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An Emerging Network for Sustainable Agriculture:
A Social Network Analysis of Permaculture Practitioners in the Philippines

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ABSTRACT

The study identified permaculture practitioners and determined how network relationship patterns can help in the mainstreaming of permaculture in the Philippines. Social network analysis was conducted to determine network structure and discover relationship patterns. Results of the study identified 204 permaculture practitioners with 75 individuals belonging to 53 projects that fall under nine project types. This is the first systematic documentation of practitioners in the Philippines. The network structure had a low density (0.185598) suggesting the high diversity of members in its network composition. Degree centrality index (max=92) revealed the network's prominent practitioners while local clustering coefficient (max=0.999) identified the presence of eight organizations and local government offices implying that membership was not limited to the participation of individuals. In conclusion, the way the permaculture network was constructed gave it a strategic position to mainstream permaculture to a broader audience which includes farmers and non-farmers.

KEYWORDS

Agroecology, Network Theory, Rural Sociology, Social Capital, Social Movements

INTRODUCTION

Since its conception in the late 1970s, the permaculture network has gained a diverse international following of closely-knit grassroots networks of designers, farmers, and teachers (Ferguson & Lovell,

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2014). But despite its presence in the Philippines, there have been few studies, if any, about its local practitioners (adopters) and how they contribute to the promotion of permaculture in the Philippines.

As a design science anchored in ecology (Hirschfeld and Van Acker, 2019); and systems-thinking (Mobus, 2018), permaculture's spread from its Australian origins (Crosby et al., 2014) to the global stage in the 1980s to 1990s was led by its co-founder, Bill Mollison—a senior lecturer of Environmental Psychology at the University of Tasmania. The applications of permaculture core ethics and design principles were disseminated via the 72-hour Permaculture Design Certificate (PDC) course format which was generally considered as the de facto mode of entry into the permaculture network for most practitioners (Abiral, 2019). PDC courses were reported to have been offered in countries such as India (Suresh, 2010; Fadaee, 2019), Japan (Paull, 2011; Chakroun, 2020), Nepal (Upreti & Upreti, 2002; Bhandari & Bista, 2019; Mayer, 2019) as well as Continental Europe (Ulbrich, 2016; Kolarova, 2020; Oliveira & Penha-Lopes, 2020) and the Americas (Millner, 2017; Caraway, 2018) among many others.

In a worldwide survey of permaculture practice (Ferguson & Lovell, 2015), 731 self-identified permaculture practitioners from 45 countries were discovered. Unfortunately, socio-demographic data revealed that there was a lack of ethnic diversity in the global network with an overwhelmingly White/Caucasian majority (90.4%). On the other hand, the Permaculture Worldwide Network database (Permaculture Global, 2017)—a project of the Permaculture Research Institute-Australia (PRI Australia)—has reported a much larger number of practitioners. As of 2017, the project has mapped out 21,648 practitioners and 2,614 projects registered on their website. To this day, the discovery of permaculture practitioners and their actual projects (i.e. farms, gardens) remain dependent on self-declaration—which is common in loosely organized social networks.

In the Philippines, permaculture is a relatively new idea. In 2000, an effort to organize practitioners was highlighted when the Philippine Permaculture Association (PPA) was registered at the Securities and Exchange Commission (SEC). Since its inception, however, national gatherings, called 'Convergences,' have only been held twice. The first event organized by the PPA and graduates of a permaculture school in Nueva Ecija sought to gather local practitioners in Cebu. After 8 years, the second Convergence was held in Laguna in 2018. Thus, documentation on permaculture's history in the country is barely existent and, with a fragmented narrative, its practitioners lack a collective identity as well. Furthermore, it does not help that the design practice lacks institutionalized standards according to the International Federation of Organic Agriculture Movements (IFOAM). Nonetheless, the valuable impact of permaculture practitioners and permaculture principles in local sustainable agriculture cannot be easily undermined.

To address these knowledge gaps, the study aimed to shed light on the people involved in permaculture (referred to in this study as 'permaculture practitioners') in the Philippines. Hence, the objectives of this study were to identify permaculture practitioners in the Philippines and determine how relationship patterns of practitioners in the network can help mainstream permaculture as a local practice of sustainable agriculture.

MATERIALS AND METHODS

Identification of Practitioners

Permaculture has a strong online presence especially in social media platforms such as Facebook (Flores et al., 2017). Therefore, the internet as a 'virtual landscape' was the site for this network study. Non-probability sampling methods were employed to aggregate an initial list of available names and provide an estimate on the number of practitioners in the country. Data was obtained using the following data collection methods: online survey, Google search, informant referrals, and secondary data which includes attendance to the 2nd Philippine Permaculture Convergence. Data were then tabulated on a Microsoft Excel (2016) spreadsheet.

A geographic distribution map was created using geographic information systems software, ArcGIS 10.1, by overlaying practitioner attribute data (province of origin) on a political map of the Philippines (PhilGIS).

Determination of Relationship Patterns

Determining the relationship among permaculture practitioners was done using social network analysis (de Guzman et al., 2017; Cadger et al., 2016). Social Network Visualizer 2.4 (Kalamaras, 2015) was used to create a sociogram (Moreno, 1934; Huang et al., 2006), or social network map (Tracy & Abell, 1994), of the permaculture network. The sociogram was created on the assumption that all names on the initial list were permaculture practitioners. Using network terminology, practitioners were represented by shapes called 'nodes.' Each node has embedded attribute data which includes place of origin (province), project location (province), training background (PDC), attendance to the Convergence (2018), and organizational affiliation (Table 1). These attributes defined the network boundary, which in this case, only considered event-based and relation-based approaches to networking (Laumann et al., 1983). The relationships that connected each node were represented by weighted line segments called 'edges.' The network structure (Raya, 2016) was determined by the total number of nodes, edges, and its corresponding network density which is the ratio of actual connections with the total number of possible connections.

The network was visualized using a combination of prominence index layouts (Sabidussi, 1966) and a force-directed algorithm (Kamada & Kawai, 1989). The latter positions nodes in a radial layout according to 'importance' while the former is based on the principle that nodes repel each other while edges create attractive forces. As a result, nodes with strong links were visualized to be closer together forming clusters and revealing subgroups.

Degree Centrality (DC) index, a type of prominence index, was used to identify which nodes had the most 'neighbors' or connections. This is an ideal index for undirected networks (Kalamaras, 2015) like in this study.

The radial layout visualization arranged the nodes in layers of concentric circles by DC score with hubs located at the innermost layer while nodes with lower scores were located at succeeding layers and the peripheries. The Kamada-Kawai force directed algorithm was implemented for the final visualization to optimize the distances and placement of the nodes on the graphical plane.

The network type used for the study was 'undirected' or 'non-directional.' This type of model did not illustrate 'flows' (i.e. information or resources) but rather visualized reciprocal binary relationships on the basis of shared attributes. Hence, connections between nodes were established based on 'network homophily'—a similarity based on shared attributes (McPherson et al., 2001).

Table 1. Relational information includes assumptions regarding node attributes. Similarity between node attributes have a corresponding edge weight of 0.5 (possible connection) and 1.0 (actual connection).

Node Attributes	Assumptions	Edge Weights
Place of origin (Province)	Individuals from a common place of origin may or may not know each other	0.5
Project location (Province)	Individuals with a project in the same location may or may not know each other	0.5
Training background	Individuals who participated in a PDC course may or may not have attended the same course	0.5
Attendance to an event (PPC 2018)	Individuals who attended the Convergence had some form of interaction	1
Organizational affiliation	Individuals who belong to the same organization had some form of interaction	1

Similarity of nodes created connections based on relationship assumptions that have corresponding edge weights to illustrate the likelihood of interaction. In this network type, the relationship of Node A to B is the same as Node B to A.

The relationship patterns in the network can be further described using indices. Network prominence centrality (DC) and cohesion (local clustering coefficient) indices were used for analysis. In an undirected network, the DC index is the sum of edges attached to node u. A high DC score shows the number of neighbors a node has while also measuring actor activity (Kalamaras, 2015). Using the DC index, it was hypothesized that a node with many neighbors shared similar attributes. The degree centrality of a vertex v, for a given graph:

$G = (V, E)$ with $|V|$ vertices and $|E|$ edges

is defined as:

$CD(v) = deg(v)$

In network theory, a high DC score is indicative of a node being a network 'hub' or key node visualizing role importance in a group.

The local clustering coefficient (CLC), on the other hand, quantified how close a node and its neighbors were to becoming a subgraph or clique (Watts & Strogatz, 1998). In graph theory terminology, a clique is a subset of vertices (nodes) wherein two vertices are adjacent to each other. A complete subgraph has a maximum score of 1.000. CLC also indicates network transitivity (Kalamaras, 2015).

The formula for an undirected network is:

$C_i = 2|\{ejk: vj,vk \hat{I} Ni, ejk \hat{I} E\}| / ki(ki-1)$

where k_i is the number of vertices, $|Ni$, in the neighborhood, and Ni, of a node I (Kalamaras, 2015).

Interviews were conducted on selected practitioners to provide qualitative accounts and validate results from the social network analysis.

RESULTS AND DISCUSSION

Identified Permaculture Practitioners

Table 2 reports an aggregated list of 204 individuals in the Philippine permaculture network grouped by geographic location. The majority (129) of practitioners trace their origins to the island of Luzon, more specifically the National Capital Region (32) and Region IV-A (35). Figure 1 illustrates the geographical distribution of practitioners per province. Provinces with the most practitioners included Cebu (25), Cavite (10), and Benguet (10). Eight foreigners were also found to be practicing permaculture in the country. Individuals from this subgroup came from diverse backgrounds working in development aid, education, and religious sectors prior to experimenting with permaculture. Those who came from temperate climates (i.e. USA, England, Belgium) found the Philippines' tropical climate and fertile soil an ideal environment for year-round crop production. All of them had links with Filipinos either through marriage or work. Literature has shown that foreigners, Caucasians in particular, coming to the Global South to promote and practice permaculture is a common trend (Millner, 2017; Abdala & Mocellin, 2010). In popular culture, the influx of Caucasians in developing countries is well-documented in Youtube channels (Peralta, 2019).

Out of 204, the total number of practitioners, 75 (37%) claim to be involved in established permaculture projects. Results showed that there were 53 unique permaculture projects suggesting that some practitioners on the database were working together. The most commonly mentioned project type (Table 3) were farms followed distantly by advocacy groups/non-governmental organizations.

Table 2. Identified permaculture practitioners in the Philippines categorized by geographic location

Major Island Group	No. of Practitioners	Region	No. of Practitioners	Province	No. of Practitioners	With Permaculture Project?		Completed PDC Course?	
						Y	N	Y	N
Luzon	129	Cordillera Administrative Region	12	Benguet	10	7	3	2	8
				Abra	1	0	0	0	1
				Mountain Province	1	1	0	0	1
		National Capital Region	32	Metro Manila	32	6	28	5	27
		Region I	9	La Union	5	4	1	2	3
				Pangasinan	3	1	2	1	2
				Ilocos Sur	1	0	1	0	1
		Region II	13	Isabela	8	7	1	1	8
				Nueva Vizcaya	1	0	1	0	1
				Cagayan	3	3	0	1	2
				Quirino	1	0	1	0	1
		Region III	7	Nueva Ecija	2	1	0	0	2
				Bulacan	2	0	2	0	2
				Tarlac	2	0	2	0	2
				Pampanga	1	1	0	0	1
		Region IV-A	35	Laguna	9	5	4	2	7
				Rizal	6	3	3	0	6
				Quezon	4	2	2	2	2
				Batangas	6	3	3	0	6
				Cavite	10	8	2	0	10
		Region IV-B	11	Palawan	7	2	5	0	7
				Marinduque	2	0	2	0	2
				Oriental Mindoro	1	0	1	0	1
				Romblon	1	0	1	0	1
		Region V	10	Camarines Norte	8	1	7	1	7
				Camarines Sur	1	0	1	0	1
				Albay	1	0	1	0	1
Visayas	38	Region VI	7	dental	5	2	3	0	5
				Capiz	1	0	1	0	1
				Aklan	1	0	1	0	1
		Region VII	30	Cebu	25	7	18	7	18
				Negros Oriental		0	5	0	5
		Region VIII	1	Northern Samar	1	0	1	0	1

continued on following page

Table 2. Continued

Major Island Group	No. of Practitioners	Region	No. of Practitioners	Province	No. of Practitioners	With Permaculture Project?		Completed PDC Course?	
						Y	N	Y	N
Mindanao	26	Bangsamoro	2	Maguindanao	2	0	2	0	2
		Region IX	4	Zamboanga del Sur	1	1	0	1	0
				Zamboanga del Norte	2	0	2	0	2
		Region X	8	Lanao del Norte	2	0	2	0	2
				Camiguin	1	0	1	1	0
				Misamis Occidental	3	0	3	2	1
				Misamis Oriental	2	0	2	0	2
		Region XI	8	Davao	8	1	7	3	5
		Region XII	3	Sarangani	2	0	2	0	2
				South Cotabato	1	1	0	0	1
		Region XIII	1	Agusan del Sur	1	0	1	0	1
Overseas	8					8	0	5	3
No available information	3					0	3	0	3
TOTAL	**204**					**75**		**36**	

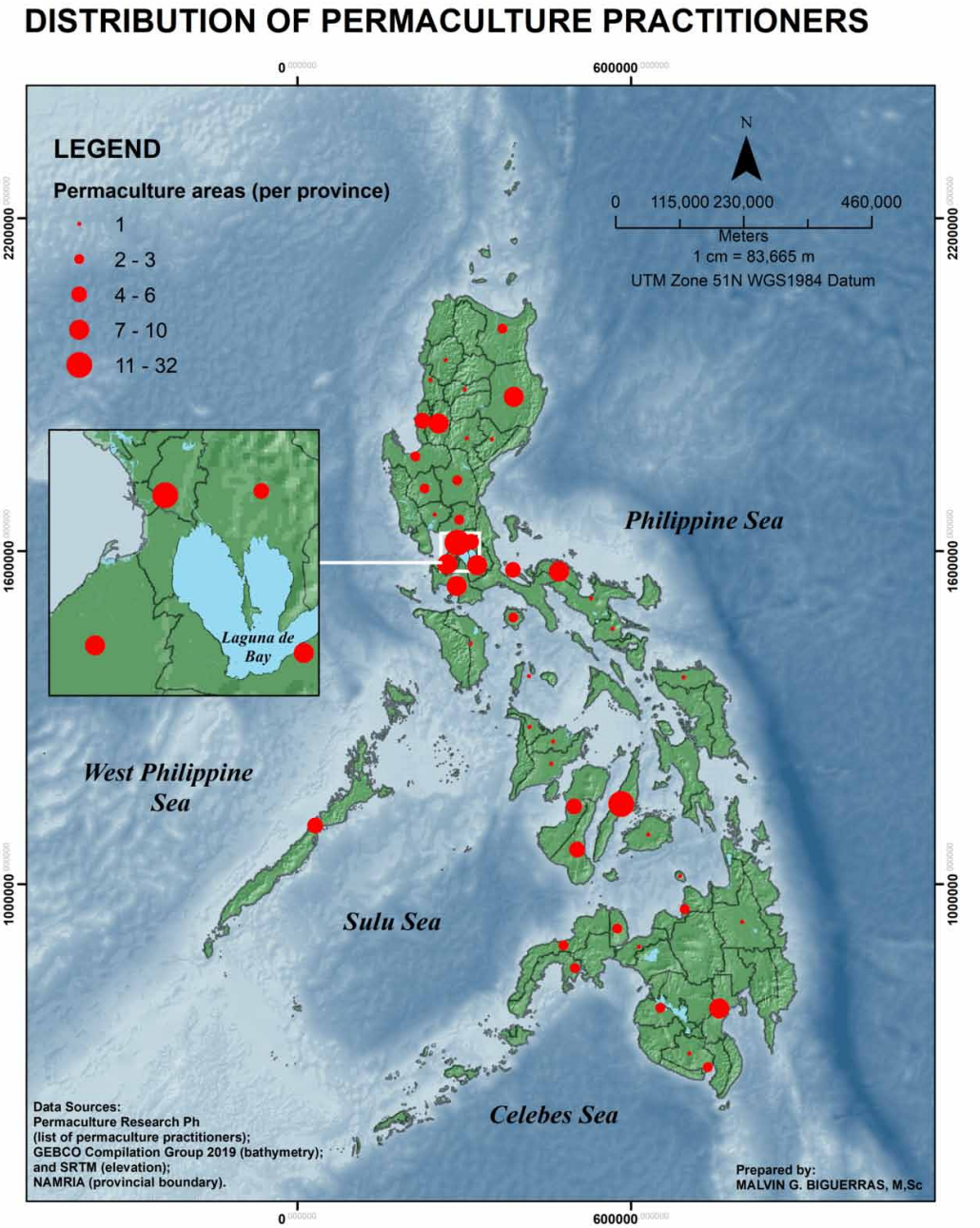
These findings show that not all network members have or currently belong to existing projects. It is very likely that most of them are still in the process of learning permaculture and have yet to share their outputs publicly (Hockin-Grant, 2017).

With regard to training background, 36 practitioners (18%) have claimed to accomplish a Permaculture Design Certificate (PDC) course. Completion of a PDC was either done locally or abroad. Results of the study showed that not all of those who have permaculture projects have a PDC. A possible explanation is that either they were trained by a PDC graduate through a workshop or seminar, or learned permaculture on their own online. Nevertheless, keeping a database on PDC graduates is crucial in determining how courses have contributed to the development of actual projects. One permaculture teacher admitted that their organization was unable to conduct tracer studies of their graduates in order to observe or document their progress. This only shows that more effort is needed to find these individuals and determine whether their training has translated into concrete actions either on the household, farm, or community level.

Ferguson and Lovell (2014) have attempted to find practitioners around the world using an online survey and resulted in the discovery of 731 individuals with majority coming from the USA, Australia, Canada, United Kingdom, and 41 other countries in the Americas, Europe, Africa, and Asia. But the study found self-declared practitioners and not necessarily graduates of a PDC course. In contrast, Ulbrich (2016) has reported ~300 *Permakultur Akademie* (PKA) 'formal' members, 26 *Permakultur Institut e.V.* (PKI) teachers and ~80 students of the Diploma in Applied Permaculture Design in Germany based on PKI records. Aside from these, no other similar study has been conducted at the national and global scales so far. Literature on current permaculture research was limited to case studies of ecovillages (Abdala & Mocellin, 2010) and small communities (Chakroun, 2020).

In addition, it is difficult to verify whether individuals on the list have legitimate projects unless ocular visits are made for validation. At present, assumptions can only be made based primarily on available public data or open data. Furthermore, because permaculture is not yet recognized as a regulated practice in the country, any official data is hardly obtainable. However, despite a lack of

Figure 1. Geographic distribution of permaculture practitioners in the Philippines. Highest concentrations of practitioners were located in NCR, Region IV-A, and Cebu. Inset shows practitioners in Metro Manila, Rizal, Cavite, and Laguna.



awareness and interest on the national level about existing permaculture activities in the Philippines, posts on social media have cited that some local government units (LGUs) have already partnered

Table 3. Types of permaculture projects in the Philippines

Project Type	N
Farm	30
Cooperative	1
Hospitality and tourism services (restaurant, B&B, resort, hotel, travel & tours)	4
Advocacy Group/NGO	6
Ecovillage	3
Product/service	2
Home project	2
Training center/school	3
Park/nature conservation	2
Total	**53**

with PPA for local projects. These include Bayawan City, Negros Oriental; the Municipal LGU of Dumingag, Zamboanga del Sur; the Province of Isabela; and the Province of Camarines Norte.

Determined Relationship Patterns Among Permaculture Practitioners

Figure 2 graphically visualized the permaculture network structure and patterns of relationships among members. Table 4 shows the network structure is composed of 204 nodes (representing individual practitioners) and 3843 edges (representing connections and/or similar attributes) with an equivalent network density of 0.185598. Though the network has homophilous relationships (Bond and Gaoue, 2020), the low network density showed low connectivity which meant that practitioners shared few attributes that created dyadic relationships. This statistic implies that the majority may still not know each other despite belonging to the same network. But a low density may not necessarily be a disadvantage (Friedkin, 1981). Based on strength of weak ties (Granovetter, 1973), it can be beneficial for the network's growth because of the potential linkages it can create with individuals outside of the network boundary (i.e. affiliations with other groups) that may increase social capital (Young, 2011). This means the permaculture network is still receiving external inputs (ideas, information, etc.) from other social networks through bridging ties (Greenbaum, 1982). This is in contrast to high-density networks where groups may tend to be more exclusive having limited to no growth at all (Liu & Duff, 1972).

Given the analysis of the network structure, it can be projected that there will be growth and diversity in the permaculture network in the foreseeable future in the Philippines. Participation has been reported in countries such as Germany (Ulbrich, 2016), Turkey (Abiral, 2019), and El Salvador (Millner, 2017) with an estimated number of worldwide PDC graduates ranging between 100,000 to 150,000 in 2011 (Abiral, 2019). The European Network for Community-Led Initiatives on Climate Change and Sustainability (ECOLISE) estimated that there were 3 million practitioners worldwide as reported in a study in 2019 (Ulbrich and Pahl-Wostl, 2019). Indeed, growth was observed within a decade.

Practitioners, referred to as nodes, were visualized in a radial layout (Crnovrsanin et al., 2014) based on node 'prominence' using the degree centrality (DC) index (Yang et al., 2014). This visualization organized the clusters of nodes into four main subgroups: the Convergence cluster, the PDC cluster, the Metro Manila cluster, and the Cebu cluster. Using node symbology, the sociogram clearly illustrated how the Convergence was attended by individuals belonging to the other subgroups. The sociogram provided two key observations. First, 61 practitioners (30%) had actual interactions

Figure 2. The sociogram shows the relationships of 204 actors (nodes) based on five data attributes. Clustering at the center illustrates the convergence of practitioners from the three main island groups during the Philippine permaculture convergence (PPC) with delegates from Luzon dominating the sub-graph. Clustering on the second layer (right hand) displays practitioners who have a permaculture design certificate (PDC) training background. Two nodes from Cebu with the highest degree centrality (DC) scores act as hubs to the four most visible clusters in the sociogram.

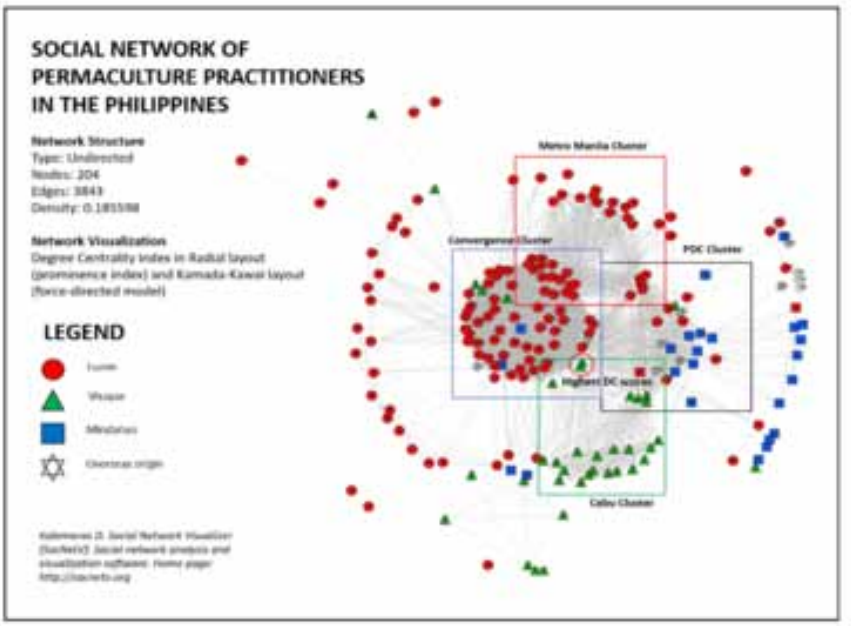


Table 4. Sociogram network statistics showing the network structure of permaculture practitioners

Data	Statistics	Interpretation
Type	Undirected	Model type visualized reciprocal binary relationships based on shared/similar node attributes. Similar nodes tend to cluster together.
Nodes	204	Represents the total number of practitioners in the Philippine permaculture network in 2018.
Edges	3843	Represents the total number of connections/links between nodes.
Density	0.185598	Describes the connectivity of the network based on the ratio of actual connections to the number of possible connections. The low density indicates high diversity in membership composition.

during the Convergence, with the majority of attendees coming from Luzon. And second, nodes who attended the event created 'bridging ties' (or linkages) to smaller subgroups.

Shared attributes allowed individuals to occupy similar positions in a social structure (Marin & Wellman, 2011). In plotting the sociogram, nodes were linked together and were co-located in a shared two-dimensional space. This framework was founded on the assumptions of Granovetter's strength of weak ties (SWT) theory (1973). The theory states that the stronger the ties (connections) between people, the more likely their social worlds would overlap as illustrated in the clustering of nodes in the sociogram. Granovetter suggests that people with similar characteristics have 'homophilous relationships' which meant that the strength of their ties depended on similarities between themselves (Borgatti & Lopez-Kidwell, 2009). Weighted edges quantified strong ties while the force-directed algorithm was responsible for the visualization of clustering.

In the study, ties or connections were based on the number of shared attributes such as places of origin (location) and attendance to a social function (training or convergences). A similarity between two nodes (A and B; A and C) increased the likelihood of forming a complete network with a third node (B and C). SWT theory also proposes that 'bridging ties' function as a source of 'novel ideas' with reference to information being circulated within a group. Novel ideas may refer to practices or knowledge that may come from groups that have similar interests as mentioned earlier in network structure. For example, a node connected to a subgroup engaged in natural farming or organic agriculture may bring in new knowledge about crop production techniques or soil management. A subgraph that has ties to an academic network may offer science-based explanations on the ecological processes they observe in the farm and so on. This is why network structure and connectivity are important because the diversity of nodes increases the chances of permaculture for collaborating with other people. Social capital is a much-needed resource in permaculture and this can be gained through involvements with other practitioners as demonstrated in Germany (Ulbrich, 2016) and also collaborations with larger social networks of educators, farmers, and environmental activists (Abiral 2015; Millner, 2017).

To protect their privacy, practitioners were assigned equivalent node numerical labels. The degree centrality (DC) index discovered nodes with the greatest number of linkages in the network called 'main hubs.' In network analysis, these nodes have significant influence on the network. Results revealed that Node 22 from Cebu had the highest computed DC score (92) making it a main hub that connects the Cebu cluster (25 nodes) with the Convergence cluster (61 nodes). In addition, it also bridged the more geographically diverse cluster of PDC graduates (33 nodes). It is important to add also that Node 22 shares a link with a relative (Node 25) who works with him on the same permaculture project. It was later verified in an interview that both of them were instrumental in the dissemination and promotion of permaculture in Cebu through social and environmental advocacy work, a chain of permaculture-inspired hotels and museums, and farm projects. Node 25, another main hub also from Cebu, has the second highest DC score of 89. Further inquiry into these practitioners revealed that they belonged to the pioneer batch of students of the first permaculture training site in the Philippines located in Nueva Ecija.

The top 10 nodes with the highest DC scores were found to have attended the Convergence in 2018 (Table 5). In addition, these nodes belonged to provinces with the largest representations in the permaculture network. This connectivity facilitated by these main hubs suggests that permaculture influence has a clear path to reach more people and their respective circles of influence. The roles of the main hubs are crucial for shaping how permaculture will manifest into actual projects and how it will be taught and practiced in their respective communities. The importance of main hubs was demonstrated in studies in El Salvador (2017) and Japan (2019). In the former, 2 key people were identified to be responsible for introducing permaculture to *campesino* farmers (Millner, 2017). One was a former civil war exile while another was a development worker. Both of them attended the same permaculture training course in Scotland. In Japan, a rice farmer and a landscape architect were instrumental in promoting permaculture as they founded the Permaculture Center Japan in Kanagawa Prefecture in 1996. It was inaugurated by Mollison himself (Chakroun, 2019).

Table 6 shows the largest subgroups belonged to Kai Farms, Philippine Permaculture Association (PPA), the Provincial LGU of Camarines Norte, Ale-Ale Permaculture Cooperative, the LGU of Bayawan City, Global Seed Savers, Cabiokid Foundation Inc., and the Columban Missionaries. The data demonstrate that the permaculture network did not only consist of independent practitioners but also included private and religious organizations and public offices. A notable subgroup is Cabiokid Foundation Inc. because it was the first to formally offer and promote a Permaculture Design Certificate (PDC) course in the Philippines.

Graphically, the local clustering coefficient (CLC) index (Iskhakov et al., 2020) identified nodes that formed subgraphs (or subgroups in a network). A CLC score of 1.000 indicated a complete subgraph in which all possible connections between nodes have been realized. Though this index may

Table 5. Top 10 nodes with the highest degree centrality (DC) scores with equivalent clustering coefficient (CLC) scores

Rank	Node Label	Node Attributes					DC Score	CLC Score
		Project Location	Place of Origin	Training Background	Attendance to Convergence	Organizational Affiliation		
1	22	Cebu	Cebu	PDC	Yes	The Justice German Lee Jr. Nature Sanctuary	92	0.511
2	25	Cebu	Cebu	PDC	Yes	n/a	89	0.511
3	103 104 105 106 107 108	Cavite	Cavite	n/a	Yes	Kai Farms	84	0.915
4	141	La Union	La Union	PDC	Yes	The Pitak Project	83.5	0.630
5	138	Nueva Ecija	Isabela	PDC	Yes	Cabiokid Foundation Inc.	82	0.619

Table 6. Prominent subgroups in the network discovered using the local clustering coefficient (CLC) index

Subgroup	Province	No. of Nodes	Max CLC	Min CLC
Kai Farms	Cavite	7	0.999	0.915
PPA	Metro Manila	5	0.968	0.607
Provincial LGU	Camarines Norte	4	0.968	0.968
Ale-Ale Permaculture Cooperative	Isabela	4	0.919	0.919
Bayawan City LGU	Negros Oriental	3	0.959	0.959
Global Seed Savers	Benguet	3	0.901	0.615
Cabiokid Foundation, Inc.	Nueva Ecija	3	0.732	0.500
Columban Missionaries	Metro Manila	3	0.762	0.762

be sometimes misleading because a high CLC score may only represent small dyadic relationships (2 nodes) which is not indicative of a cluster. To identify subgroups with more than two members, the DC index was used as a cross-reference.

Collective action through membership in an organization can have more influence in shaping public opinion or public policy compared to individuals. Though permaculture advocates for positive individual action, cooperation between individual efforts is the end goal of the design. Since permaculture is loosely organized in a national context, smaller groups or clusters can be better options for delivering permaculture-based or permaculture-inspired ideas to the public. Through these groups, permaculture can also be communicated using terminologies that people are more familiar with such as organic agriculture or urban gardening.

Requests for a list of permaculture practitioners and educators have been a common query from practitioners and non-practitioners alike. Building local social capital and networking either for the purpose of collaboration, training, or spreading awareness is a strength of permaculture which practitioners in the network can explore to address food security in their communities and circles of influence. This networking phenomenon was observed in virtual platforms such as in the case of Permaculture Out West (POW) in Australia (Hillis, 2011), and in physical platforms such as PKI in Germany (Ulbrich, 2016).

Further insight into the permaculture network can be gained by reviewing examples of other sustainable farming systems (Krebs & Bach, 2018; Putro & Miyaura, 2020) in the country, especially organic agriculture (Suh, 2015). Experience with local permaculture practitioners led to the hypothesis that the organic agriculture movement may have prepared the groundwork for permaculture to take root in the country. The two approaches are closely related since most permaculture practitioners consider 'organic' as the primary system of crop production practiced in a permaculture design.

Literature shows (Suner et al, 2016) that prior to the 1970s, the Philippines has been growing crops using traditional methods of farming which can be considered 'organic' in today's standards. It was then when global food security threats paved the way for a technological breakthrough in agriculture research and industry called the Green Revolution (Estudillo & Otsuka, 2006; Suner et al, 2016). After decades of 'conventional' or 'industrial' farming (Maghirang et al., 2013) landscapes began to change which resulted in damaging effects on soil health, water quality, and terrestrial and aquatic ecosystems. It is plausible that permaculture arrived in the 1980s at a time when non-governmental organizations (NGOs) and farmers' groups began to criticize the Green Revolution and the negative impact of chemical farming on health and the environment. These sentiments were articulated by the Farmers Assistance Board in "Profits for Poison" by Noel Mondejar in 1980 and "The Miracle that Never Was" by the Agency for Community Education and Service in the mid-80s (Carating & Tejada, 2012). During this decade, NGOs advocated for a shift to traditional ways and promoted organic farming (Suner et al., 2016) in an attempt to restore farming communities and agricultural landscapes.

It is also probable that permaculture entered the sustainable agriculture conversation in the 1990s when the low-external-input-sustainable-agriculture (LEISA) global movement gained traction in the Philippines through the formation of the Sustainable Agriculture Coalition and the Philippine Forum for Sustainable Agriculture (Carating & Tejada, 2012). Though there is no published evidence regarding the link between LEISA and permaculture in the country, the arrival of the former has helped push the larger sustainable agriculture agenda forward.

The earliest piece of published evidence of Filipino participation in the permaculture movement is found in the conference proceedings of the Sixth International Permaculture Conference in Perth, Australia in 1996. A professor from the University of the Philippines Los Banos-College of Agriculture (UPLB-CA), presented a paper during the conference entitled, "Upscaling the Adoption of Ecologically Sound Agriculture in the Philippines," which promoted sustainable agriculture among rice farmers (Permaculture Association of Western Australia Inc., 1996). Coincidentally, four years later, the Philippine Permaculture Association (PPA) was formed in 2000.

CONCLUSION AND RECOMMENDATIONS

Social network analysis identified the individuals and groups involved in the permaculture network and how they are connected. Key individuals were instrumental in its promotion and there were subgroups that linked permaculture to other networks which diversified the composition of its membership.

Results of this study will provide the much-needed resource for practitioners and non-practitioners alike, thus helping build social capital and facilitate networking for local collaboration, training, and spreading awareness. The strength of permaculture lies in the quality of the relationships found in its network which, in turn, helps in the dissemination of the concept and attracts a wider audience by encouraging participation from those without farming backgrounds.

Furthermore, encouraging the participation of non-farming individuals and groups makes permaculture an inclusive platform for advocacy, capacity-building, and empowerment of local food producers. This encompasses those who are engaged in either traditional or other various methods or approaches to food production.

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