



Dryland co-management in Kerman province, Iran: a dynamic analysis of social networks

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Received: 23 April 2022 / Accepted: 11 December 2023
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Abstract

Capacity building and social empowerment of the villagers are preconditions for sustainable development. Accordingly, the objective of the current study was to evaluate the structural characteristics of social capital for co-management and empowerment of rural communities by social network analysis (SNA) as a research method. According to the results, the density index in all of the studied areas was increased after the implementation of the empowerment project. In addition, on average, the reciprocity index increased nearly 30.50% in trust and 18.31% in collaboration networks in the studied villages. Thus, it could be understood that social capital and empowerment in local communities are both required and complementary. As a result, any action aimed at building the capacity of the local community, increasing social capital, and promoting trust and collaboration among local communities will ultimately lead to maintaining and strengthening the social structures of that community. Therefore, this community develops into a region, which serves as the foundation for long-term rural development. These results can be administered to other areas of research and interference such as studies of community development, participatory research, and social intervention. By exploiting these results, planners and policymakers can plan to improve the empowerment of rural communities, self-reliance, and rural development.

Keywords Empowerment · Social capital · Rural communities · Social network indexes · Collective efficacy

1 Introduction

Approximately 41% of the earth's surface is made up of dry land, which is the largest biological complex on earth (Zeweld et al., 2018). Given the magnitude, frequency, and spatiotemporal distribution of precipitation episodes (Yuniarti et al., 2018), as well as significant diurnal temperature swings and solar radiation intensities, these regions have been affected by global changing climates (Mazhar et al., 2021). This vast biome has produced a wide variety of ecosystems with amazing biological diversity, providing all the goods and services for the ecosystems needed by the various primary peoples and cultures that

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emerged in dry places (Peng et al., 2021). The connection between the earth and human has developed and strengthened them for thousands of years by creating a compromise between water scarcity and arid lands and their livelihoods (Yazdanparast et al., 2023). As a result, drylands have one of the oldest social-ecological legacies on the planet, particularly in rural regions (Hou et al., 2020; Rienties et al., 2015; Yuniarti et al., 2018). Accordingly, a variety of ecosystem goods and services are needed to support sustainable life to maintain rural dryland systems in the long run (Gaur & Squires, 2018). This allows livelihoods improvement and development integrated in nature (Yang et al., 2018), cultural (Sainju et al., 2016) and social capital (Maaz et al., 2018).

The characteristics of social life that include norms, reciprocal behaviors, and social trust are called social capital (Pillai et al., 2021) which facilitate mutual benefits (Ali & Yousuf, 2019). A system of social transactions and communications that enables individuals to pursue common goals mutually is called social capital. The notion of community capital is widely used in social sciences to measure transactions between each other and personal relationships (Farkas, 2021; Nelson, 2019) and promotes positive progress in society (Lin et al., 2019). The functioning of society is influenced by a common source, i.e., social capital. According to Meyer (2018) and Hartlieb et al. (2020), the social capital of a community is a set of resources, real or virtual, which is given to a person or group through having a stable network of more or less regularized relationships of mutual awareness and cognition. To put it another way, as shown by Ramón-Hidalgo et al. (2018), “social capital is perceived as the characteristics of a social structure such as networks, rules, and social reliance that promote coordination and collaboration for mutual advantage.” Accordingly, social capital importance to social businesses and communities’ empowerment intentions has gained attention in the literature (e.g., Mandulangi, 2021; Purwati et al., 2021; Norouzi et al., 2019; Ramón-Hidalgo et al., 2018; Tebay & Mallongi, 2020). In the category of social development, one of the basic topics can be considered the empowerment of society or, in fact, the construction of society, and to move in this direction, one of the effective approaches is empowerment (Islam & Morgan, 2012).

Community empowerment refers to the process of enabling communities to increase control over their lives. “Communities” are groups of people that may or may not be spatially connected, but who share common interests, concerns or identities (Alemu et al., 2018). These communities could be local, national or international, with specific or broad interests. ‘Empowerment’ refers to the process by which people gain control over the factors and decisions that shape their lives. It is the process by which they increase their assets and attributes and build capacities to gain access, partners, networks and/or a voice, in order to gain control (Mwambi et al., 2021). “Enabling” implies that people cannot “be empowered” by others; they can only empower themselves by acquiring more of power’s different forms (Labonté & Laverack, 2008). Through acquiring an efficient understanding of community empowerment, the individuals will be able to recognize their own potential and gain confidence (Cinar & Kose, 2018). Similar to the international Cittaslow movement that brings together towns that promote the slow life philosophy. The concept has been developed in response to the increasing pace of life and the adverse effects of globalization. According to the members of Cittaslow, the organization contributes to the sustainable development of their regions and to improvement of the quality of life (Pietrzyk, 2018).

Empowerment in a local community involves the enhancement of individuals attitudes, knowledge, and abilities to enable them to play an active role in their community’s development and progress (Limatius, 2020). It also means that individuals attain personal growth levels that allow them to make choices based on their desires (Naughton

et al., 2017; Ramón-Hidalgo et al., 2018) while expanding their human right to freedom of action (Hirschmann, 2018). Empowerment is a gradual process that involves building trust and confidence, enhancing awareness, and improving skills to leverage the resources and potentials of the region toward achieving set goals (Mostafa, 2021). Community members can participate in training–consulting workshops and offer self-solutions to prioritize their needs (Farida, 2021; Ghorbani, 2016). Sustainable development requires capacity building and social empowerment of the villagers (Rachmawati & Fountain, 2020) through increased social capital, education, and creating awareness about their significant role in the region’s prosperity (Rahman et al., 2021).

Community empowerment necessarily addresses the social, cultural, political, environmental and economic determinants that underpin health and seeks to build partnerships with other sectors in finding solutions. Communication plays a vital role in ensuring community empowerment. Participatory approaches in communication that encourage discussion and debate result in increased knowledge and awareness, and a higher level of critical thinking. Critical thinking enables communities to understand the interplay of forces operating on their lives and helps them take their own decisions.

Social capital refers to “resources embedded in social relations” (Ramón-Hidalgo et al., 2018). It is known for its potential role in the joint management of natural resources (Mandulangi, 2021). Because it may reduce the expenses of working, enhance information transition, improve social movement, and encourage collaboration by shared standards, it is becoming increasingly popular (Naughton et al., 2017; Tian & Lin, 2016). Numerous studies (e.g., Edwards, 2019; Farida, 2021; Matsukawa & Tatsuki, 2018) have examined the effects of social capital, focusing on community empowerment (Crona et al., 2017). The distribution of social resources among different communities has different characteristics (Kail et al., 2020). Therefore, in order to reduce conceptual complexities and homogenize the interests of residents, especially in rural communities, increased research on joint management of social capital and empowerment has been emphasized (Ghorbani et al., 2022; Tantoh & McKay, 2020). Therefore, there is a need for more research on related empowerment outcomes at the community level and different access to social capital (Farida, 2021).

Access to resources, information transfer, social mobility, and the ability to collaborate for collective solutions all require social capital. Different institutional structures can be used to build social capital in social enterprise and community empowerment programs (Musavengane & Kloppers, 2020). Regular face-to-face meetings, agreed goals and enforced standards, dispute resolvent skills, and responsibility and clarity techniques are just a few examples. These methods are thought to improve collaboration by facilitating connection and fostering reliance in society (Ramón-Hidalgo et al., 2018). Furthermore, reformation in policies has been confirmed by enhancing social capital through group-based approaches (Masud-All-Kamal et al., 2021). As Meyer (2018) has stated, microfinance institutions, for example, have assisted groups in learning how to interact in order to get loans. As a result, social knowledge, a manner that improves cooperation, confidence, and network variety, is a means of increasing social capital for both personal and societal advantages (Meyer, 2018). Researchers (e.g., Sangari et al., 2020; Schnegg, 2018; Soltis, 2019) have frequently investigated the importance of social networks in achieving resource management. In many studies such as those by Nunkoo (2017), Straub et al. (2020), and Musavengane and Kloppers (2020) investigate the ways in which variety and the potential for social interaction affect a community or individual’s capacity to manage resources. An individual-centered theory of social capital has contributed to these research developments. In this regard and according to Ramón-Hidalgo et al. (2018), people use social resources set in social networks to obtain particular results. These resources, which spread

information and knowledge and include the factors of wealth, condition, and influence, provide social credibility, and confirm their identity. If the intended social resources are available, they can be mobilized for a supposed return to social capital based on a network procedure. Ramón-Hidalgo et al. (2018) highlighted that the recognition factors related to social capital as common goods can influence people to mutually benefit cooperative practice. Moreover, through social networks among individuals or groups, the features and quality of social networks may simplify such a practice by mobilizing social resources (Ramón-Hidalgo et al. (2018). The network of weak links is detected from strong links by structural social capital (Ghorbani & Azadi, 2021). Ties that are weak act as connections and are significant for the current of new data. Through these ties, special measures such as the impact on civic life and job creation are facilitated (Moghfeli et al., 2022). In contrast, patterns of belief and reciprocal action are strengthened in reliable ties, with desirable outcomes such as maintaining mental health, general cognition, and a sense of life satisfaction (Vazirian et al., 2021). Based on the findings of Ghorbani and Azadi (2021), two or more organizations are required for joint management that facilitates natural capital management. Social network analysis (SNA) is one of the most widely used and reliable methods considering the difficulty of measuring social capital.

A social network or source of social capital is a combination of actors and the relationships between them (Lombardi et al., 2020). In other words, the social network is a model of relationships that connect actors. A social network can be a collection of people or organizations or other social groups that are connected to each other through social relationships such as friendship, collaboration, or information exchange (Kc et al., 2018). Thus, social networking is a pattern of communication that connects people to each other or links that connect people with groups of people. The network analysis approach is also an approach to the study of social structures (Raj et al., 2018). This method is used first to describe the objective relationships and communication patterns between social actors and then to describe the behavioral effects of these communication patterns (Ghorbani et al., 2017). According to the mentioned definitions and based on the objectives of the research, the study of social capital and its examples, including trust and collaboration in the empowerment of rural society, is a key principle in rural development. To achieve this, the SNA approach, which is a new and reliable method, seems necessary (Vahidzadeh et al., 2021). A review of past literature (e.g., Zetter et al., 2005; Ghorbani et al., 2022; Khairani et al., 2021) shows that despite numerous studies on SC, there are still few studies on SC analysis for resource co-management and rural empowerment. This current research gap led us to examine the role of resource co-management in empowering local communities using SNA. Because the analysis of social capital using SNA is very important in providing knowledge, insight and important views about the role of resource co-management in empowering the local rural communities of Iran in order to advance the goals of local, national and international plannings in Iran and other similar countries. Therefore, using SNA to examine the empowerment of local communities through social projects is one of the innovations of this study. In addition, this research is one of the few studies that determined the empirical aspects of social capital using SNA over time. So the other innovation of this research is the generation of longitudinal data that shows changes over time and is widely used in social sciences, including among sociologists, economists, and political scientists. Therefore, because of their dynamic nature compared to cross-sectional data (static), are of particular importance.

Accordingly, the objective of the current study is to investigate the structural characteristics of social capital for co-management and empowerment of rural communities by using SNA. According to this goal, the following main questions will be investigated:

1. Do individuals with more access to social capital indicate higher levels of perceived empowerment than those with less access to social capital?
2. Does social capital co-management promote local community empowerment?
3. To what degree can these structural aspects in community empowerment be objectively quantified and compared using the SNA?

2 Materials and methods

2.1 Study area

Ghaleganj county is located in Kerman province, Iran, with a population of 76,376 people and a land area of 14,200 km² (Fig. 1). This area has a semi-humid climate and due to the reduction in rainfalls in recent years; this region has been witnessing drought. Rainfall in this region is generally affected by two high-pressure and low-pressure masses, which come from the Indian Ocean every summer and from the Mediterranean Sea every winter, which sometimes can cause floods in this area. In summer, the highest temperature reaches 52 °C, while in winter the least temperature reaches 2 °C (Akbari & Avazpour, 2022). Due to the lack of mines, factories, and important economic centers in this city, most people are engaged in agriculture and animal husbandry and their annual income depends on these sectors (Ghorbani, 2020).

Given this environmental background and economic issues in this region, the Social Business and Local Communities Empowerment Project (LCEP) was established in this

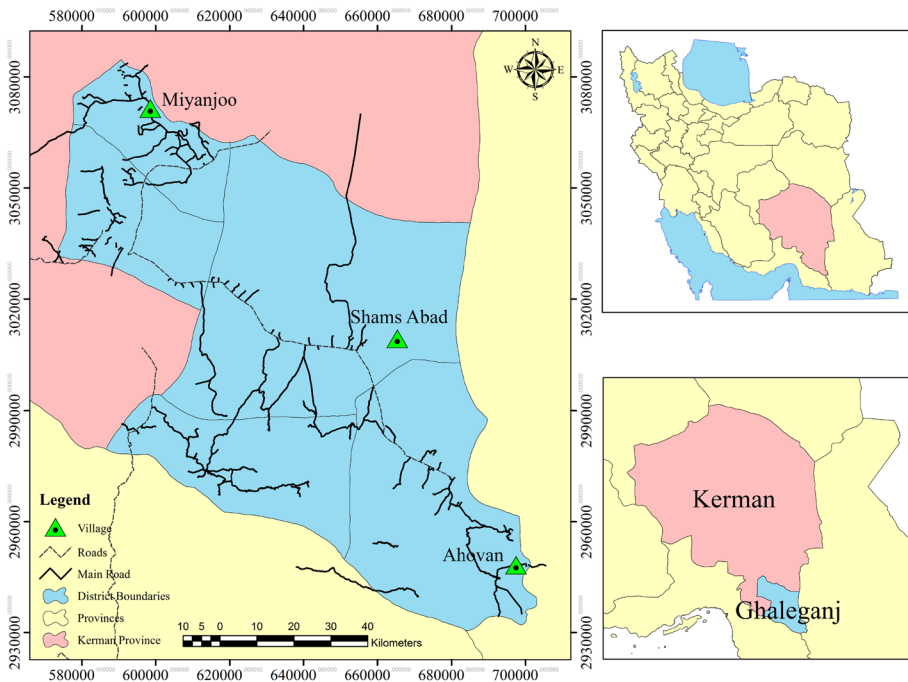


Fig. 1 Location of the study area *Source* (Ghorbani 2019)

area. This project aimed to institutionalize and build capacity among rural people, which enables their empowerment and collaboration in natural resources management, as well as the empowerment of rural communities, to improve their livelihood and living standards. In general, this project had significant and main objectives including mobilizing local communities and strengthening the social capital of the target community along with developing target villages. In fact, the creation of micro-credit funds has been formed with the approach of micro-financing based on the production value chain and supporting sustainable employment in this field (Ibrahim et al., 2021). Strengthening human capital, creativity, entrepreneurship, skills development and education of the local community, establishing business clinics and providing advice to the target community based on services and local benefits, implementation of resilience principles with emphasis on the sustainability of ecosystem services in a socio-ecological system, promoting self-belief and self-confidence, maintaining the dignity of the villagers, and stabilizing the rural population are other benefits (Ghorbani, 2016).

2.2 Local communities empowerment project (LCEP)

The empowerment of local communities entails three fundamental components which include social organization, skill development, and financial power. This journey starts with institutionalization and capacity building. Institutionalization and capacity building of the local community make it possible to empower the villagers and improve the standard of living, especially the livelihood and participation of local communities in the management of natural resources, as well as the empowerment of rural communities to improve the standard of living, especially the livelihood of villagers. Creating necessary structures and capacity building of local communities pave the way for active participation of people in village management, i.e., co-management. Therefore, LCEP has been run in 40 villages in Ghale Ganj district, located in the south of Kerman province. In 2013, the University of Tehran and the Mostafazan Foundation initiated a collaborative project (Ghorbani et al., 2020). The outlined steps of this project are presented in Table 1.

2.3 The establishment of village development groups (VDG) and micro-credit finance in LCEP

The Local Community Empowerment Project (LCEP) aims to establish participatory management practices among local communities and develop a model for managing natural resources in arid regions. This requires a shift in participatory approaches, with decision-making, planning, and implementation moving from the bottom to the top. In order to improve degraded lands' capacity to provide sustainable livelihoods, food security, and prevent desertification, barriers to sustainable land and forest management need to be addressed. Capacity building and mobilization of communities through social structuring and popular organizations are crucial principles in public participation activities.

One successful method used in developing countries is the formation of Village Development Groups (VDGs) and local sustainable development funds. These funds aim to preserve and rehabilitate degraded lands and natural resources, create environmentally friendly livelihoods, and support community activities. They consist of 10–15 people, with one member acting as head and collecting funds. The rural fund has a bank account managed by the committee's executive board, and members hold monthly meetings to raise

Table 1 The outlined steps of LCEP project

Steps	Definition
1 Preliminary measures	As part of Step 1, the preliminary measures included selecting facilitators from among the natives for each rural district, conducting facilitator training courses, equipping project offices in each rural district, finalizing the list of target villages, and defining the stages of the empowerment project for each village in coordination with governorates and district administrators, as well as studying the natural, economic, social, cultural, and infrastructural features of the region
2 Local communities mobilization	The local communities mobilization, various actions were taken, including meeting with the local authorities of the county to introduce the project, engaging in discussions with local administrators, including Islamic council members and trusted individuals from the target villages, for project introduction purposes. Additionally, efforts were made to gather all villagers and effectively communicate the goals and objectives of the local communities' empowerment project. Furthermore, the members of the village development committee were determined and confirmed to ensure their participation in the project
3 Participatory village exploration	Known as participatory village Exploration, involved several activities, including mapping the socio-economic resources of the village through collaboration with the villagers, conducting a village tour accompanied by the members of the village development committee, engaging in participatory trending to create the seasonal and daily calendar of the village, conducting a cost-benefit analysis of the main occupations in the village to analyze subsistence, assessing and prioritizing the needs of the village through collaboration with the villagers, drawing a "problem tree" to identify problems and provide solutions, performing a stakeholder analysis using a Venn diagram, and summarizing contributions based on the "five capitals" model

Table 1 (continued)

Steps	Definition
4 Starting up micro-credit funds of villages	<p>In step 4, the focus was on starting up Micro-Credit Funds of Villages, which involved various actions such as elaborating regulations for village development and micro-credit funds with the participation of villagers, evaluating the regulations and forming village development groups, opening bank accounts for villagers, designing social structures using the social network analysis method and dynamic analysis of local community social capital. Additionally, the financial status of the funds was monitored, and monthly symposiums were held to evaluate the performance of each fund. Training on accounting was provided to the heads of groups and account holders of micro-credit funds, and visits were conducted to observe money-making initiatives and monitor facilities granted to fund members. Furthermore, a website was launched for managing village micro-credit funds, while efforts were made to promote a participatory environment protection culture with the motto “each group, a tree” and to foster the culture of empowerment in schools</p>
5 Establishing cooperatives in rural districts	<p>Planning to establish national cooperatives with the assistance of the governorate and the office of cooperatives, labor, and social welfare</p> <p>Issuing a public call by project facilitators to launch cooperatives for villagers who have access to micro-credit funds</p> <p>Meeting with the board of management of micro-credit funds in each province to emphasize the significance and necessity of establishing cooperatives. This involved discussing the objectives and editing the memorandum of association</p> <p>Organizing a general meeting of the cooperatives facilitated by the office of cooperatives, labor, and social welfare. During the meeting, members of the management board of the cooperative and its inspectors were appointed</p> <p>Collecting shares from cooperative members and submitting the related documents to the general office of cooperatives, labor, and social welfare of Kerman Province</p> <p>Appointing the general director and completing the necessary documents to be sent to the general office of cooperatives, labor, and social welfare of Kerman Province</p> <p>Selecting a name for the cooperative and completing the final registration process</p>
6 Need assessment of technical and vocational curriculum and monitoring instructional courses	<p>Involved the need assessment of technical and vocational curriculum, encompassing the definition of required educational courses to reinforce human capital and introduce individuals to the county's technical and vocational center, as well as the supervision of technical and vocational courses conducted in the villages where the LCEP was implemented</p>

Table 1 (continued)

Steps	Definition
7	<p>Establishment of business clinic and providing complementary facilities</p> <p>Involved the establishment of a business clinic and the provision of complementary facilities, which included activities such as specifying job vacancies and regional advantages based on development studies, conducting entrepreneurship and business courses for cooperative management, facilitators, and fund managers, setting up a business clinic to provide consultation services to target groups, and granting supplementary bank facilities, in addition to micro-credit, to members of the village development and progress fund</p>

savings and discuss village issues. The funds include people's savings, income from environmental activities, government funds, donations, and loans.

To increase participation in rehabilitation activities after social restructuring, the LCEP organizes workshops and training courses. This empowers and builds the capacity of local communities, allowing them to manage their own resources and influence project implementation policies. Ultimately, this can lead to the rehabilitation of areas destroyed by the communities themselves.

2.4 Methodology

2.4.1 Social network analysis

SNA is considered a quantitative approach that examines social relationships. Creating an alliance between individualistic and holistic views is one of its great benefits (Kc et al., 2018).

The social-relational approach argues that “they are categorized through the dependence of human action (based on social groups and race), and their purpose is to create a structure of social associations in which the actors are distinguished” (Ghorbani & Azadi, 2021). This method allows researchers to investigate structured connections among players inside a system that either facilitate or hinder human behavior. Provides a systematic approach to examining the role of associates in a network and communication to measure the hypotheses of group practices and social functions that are eligible to evaluate the characteristics of a network before and after the implementation of a project (Giurca & Metz, 2018).

2.4.2 Social network indexes

In this research, the highest-level indexes of the social network have been studied which are introduced as follow:

2.4.2.1 Density It specifies the number of connections within a network, which is estimated by the number of probable links. The relationships of each node are usually recommended for use in combination with depth to avoid the risk of misunderstanding of score efficiency (Gonzalez et al., 2019). Density emphasizes the direct relationships between actors in a social network. High density and cohesion can promote trust and thus increase social capital. In this case, the sense of responsibility for social monitoring and control will also increase (Ghorbani & Azadi, 2021; Hamdan et al., 2014; Koohsari et al., 2021).

2.4.2.2 Reciprocity The stability and degree of interaction within a network of relationships can be determined using an index (Moghfeli et al., 2022). A higher value of this index indicates greater levels of interaction and cooperation between the actors in the network, ultimately contributing to its stability. Results of this index are presented on a scale of 0–100%, with higher values indicating stronger network resilience to environmental changes and stresses (Afkhami et al., 2021).

2.4.2.3 Transitivity The transferability indicator is based on the sharing of links among three actors, where one serves as a bridge between the other two. Essentially, if actor “A” has a connection with actor “B,” and “B” has a connection with actor “C,” then “A” can

potentially establish a link with “C.” This measure gauges the number of transferable actors in a network, which corresponds to higher rates of stability and permanence in relationships between actors (Rahimi et al, 2022). The index also serves as a metric to assess equilibrium and balance in networks and is presented as a percentage or a value ranging from zero to one (Borgatti et al., 2013).

2.4.2.4 Geodesic distance The shortest distance between two actors is the social distance between two people, which is measured by the least number of intermediaries between one person and other people in the network. Through this analysis, the path length of the studied links between the two actors can be identified in the shortest possible time, and the average rotation speed of the studied links can also be measured (Borgatti et al., 2013). Therefore, distances with low geodesic measurements show the great rate of information flow between the two actors (Ghorbani et al., 2021).

2.4.3 Questionnaire and data collection

In order to evaluate the network characteristics, a structured questionnaire was administered in the study regions. The data utilized in this study were gathered by the Social-Ecological-Systems Modelling Lab (SESM) at the University of Tehran in Iran. The statistical population for this research is comprised of all members of microcredit funds in 40 villages (totaling 2355 members), while the sample size consists of 238 individuals who are members of local microfunds in three randomly selected villages: Shams Abade Chehel Mani ($N=100$, $N(\text{male})=39$, $N(\text{female})=61$), Mianjoo ($N=76$, $N(\text{male})=36$, $N(\text{female})=40$), and Ahovan Sofla ($N=62$, $N(\text{male})=27$, $N(\text{female})=35$). The “full network method” was used, meaning that empirical data for this study were obtained from every member of the VDG in the target areas. Trust and collaboration ties were evaluated using close-ended questions on a Likert scale ranging from 0 to 5. This straightforward design was chosen to ensure comprehension among the rural population, many of whom are illiterate (Ghorbani, 2016). The questionnaire items for each measure were as follows:

- 1) Trust: how much trust do you have in people living in rural areas on a scale of zero to five?
- 2) Collaboration: how actively do you collaborate with people in rural communities to conservation and responsible use of natural resources on a scale of zero to five?

In order to evaluate the lasting impact of social mobilization activities, it is essential to analyze longitudinal data that takes into account the social capital before and after the implementation of the LCEP. If the project was successful, changes in the trust and collaboration networks’ structural characteristics could be considered a representative of the desired change in social capital (Ghorbani et al., 2021). As part of an assessment of the social dimension in the ongoing LCEP in Qaleganj, the SESM-Lab staff collected data from a report that evaluated changes in network characteristics across three villages: Shams Abad Chehel Mani, Mianjoo, and Ahovan Sofla. The first data collection was in 2013 (during the formation stage of VDGs and micro-credit finance) and the second one was in 2018 (after LCEP’s implementation).

In order to improve the reliability of the results, the raw data were simplified. Dichotomization is a process that reduces the complexity of the measured values (Borgatti et al.,

2013). Afterward, the existence or non-existence ties (binary data) are investigated. Dichotomization can be easily achieved using the UCINET-method routine. As the ties were measured on a scale from 0 to 5, a cut-off value of 3 was selected. All ties with a value of 3, 4, or 5 were given the value one, while all other ties, including 0, 1, and 2, were given the value zero. To analyze the LCEP data collected by the SESM-Lab, the UCINET software (Borgatti et al., 2002) was used to calculate network characteristics, using implemented algorithms. The results were stored using Microsoft Excel and a UCINET specific format.

3 Results

3.1 Analyzing the highest-level indexes of social networks among studied villages

3.1.1 Density

According to the data represented in Table 2, the density index in all of the studied villages and in both trust and collaboration networks was increased after the implementation of the empowerment project. In Mianjoo, for example, this index was 18.8% in the trust network and 18.2% in the collaboration network, which increased to 89.01% and 81.03% among the studied people after this project. In Shams Abade Chehel Mani, similarly, the rate of density in trust increased from 21.2 to 87.7% and from 10.4 to 80.4% in collaboration. This growing rate in density, also, can be seen in Ahovan Sofla where the rate of this index in trust network increased from 23.8 to 84.2% and in collaboration network increased from 23.8 to 80.5%.

Accordingly, on average, the difference rate of this index was 65.70% and 63.17% in trust and collaboration networks, respectively, in the studied villages after this project. Therefore, it can be stated that implementing this project had a positive impact on increasing this index. As a result, social cohesion and social capital among the studied people have increased and consequently, by boosting their collective actions, could have a positive impact on cooperative management and could lead to empowerment and sustainable development in this area.

3.1.2 Reciprocity

In Table 3, the results of the reciprocity index in trust and collaboration networks in the studied villages before and after conducting the empowerment project are displayed.

Table 2 Density index in trust and collaboration networks in the studied villages before and after implementing the empowerment project

Village	Network	Before (%)	After (%)	Difference (%)
Mianjoo	Trust	18.8	89.01	70.21
Shams Abade Chehel Mani		21.2	87.7	66.5
Ahovan Sofla		23.8	84.2	60.4
Mianjoo	Collaboration	18.2	81.03	62.83
Shams Abade Chehel Mani		10.4	80.4	70
Ahovan Sofla		23.8	80.5	56.7

Table 3 Reciprocity index in trust and collaboration networks in the studied villages before and after implementing the empowerment project

Village	Network	Before (%)	After (%)	Difference (%)
Mianjoo	Trust	54.32	80.97	26.65
Shams Abade Chehel Mani		45.01	78.43	33.42
Ahovan Sofla		29.51	60.95	31.44
Mianjoo	Collaboration	54.61	70.75	16.14
Shams Abade Chehel, Mani		42.14	67.63	25.49
Ahovan Sofla		28.51	41.81	13.3

Overall, the results show that like density, this index was also increased after this project. In Mianjoo, this index was raised from 54.32% in the trust network to 80.97% and in the collaboration network from 54.61 to 70.75%. In Shams Abade Chehel Mani, likewise, the rate of this index in trust was 45.01% and in collaboration was 42.14% that increased to 78.43% and 67.63%, respectively. In Ahovan Sofla, also, the reciprocity index went up from 29.51 to 60.95% in trust and from 28.51 to 41.81% in collaboration. Thus, it can be noted that on average, the reciprocity index increased by around 30.50% and 18.31% in trust and collaboration networks, respectively, in the studied villages.

This increase indicates that reciprocal relationships between members of local funds have increased. As a result, social capital improves them and enables them to collaborate in the local development fund and reap the benefits that have led to their greater empowerment.

3.1.3 Transitivity

The results of the transitivity index among the studied people before and after the empowerment project are presented in Table 4. Accordingly, the rate of this index in Mianjoo in trust and collaboration networks was increased from 43.17 to 77.4% and from 42.15 to 77.6%, respectively. In Shams Abade Chehel Mani, likewise, the transitivity in trust and collaboration was 46.3% and 31.7%, which, respectively, increased to 85.99% and 79.12% after the project. Moreover, in Ahovan Sofla, this index in the mentioned networks (trust and collaboration) went up from 33.15 to 54.5% and from 30.15 to 49.32%, respectively. The overall increase of this index (31.75% and 34.01% in trust and collaboration networks, respectively) shows that now the network of collaborators in the local fund is experiencing

Table 4 Transitivity index in trust and collaboration networks in the studied villages before and after implementing the empowerment project

Village	Network	Before (%)	After (%)	Difference (%)
Mianjoo	Trust	43.17	77.4	34.23
Shams Abade Chehel Mani		46.3	85.99	39.69
Ahovan Sofla		33.15	54.5	21.35
Mianjoo	Collaboration	42.15	77.6	35.45
Shams Abade Chehel Mani		31.7	79.12	47.42
Ahovan Sofla		30.15	49.32	19.17

a higher level of stability which as a result can improve their resilience when facing economic and environmental crises.

3.1.4 Geodesic distance

According to Table 5, which displays the results of the geodesic distance index among the local people of the studied villages, it can be stated that in general, this index was decreased (-1.03 and -0.73 in trust and collaboration networks, respectively) after the implementation of the empowerment project. In Mianjoo, the geodesic distance among the studied people was decreased from 2.71 to 1.1 in the trust network and from 2.01 to 1.18 in the collaboration network. In Shams Abade Chehel Mani, this distance in the trust network was reduced from 1.78 to 1.12 and from 1.77 to 1.19 in the collaboration network. In Ahovan Sofla, also, this distance between the members of the local funds after the implementation of this project experienced a decrease in trust and collaboration networks from 2.09 to 1.25 and 1.31.

These results show that after this project, the unity and coordination among those stakeholders were increased which, as a result, could facilitate and increase the cooperative activities and ultimately improve their resilience and empowerment.

4 Discussion

Empowerment is a key concept in social development, and it is considered an important strategy for regional and rural development. In fact, capacity building and empowerment of villagers and associations are prerequisites of sustainable development. According to the results, once the empowerment initiative was implemented, the density index in all of the investigated villages, as well as trust and collaboration networks, was increased. Hence, the implementation of a strong network of trust and collaboration is considered a great gap that requires more policy attention. In general, Iran will move to a high level of trust and collaboration network in empowerment projects. This process can occur in an undesirable way or in a desirable approach (Ghorbani & Azadi, 2021). Achieving a point that seeks to develop economic issues in rural areas and empower local communities while protecting the environment can improve livelihoods and living standards for these communities. As a result, higher density and trust between network members lead to faster creation of the network. The rate of natural use will be higher than the population density if the current route is not adjusted. This trend can also damage natural resources and reduce the empowerment

Table 5 Geodesic distance index in trust and collaboration networks in the studied villages before and after implementing the empowerment project

Village	Network	Before (%)	After (%)	Difference (%)
Mianjoo	Trust	2.71	1.1	-1.61
Shams Abade Chehel Mani		1.78	1.12	-0.66
Ahovan Sofla		2.09	1.25	-0.84
Mianjoo	Collaboration	2.01	1.18	-0.83
Shams Abade Chehel Mani		1.77	1.19	-0.58
Ahovan Sofla		2.09	1.31	-0.78

of societies. Today, local communities' empowerment, restoration, and development will not be possible without the active collaboration of stakeholders. Trust is a step toward collaboration and facilitates this practice among local performers. These results are in line with the findings of Bogart et al. (2020) and Li and Feng (2021) as mentioned, trust is the most important element in empowering local communities.

The most important principle in public participation activities is capacity building and the mobilization of local communities through social structuring and the creation of popular organizations accepted by rural communities (Ghorbani et al., 2021). Implementing LCEP through formation village development groups (VDG) and village sustainable development funds had a positive impact on increasing social capital. This process was done through holding monthly meetings to increase savings. In these meetings, in addition to receiving savings and financial issues, decisions are made about various problems of the village and their solutions. During this process, people will become aware and their self-confidence will increase and they will learn to solve their problems by themselves. Considering that this process is repeated every month, it causes capacity building, trust building, increased collaboration and cooperation, and as a result, increased social capital among the members of the village development groups. These results are consistent with the findings of Emerson and Nabatchi (2015); Kocho-Schellenberg and Berkes, (2015). Increasing social capital causes local people can manage their own local resources and gain the capacity and self-confidence to influence project implementation policies, and eventually rehabilitate areas destroyed by the communities themselves (Senga, 2016).

The SNA participates in addressing issues of how they interact on social media and trusts researchers as facilitators. According to the results, in social networks, there is a great cohesion between confidence and cooperation of people. Based on the study of the connections between the actors, there is a close-knit relation between the members of the studied networks. The findings are in line with the results of Scholz and Binder (2011), Ghafari et al. (2008), Ghorbani (2016), and Ebrahimi-azarkharan et al. (2020). Based on their results, one of the factors is increasing trust and strengthening relations between members of agricultural clusters. Consequently, members rely less on each other's resources because of the verification or sharing of information. Relying on existent networks of farmers is a good means to enhance the adaptation of sustainable technologies and obtain land use planning goals. Therefore, the emphasis on trust is essential to improving joint management in dryland and empowering societies. This is because it is considered the most vital feature of all sustainable social interconnections and a key element at the beginning of cooperative activities. According to the results of the study, the level of cooperation increased significantly. According to Ghorbani and Azadi (2021) and Urgenson et al. (2017), developing a participatory network is crucial to the achievement of empowerment plans. According to the results, mutual and reciprocal connections among members of local funds have improved, allowing them to cooperate and gain advantages from local development funds, resulting in enhanced empowerment. Indeed, institutionalization and capacity development among rural people create the circumstances for their empowerment and involvement in natural resource management, which improves their livelihood and living standards. This project can provide important and main goals such as mobilizing local communities and strengthening the social capital of the target community along with rural development. Establishment of micro-credit funds with micro-financing approaches based on the production value chain, supporting sustainable employment, strengthening human capital, creativity, entrepreneurship, skills development, and local community education with an emphasis on the sustainability of ecosystem services in a socio-ecological system are the achievements of this project. Based on the findings of Ryan and Urgenson (2019),

participatory capacity is very helpful in overcoming obstacles to the development of joint management, but in the absence of trust, challenges will arise for landscape reconstruction programs. According to the results of the density index in the investigated networks, this rate is medium to high, and in terms of trust, cooperation, and social capital, the continuity between the networks rises by the same amount. Accordingly, between the studied links, dense networks can be supposed. In the field of using social networks in participatory management of natural resources, the results obtained in some studies also confirm this. In this context, Gašević et al. (2019) noted that as the density of social networks increases, the cooperation of people in that network rises. In the network, this approach can be useful to enhance and develop the social capital of the members. Moreover, based on the outcomes of Zhang et al. (2017), the rate of cooperation and social knowledge in social networks with low density is considerably decreased. Consequently, better social outcomes will be observed with rising density in a social network.

In the SNA method, it should be considered that factors such as misconceptions of individuals in a network can lead to the configuration of a particular network, and the consequences of misunderstanding affect the reliability of highly accurate measurement calculations. This is one of the most important limitations of SNA. Another limitation is the “dark side” of the social capital approach. People on the margins of the network are easily left out when concentrating on social capital. As a result, social capital has a powerful impact and possibility for improving the empowerment of society. Yet, the flexibility of traditional societies cannot be assessed through the SNA lens alone.

5 Conclusion

The structural characteristics of social capital for dryland co-management were analyzed using the SNA method. The structural features of the studied villages showed the development of social networks elements, which can be associated with confident outcomes during the activation manners of local plans. Moreover, financial prosperity and social cooperation may be increased, helping to reduce social deprivation. After the approval of this plan, the external social capital of the society has increased throughout the communities, which in fact claims to reduce social differences, increase social security and strengthen citizen collaboration. According to the results, it can be concluded that network analysis will evaluate and analyze valuable metrics related to social variables that affect sustainable local development and empowerment. More effective cooperation in rural livelihoods, policy-making, and improvement of social services depends on the creation and expansion of micro-credit funds with a micro-financing approach. Concentrating on trust and cooperation is important to achieve social empowerment in a positive way, which contributes to local economic growth and eliminates social barriers. Furthermore, with the advancement in improving social resources, even the standard of living in the project area will improve. More effective trust relationships between organizations in the four regions will lead to sustainable rural development and will be an important achievement in performing resilience principles with an emphasis on the sustainability of ecosystem services. Therefore, improving self-belief and self-confidence, protecting villagers’ dignity, and stabilizing villages’ population are contrary to social isolation and play a key role in socio-ecological resilience.

SNA approach, by examining the relationships between all stakeholders during the implementation of a project and in different stages of project implementation, is able to evaluate the changes in social capital during the implementation of the project. Thus, it can

be used to analyze the effectiveness of a project from a social perspective. Therefore, it can be argued that social capital and empowerment in local communities are necessary to each other. In addition, any activity to increase capabilities in local communities enhances social capital, improves the level of confidence and collaboration and, finally, maintains and strengthens social structures. Generally, it can be concluded that being a part of a social network enhances communications with many resources of knowledge and impacts trust in certain sources of knowledge, eventually enhancing the empowerment of rural people.

In the end, there is an important limitation in this quantitative analysis that is only theoretical concepts are concluded of any relation between structural features and values of the citizens. Therefore, any assessment of social capital focused solely on institutional features remains incomplete. Structural features provide essential means for the production of social capital, but they are not adequate to justify its appearance.

Data availability Data for this project will be made available upon request.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Afkhami, M., Ghorbani, M., Zahraee, B., & Azadi, H. (2021). Role of social network measurements in improving adaptive capacity: The case of agricultural water users in rural areas of Western Iran. *Society & Natural Resources*, *34*, 1338–1357.
- Akbari, E., & Avazpour, L. (2022). Analyzing the dynamics of social capital in the development and empowerment of local communities in dry areas; application of social network analysis. *Iranian Journal of Rangeland and Watershed Management*, *75*(3), 333–345.
- Alemu, S. H., Van Kempen, L., & Ruben, R. (2018). Women empowerment through self-help groups: The bittersweet fruits of collective apple cultivation in highland Ethiopia. *Journal of Human Development and Capabilities*, *19*(3), 308–330. <https://doi.org/10.1080/19452829.2018.1454407>
- Ali, A., & Yousuf, S. (2019). Social capital and entrepreneurial intention: Empirical evidence from rural community of Pakistan. *Journal of Global Entrepreneurship Research*, *9*(1), 1–13.
- Bogart, L. M., Matovu, J. K., Wagner, G. J., Green, H. D., Storholm, E. D., Klein, D. J., & Kambugu, A. (2020). A pilot test of game changers, a social network intervention to empower people with HIV to be prevention advocates in Uganda. *AIDS and Behavior*, *24*(9), 2490–2508.
- Borgatti, S. P., Everett, M. G., & Freeman, L.C. (2002). Ucinet 6 for windows: Software for social network analysis harvard. Analytic Technologies.
- Borgatti, S.P., Everett, M.G., Johnson, J.C. (2013). In: Seaman, J. (Ed.), *Analyzing social networks*. Sage Publications Ltd, p 384.
- Cinar, K., & Kose, T. (2018). The determinants of women's empowerment in Turkey: A multilevel analysis. *South European Society and Politics*, *Routledge*, *23*(3), 365–386. <https://doi.org/10.1080/13608746.2018.1511077>
- Crona, B. I., Gelcich, S., & Bodin, Ö. (2017). The importance of interplay between leadership and social capital in shaping outcomes of rights-based fisheries governance. *World Development*, *91*, 70–83. <https://doi.org/10.1016/j.worlddev.2016.10.006>
- Ebrahimiazarkharan, F., Ghorbani, M., Malekian, A., & Bressers, H. T. A. (2020). Analyzing stakeholders' network to water resources co-management at a watershed scale: A case study from the Taleghan watershed in Iran. *Networks in water governance* (pp. 239–265). Palgrave Macmillan.
- Edwards, D. B., Jr. (2019). Shifting the perspective on community-based management of education: From systems theory to social capital and community empowerment. *International Journal of Educational Development*, *64*, 17–26.
- Emerson, K., & Nabatchi, T. (2015). *Collaborative governance regimes*. Georgetown University Press. <http://www.jstor.org/stable/j.ctt19dzcvf>

- Farida, U. (2021). Local social capital for community empowerment poor rural (PNPM-MD) in Kalumpang district Mamuju regency.
- Farkas, T. (2021). The role of the social capital in rural development. Case study analysis of village research camps in Romania and Hungary. *European Countryside*, 13(3), 584–598.
- Gašević, D., Joksimović, S., Eagan, B. R., & Williamson Shaffer, D. (2019). SENS: Network analytics to combine social and cognitive perspectives of collaborative learning. *Computers in Human Behavior*, 92, 562–577. <https://doi.org/10.1016/j.chb.2018.07.003>
- Gaur, M. K., & Squires, V. R. (Eds.). (2018). *Climate variability impacts on land use and livelihoods in drylands*. Springer International Publishing.
- Ghafari, S., Hasan, M., & Aroua, M. K. (2008). Bio-electrochemical removal of nitrate from water and wastewater—a review. *Bioresource Technology*, 99(10), 3965–3974.
- Ghorbani, M. (2016). Report of the project of analysis and assessment of the social-policy networks of grassroots association, Institutions and Sustainable Development FundsRFLDL Project (Sarayan District-South Khorasan). University of Tehran, in persian.
- Ghorbani, M. (2019). Report of the studies and implementation of the empowerment project of local communities in Qalaganj county, *University of Tehran*, In persian.
- Ghorbani, M. (2020). An analysis of validation of livability constructs of the local communities (Case study: Ghale Ganj district). *Iranian Journal of Agricultural Economics and Development Research*, 51(2), 243–261.
- Ghorbani, M., & Azadi, H. (2021). A social-relational approach for analyzing trust and collaboration networks as preconditions for rangeland comanagement. *Rangeland Ecology & Management*, 75, 170–184.
- Ghorbani, M., Bouzarjomehri, K., Avazpour, L., & Mansouri, Z. (2017). The efficacy of community-based management approach toward strengthening bridging social capital and reducing social exclusion (Case study: Rigan County, Kerman Province). *Iranian Journal of Research and Rural Planning*, 6(2), 157–169.
- Ghorbani, M., Hajalizadeh, A., & Heidarvand, M. (2020). Verification of the sustainability structures of the Rural credit fund members on biodegradability basis, case study: Qaleh Ganj county. *Space Economy & Rural Development*, 9(32), 127–148. in persian.
- Ghorbani, M., Javadi, A., Rasekhi, S., Yazdanparast, M., & Azadi, H. (2022). Bonding social capital of rural women in Southwest Iran: Application of social network analysis. *Journal of Rural Sociology*. <https://doi.org/10.1111/ruso.12430>
- Ghorbani, M., Naderi, A., Janeckova, K., Sklenicka, P., Azadi, H., & Witlox, F. (2021). Sustainable co-management of arid regions in southeastern Iran: Social network analysis approach. *Journal of Arid Environments*. <https://doi.org/10.1016/j.jaridenv.2021.104540>
- Giurca, A., & Metz, T. (2018). A social network analysis of Germany's wood-based bio economy: Social capital and shared beliefs. *Environmental Innovation and Societal Transitions*, 26, 1–14.
- Gonzalez, M., Sanders-Jackson, A., & Henriksen, L. (2019). Social capital and tobacco retail outlet density: An empirical test of the relationship. *American Journal of Health Promotion*, 33(7), 1020–1027.
- Hamdan, H., Yusof, F., & Marzukhi, M. A. (2014). Social capital and quality of life in urban neighborhoods high density housing. *Procedia-Social and Behavioral Sciences*, 153, 169–179.
- Hartlieb, S., Loy, T. R., & Eierle, B. (2020). Does community social capital affect asymmetric cost behaviour? *Management Accounting Research*, 46, 100640.
- Hirschmann, N. J. (2018). Revisioning freedom: Relationship, context, and the politics of empowerment. *Revisioning the political* (pp. 51–74). Routledge.
- Hou, Y., Long, R., Zhang, L., & Wu, M. (2020). Dynamic analysis of the sustainable development capability of coal cities. *Resources Policy*, 66, 101607.
- Ibrahim, M. A., Adnan, N. I. M., Aziz, A., Adnan, H. M., & Adnan, N. I. M. (2021). The view of Zakat practitioners on micro financing from Zakat funds as productive Zakat for Asnaf entrepreneurs. *International Journal of Academic Research in Business and Social Sciences*, 11(4), 1083–1097.
- Islam, M. R., & Morgan, W. J. (2012). Non-governmental organizations in Bangladesh: Their contribution to social capital development and community empowerment. *Community Development Journal*, 47(3), 369–385.
- Kail, B., Pardasani, M., & Chazin, R. (2020). The Better Future International's family care model in Tanzania: Creating social capital as a means to empowerment in social work practice. *International Social Work*, 0020872819884986.
- Kc, B., Morais, D. B., Seekamp, E., Smith, J. W., & Peterson, M. N. (2018). Bonding and bridging forms of social capital in wildlife tourism micro entrepreneurship: An application of social network analysis. *Sustainability*, 10(2), 315.

- Khairani, Z., Nasution, D., & Bukit, N. (2021). Analysis of Science Process Skills Using Learning Cycle 7E. *Journal of Physics: Conference Series*, Volume 1811, The 2nd International Conference on Sciences and Technology Applications (ICOSTA) 2020 3 November 2020, Medan City, Indonesia. <https://doi.org/10.1088/1742-6596/1811/1/012085>
- Kocho-Schellenberg, J. E., & Berkes, F. (2015). Tracking the development of co-management: Using network analysis in a case from the Canadian Arctic. *Polar Record*, *51*, 422–431. <https://doi.org/10.1017/S003224.7414000436>
- Koohsari, M. J., Nakaya, T., McCormack, G. R., Shibata, A., Ishii, K., Yasunaga, A., & Oka, K. (2021). Traditional and novel walkable built environment metrics and social capital. *Landscape and Urban Planning*, *214*, 104184.
- Labonté, R., & Laverack, G. (2008). *Health promotion in action: from local to global empowerment* (p. 215). Palgrave Macmillan publisher.
- Li, X. L., & Feng, J. (2021). Empowerment or disempowerment: Exploring stakeholder engagement in nation branding through a mixed method approach to social network analysis. *Public Relations Review*, *47*(3), 102024.
- Limatius, H. (2020). Communities of empowerment: Exploring the discourse practices of plus-size fashion bloggers.
- Lin, X., Lu, R., Guo, L., & Liu, B. (2019). Social capital and mental health in rural and urban China: A composite hypothesis approach. *International Journal of Environmental Research and Public Health*, *16*(4), 665.
- Lombardi, M., Lopolito, A., Andriano, A. M., Prosperi, M., Stasi, A., & Iannuzzi, E. (2020). Network impact of social innovation initiatives in marginalised rural communities. *Social Networks*, *63*, 11–20.
- Maaz, T., Wulffhorst, J. D., McCracken, V., Kirkegaard, J., Huggins, D. R., Roth, I., & Pan, W. (2018). Economic, policy, and social trends and challenges of introducing oilseed and pulse crops into dryland wheat cropping systems. *Agriculture, Ecosystems & Environment*, *253*, 177–194.
- Mandulangi, J. (2021). Maximizing of local community empowerment based on social capital coordination action in tourism development. In *International conference on applied science and technology on social science (ICAST-SS 2020)*, pp. 1–5. Atlantis Press.
- Masud-All-Kamal, M., Nursey-Bray, M., & Hassan, S. M. (2021). Challenges to build social capital through planned adaptation: Evidence from rural communities in Bangladesh. *Current Research in Environmental Sustainability*, *3*, 100091.
- Matsukawa, A., & Tatsuki, S. (2018). Crime prevention through community empowerment: An empirical study of social capital in Kyoto, Japan. *International Journal of Law, Crime and Justice*, *54*, 89–101.
- Mazhar, N., Shirazi, S. A., Stringer, L. C., Carrie, R. H., & Dallimer, M. (2021). Spatial patterns in the adaptive capacity of dryland agricultural households in South Punjab, Pakistan. *Journal of Arid Environments*, *194*, 104610.
- Meyer, M. A. (2018). Social capital in disaster research. *Handbook of Disaster Research*, 263–286.
- Moghfeili, Z., Ghorbani, M., Rezvani, M. R., Khorasani, M. A., Azadi, H., & Scheffran, J. (2022). Social capital and farmers' leadership in Iranian rural communities: Application of social network analysis. *Journal of Environmental Planning and Management*, *66*(5), 977–1001.
- Mostafa, R. B. (2021). From social capital to consumer engagement: The mediating role of consumer e-empowerment. *Journal of Research in Interactive Marketing*. <https://doi.org/10.1108/JRIM-09-2020-0197>
- Musavengane, R., & Kloppers, R. (2020). Social capital: An investment towards community resilience in the collaborative natural resources management of community-based tourism schemes. *Tourism Management Perspectives*, *34*, 100654.
- Mwambi, M., Bijman, J., & Galie, A. (2021). The effect of membership in producer organizations on women's empowerment: Evidence from Kenya. In *Women's studies international forum* (vol. 87, p. 102492).
- Naughton, C. C., Deubel, T. F., & Mihelcic, J. R. (2017). Household food security, economic empowerment, and the social capital of women's shea butter production in Mali. *Food Security*, *9*(4), 773–784.
- Nelson, I. A. (2019). Starting over on campus or sustaining existing ties? Social capital during college among rural and non-rural college graduates. *Qualitative Sociology*, *42*(1), 93–116.
- Norouzi, E., Vaezmosavi, M., Gerber, M., Pühse, U., & Brand, S. (2019). Dual-task training on cognition and resistance training improved both balance and working memory in older people. *The Physician and sportsmedicine*, *47*(4), 471–478. <https://doi.org/10.1080/00913847.2019.1623996>
- Nunkoo, R. (2017). Governance and sustainable tourism: What is the role of trust, power and social capital? *Journal of Destination Marketing & Management*, *6*(4), 277–285.
- Peng, Y., Hirwa, H., Zhang, Q., Wang, G., & Li, F. (2021). Dryland food security in Ethiopia: Current status, opportunities, and a roadmap for the future. *Sustainability*, *13*(11), 6503.

- Pietrzyk, K. (2018). The cittaslow movement in rural areas—a case study of a village in the Polish region of Warmia and Mazury. *Baltic Surveying*, 8, 74–84. <https://doi.org/10.22616/j.balticsurveying.2018.010>
- Pillai, V., Pandey, M., & Bhatt, B. (2021). Social sustainability at the BOP through building inclusive social capital: A case study of Drishtee. *Sharing economy at the base of the pyramid* (pp. 301–318). Springer.
- Purwati, A., Budiyo, B., Suhermin, S., & Hamzah, M. (2021). The effect of innovation capability on business performance: The role of social capital and entrepreneurial leadership on SMEs in Indonesia. *Accounting*, 7(2), 323–330.
- Rachmawati, E., & Fountain, J. (2020). Role of external stakeholders in tourism development and community empowerment. *International Journal of Applied Sciences in Tourism and Events*, 4(1), 25–36.
- Rahimi, M., Ghorbani, M., & Azadi, H. (2022). Structural characteristics of governmental and non-governmental institutions network: case of water governance system in Kor River basin in Iran. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-022-02346-y>
- Rahman, M. S. U., Simmons, D., Shone, M. C., & Ratna, N. N. (2021). Social and cultural capitals in tourism resource governance: the essential lenses for community focussed co-management. *Journal of Sustainable Tourism*, 1–21.
- Raj, A., Silverman, J. G., Klugman, J., Saggurti, N., Donta, B., & Shakya, H. B. (2018). Longitudinal analysis of the impact of economic empowerment on risk for intimate partner violence among married women in rural Maharashtra, India. *Social Science & Medicine*, 196, 197–203.
- Ramón-Hidalgo, A. E., Kozak, R. A., Harshaw, H. W., & Tindall, D. B. (2018). Differential effects of cognitive and structural social capital on empowerment in two community ecotourism projects in Ghana. *Society & Natural Resources*, 31(1), 57–73.
- Rienties, B., Johan, N., & Jindal-Snape, D. (2015). A dynamic analysis of social capital-building of international and UK students. *British Journal of Sociology of Education*, 36(8), 1212–1235.
- Ryan, C. M., & Urgenson, L. S. (2019). Creating and sustaining collaborative capacity for forest landscape restoration. *A new era for collaborative forest management* (pp. 78–95). Routledge.
- Sainju, U. M., Lenssen, A. W., Allen, B. L., Stevens, W. B., & Jabro, J. D. (2016). Nitrogen balance in response to dryland crop rotations and cultural practices. *Agriculture, Ecosystems & Environment*, 233, 25–32.
- Sangari, N., Heidari, M., & Noughzadeh Malekshah, N. (2020). The impact of organizational social networks on social capital. *Journal of Sustainable Human Resource Management*, 2(3), 195–211.
- Schnegg, M. (2018). Institutional multiplexity: Social networks and community-based natural resource management. *Sustainability Science*, 13(4), 1017–1030.
- Scholz, R. W., & Binder, C. R. (2011). Environmental literacy in science and society: from knowledge to decisions.
- Senga, M. (2016). In local collaboration we trust: The dynamics of trust network relationships in collaborative natural resource management in Tanzania. *Tanzania J Sociology*, 2&3(7), 31–46.
- Soltis, S. M. (2019). Person–environment fit and social networks: A social resource management perspective on organizational entry. In: *Social networks at work* (pp. 251–274). Routledge.
- Straub, A. M., Gray, B. J., Ritchie, L. A., & Gill, D. A. (2020). Cultivating disaster resilience in rural Oklahoma: Community disenfranchisement and relational aspects of social capital. *Journal of Rural Studies*, 73, 105–113.
- Tantoh, H. B., & McKay, T. J. (2020). Rural self-empowerment: The case of small water supply management in Northwest, Cameroon. *GeoJournal*, 85(1), 159–171.
- Tebay, V., & Mallongi, A. (2020). The role of Kamoro traditional leaders in communities empowerment and health in Mimika district. *Medico Legal Update*, 20(3), 817–821.
- Tian, F. F., & Lin, N. (2016). Weak ties, strong ties, and job mobility in urban China: 1978–2008. *Social Networks*, 44, 117–129.
- Urgenson, L. S., Ryan, C. M., Halpern, C. B., Bakker, J. D., Belote, R. T., Franklin, J. F., & Waltz, A. E. (2017). Visions of restoration in fire-adapted forest landscapes: Lessons from the collaborative forest landscape restoration program. *Environmental Management*, 59(2), 338–353.
- Vahidzadeh, R., Bertanza, G., Sbaiffoni, S., & Vaccari, M. (2021). Regional industrial symbiosis: A review based on social network analysis. *Journal of Cleaner Production*, 280, 124054.
- Vazirian, R., Karimian, A., Ghorbani, M., & Afshani, S. A. (2021). Monitoring and analyzing social networks and identifying key actors for sustainable management of natural resources. *Iranian Journal of Rangeland and Desert Research*, 28(1), 181–194.
- Yang, L., Liu, M., Lun, F., Min, Q., Zhang, C., & Li, H. (2018). Livelihood assets and strategies among rural households: Comparative analysis of rice and dryland terrace systems in China. *Sustainability*, 10(7), 2525.

- Yazdanparast, M., Ghorbani, M., Salajegheh, A., & Kerachian, R. (2023). Development of a water security conceptual model by combining human-environmental system (HES) and system dynamic approach. *Water Resources Management*. <https://doi.org/10.1007/s11269-023-03449-5>
- Yuniarti, D., Purwaningsih, Y., Soesilo, A. M., & Suryantoro, A. (2018). Food security-dryland nexus: Have livelihood assets affected?. In: *IOP conference series: Earth and environmental science*, vol. 145, No. (1), p. 012142. IOP Publishing.
- Zetter, R., Griffiths, D., & Sigona, N. (2005). Social capital or social exclusion? The impact of asylum-seeker dispersal on UK refugee community organizations. *Community Development Journal*, 40(2), 169–181. <https://doi.org/10.1093/cdj/bsi025>
- Zeweld, W., Van Huylenbroeck, G., Tesfay, G., Azadi, H., & Speelman, S. (2018). Impacts of socio-psychological factors on actual adoption of sustainable land management practices in dryland and water stressed areas. *Sustainability*, 10(9), 2963.
- Zhang, H., Cisse, M., Dauphin, Y. N., & Lopez-Paz, D. (2017). Mixup: Beyond empirical risk minimization. arXiv preprint [arXiv:1710.09412](https://arxiv.org/abs/1710.09412).

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