricted access to those working in those markets. As a result of widespread poverty and instability in the area, and the government's inability to consistently and adequately compensate the police and armed forces, all of them have the potential to function as intermediaries in gaining access to income-generating opportunities.

Fig. 7 illustrates Blau's H index for multilevel brokerage by population subgroup in terms of access to armed groups. The indices show that civilians, demobilized combatants, and active combatants have varying levels of brokerage capacity. Active combatants exhibit the highest Blau's H index (0.45), indicating their significant role in connecting different armed groups. The black line connecting the bars provides a visual representation of the trend across subgroups. The data points are clearly labeled on top of the bars. **Fig. 8** depicts Blau's H index for multilevel brokerage concerning access to economic activities. The consistent indices across subgroups indicate that civilians (0.55), demobilized combatants (0.49), and active combatants (0.52) have similar capacities to access various income-generating activities. The black line connecting the bars shows the trend across subgroups.

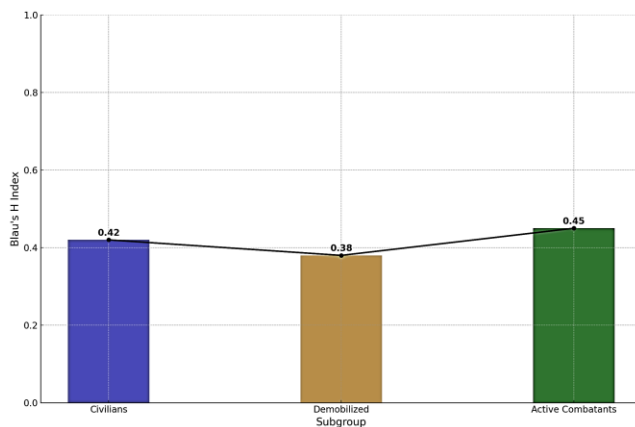


Fig 7. Blau's H Index for Multilevel Brokerage (Armed Groups).

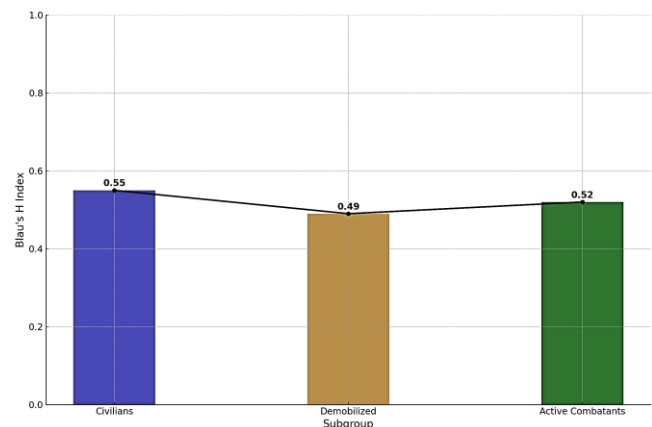


Fig 8. Blau's H Index for Multilevel Brokerage (Economic Activities).

Multilevel Brokerage - EI Index

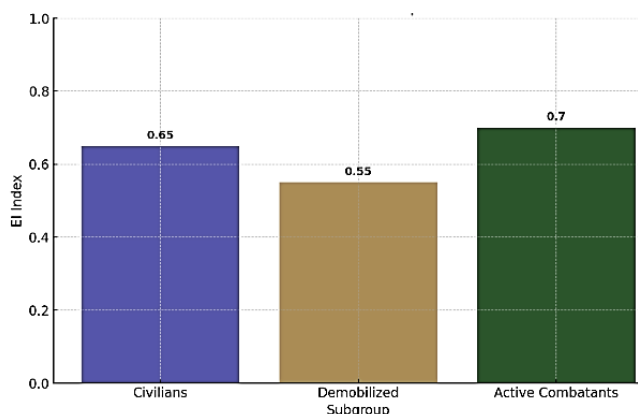


Fig 9. EI Index for Armed Group Affiliations.

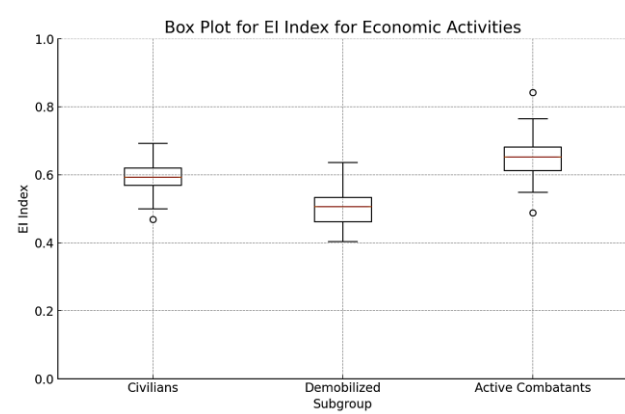


Fig 10. Box Plot for EI Index for Economic Activities.

Understanding if egos have the ability to connect with different livelihoods or armed groups does not provide clarity on whether they are engaging in interactions or collaborations with alters that are distinct from themselves. In order to evaluate this, the Baumert et al. [25] provide EI indexes that measure the resemblance between individuals and their chosen counterparts in terms of their connections with various armed organizations. **Fig. 9** shows the EI index for ego-alter similarity regarding armed group affiliations. The bimodal tendencies observed among Hunde and Rwandophones highlight their split between nominating alters with shared and differing military backgrounds. This indicates varying degrees of integration and interaction within these subgroups.

Fig. 10 provides a summary of the EI index distribution for economic activities among the different subgroups. It shows the median, interquartile range, and outliers. The plot indicates that active combatants have a higher median EI index, reflecting their broader economic interactions, while demobilized combatants exhibit more consistency in their economic engagements. **Fig. 11** presents individual data points for the EI index related to economic activities. Each point represents

an individual's EI index, with a random horizontal spread for visual clarity. The plot shows that civilians, demobilized, and active combatants have diverse economic interactions, with active combatants showing higher variability, indicating a wider range of economic engagements. We propose that there is little distinction between the categories. Hunde, on the other hand, have a somewhat stronger propensity for bimodal EI indices, which divide them into categories of nominated alters that they have armed group ties with and those that they do not. However, in this case, the sample is split between warriors from the APCLS (with the majority being Hunde) who are stationed at the defense position, and those who are secretly operating in urban areas. Rwandophones have a little greater inclination to choose individuals as alters who do not possess similar military backgrounds, especially when it comes to people who have undergone demobilization.

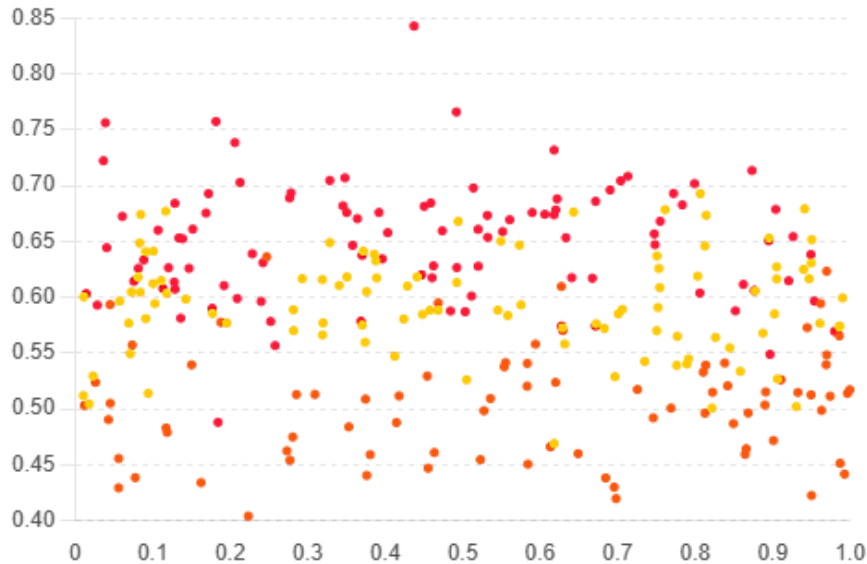


Fig 11. Scatter Plot for EI Index for Economic Activities.

Moghfehi et al. [26] evaluate the similarity between individuals and their social connections in relation to activities that generate revenue. Although there are parallels throughout the categories, most citizens picked alters who pursued careers that were radically different from their own. This inclination is less apparent in the alternative designations of active and demobilized fighters. Access to various armed organizations reveals a higher bimodal tendency among demobilized Hunde fighters and active Rwandophone combatants compared to demobilized Rwandophone militants and active Hunde combatants. Rwandophone fighters, who are mostly engaged in the military and state police forces, may lack the ability to access the diverse range of marketplaces available to Hunde soldiers. Alternatively, they may have chosen not to report their access to these markets. Hunde's major affiliation with a non-state armed organization would allow and need him to engage in several activities to ensure financial stability and the well-being of his family. They may possess a greater ability to mediate between individuals operating in other sectors, such as civilians, demobilized individuals, or other fighters.

IV. DISCUSSION

The findings of this study provide valuable insights into the social network dynamics within conflict-affected regions, specifically eastern DRC. By analyzing homophily, degree centrality, Blau's H index for multilevel brokerage, and EI indices, we have gained a nuanced understanding of how different subgroups (civilians, demobilized combatants, and active combatants) interact within their social networks and access various resources. Homophily is a common trend observed in social networks, which shows that people interact with others who are similar to themselves. In this study high level of homophily was observed in all the subgroups and the highest level of homophily was observed among the active combatants. This implies that people in this group prefer to stay close to others of their kind probably due to the trust and understanding brought about by the experiences of armed conflict. The high levels of homophily that exist among civilians demonstrate that civilians are socially integrated, which is crucial for group cohesiveness and mobilization in situations of conflict and insecurity.

As mentioned in [27], the main goal of International Humanitarian Law (IHL) is to protect people who are in situations of armed conflict and to regulate the actions of the subjects, paying attention to the fact that it is impossible to reconcile military imperatives with human compassion. The distinction between civilian population and armed forces is the most indisputable principle of IHL. This principle imposes a duty on belligerents to consistently differentiate between those who may be legitimately targeted and those who must be safeguarded and shielded from the consequences of the conflict. To ensure clarity, it is essential that these two groups of individuals be completely separate and fully complimentary. In simple terms, during armed conflict, every individual is classified as either a valid military target (military objective) or a protected person—there is no between ground. The concept of difference asserts that belligerent engagements are confined to specific clashes between organized armed forces, rather than involving whole populations. Its primary objective is to undermine and overcome the enemy's military forces, without targeting civilians [28].

Centrality is a crucial notion in social network analysis (SNA) that is essential for comprehending the structural dynamics and information dissemination inside networks. Yan and Ding [29] provides a comprehensive analysis of centrality measurements and their use in many domains. Centrality was described by Kourtellis et al. [30] to understand the possibility of using the idea for finding nodes' importance in the network. Subsequently, Camacho et al. [31] identified the other authors' literature review studies and the most employed centrality measures in their works. From the above mentioned, the most frequently used measures are eigenvector centrality, closeness centrality, betweenness centrality and degree centrality. Costenbader and Valente [32] provide the mathematical formulas of these measures and the possible uses of these indices. Furthermore, the Vastardis and Yang [33] provide a tabular comparison of the pros and cons of each centrality measure, which would help in knowing the suitability of the indices for a given network structure and objective.

Moreover, Kong et al., [34] have discussed that centrality is applied in fields such as social sciences, epidemiology, organizational behavior and information searching. They focus on the general relevance of centrality analysis and stress the fact that it is useful in many cases. It presents a rich source of information, which can be of interest to researchers, professionals, and students interested in social network analysis. It provides a broad understanding of centrality measures and the many uses of centrality measures in many disciplines. The general objective of this paper is therefore to present the concept of centrality measures to the undergraduate and postgraduate students in the field of social network analysis. The degree centrality analysis also revealed that active combatants have the highest mean degree centrality, and this means that people in this group are well-connected with other people in the social network. The H index for multilevel brokerage depicted how people can connect relations across levels and sectors.

The analysis of the differences between the brokerage in the armed groups and the economic activities revealed that there are differences in the subgroups. In this case, the H index of the armed groups involved was analyzed and found that the active combatants had the highest scores hence underlining their role of interconnecting the various factions and solving conflict situations. This capacity for brokerage is highly useful in conflict-prone environments, because the ability to mediate between different groups can contribute to better relations and less strife. According to the economic activities, civilians had the highest Blau's H index meaning that they were more involved in the different economic sectors. Luiz, Ganson, and Wennmann [35] that civilians are fully involved in the economic system and are therefore capable of playing the role of brokers in the distribution of resources and economic relations. The somewhat higher brokerage capacity in both domains can be attributed to the fact that the combatants are demobilized and trying to reintegrate into society, which entails multiple economic activities and connections with other ex-combatants.

The EI indices were, therefore, an assessment of the magnitude of external as compared to internal connections indicating whether the people are more connected internally or with people outside their respective groups. The results indicated that active combatants have a higher propensity to communicate with people belonging to other armed groups, which is in line with their connectivity. Civilians showed active external relationships in economic activities suggesting that they were involved in various economic undertakings and could therefore, be integrated into the global economy. Since EI indices are lower for demobilized combatants, this means while they are developing relations beyond their circles that include former combatant groups, they are well connected with them. Hence, the findings of this study hold significant implications for conflict management and economic growth policies in the eastern DRC. It is also important to have information on the characteristics of various subgroups in social networks with a view of enhancing on social relations and also in the provision of resources [36]. For instance, expanding on the centrality of the active combatants and their brokerage aptitude is useful in mediating conflicts and reaching agreements with other stakeholders. Likewise, supporting the economic interactions of civilians may enhance their brokerage function in economic endeavours, thus enhancing economic participation and combating poverty.

V. LIMITATIONS AND FUTURE RESEARCH

Despite these findings, it is important to acknowledge the following limitations of this study in explaining the social network dynamics of conflict affected areas in eastern DRC. First of all, we can't infer causality from the data as it is cross-sectional in nature. Perhaps, the use of longitudinal research can be helpful to find out how social networks have evolved and how they are influencing conflict and economic activity. Also, there are several limitations that may arise due to the use of self-administered questionnaires, for instance, social desirability bias and recollection bias. The respondents may not be able to recall the details of their interactions or they may report behaviors that are socially acceptable as opposed to the truth. Therefore, future studies should include other sources of data, for example, direct observation or data obtained from mobile phone records, in order to increase the reliability of the findings. Third, the sample size and sampling method may restrict the transferability of the research outcomes. Despite attempts to achieve a random sample, this study was conducted in eastern DRC which is a special case and therefore the findings may not be generalised to other conflict affected areas. It would be important for future research to include a wider variety of geographic locations and larger populations in order to replicate the results and gain a better understanding of the different forms of social networks in conflict environments.

The research mainly involved the position and the structure of social networks like homophily and brokerage. Although these are relevant, it is worthy of future research to look at the content and quality of the ties in these networks. Analyzing the nature of interactions can help to gain a better understanding of how social networks affect conflict and economic opportunities for the people involved. Furthermore, the research did not explore further into the social networks that consist of external actors of this kind, including the International Organizations and NGOs. These actors are usually involved in conflict solving and economic development and thus, their nodes in the local network should be studied further. Future research may also examine the roles of various external players in a network and their impact on the outcomes of local

initiatives. Finally, there are technological developments that can be employed in social network analysis. The use of higher computational methods and various types of machine learning can provide more detailed analysis of big network data. Future research should incorporate these technologies to identify the areas where new conflicts could arise or where business-friendly environments might exist.

VI. CONCLUSION

This study has revealed that social networks are indeed complex and influence economic activities in the conflict-stricken region of eastern DRC. High homophily within subgroups and especially the active combatants imply high internal cohesiveness and thus high trust in the internal communication and resource mobilization. The data on degree centrality show that active combatants are located in the central network positions and thus are critical for passing information and managing the economic activity within the network. Furthermore, the high Blau's H index for multilevel brokerage among the active combatants underlines their important position in mediating between different armed actors, solving the conflicts and connecting various economic segments. The level of economic brokerage capacity being shown by civilians is also very high proving that they can spearhead economic integration and economic resilience in the region. The present study emphasizes the need for more specific strategies that will use the positions of such central and brokerage users in order to foster social capital and economic recovery in conflict zones.

CRedit Author Statement

The author reviewed the results and approved the final version of the manuscript.

Data Availability

The datasets generated during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interests

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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