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Social Network Centrality and Food Security: Case of Small Holder Sweet Potato Farmers in Nakuru County, Kenya

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Abstract

Developing countries have for centuries faced food insecurity. Despite efforts by governments to allocate huge amount of their budgets towards alleviating food security, citizens are still ravaging from hunger. Traditional and bureaucratic extension services are proving futile towards information dissemination. These officers are not cognitive of the fact that other than their demonstration projects, exogenous variables contribute towards absorption of new technologies and ideas to carb food insecurity. Farmers in rural areas don't operate in solitary but rather rely on fellow farmers, group formation and other social networks to source specific information concerning their production and marketing. Considering this, farmers have been able to identify the most valuable information contacts at various levels of production process. This study therefore has analyzed the degree of centrality among various contacts in the informal networks identified by sweet potato farmers in Kenya. The analyses used the social network software; UCINET to identify the most valuable contacts identified by the farmers. Their various measures of centralities have been captured and therefore scientifically identifying the 'informal extension officers' in study. The study has implication on the policy aspect in developing countries. Governments in developing countries should empower these contacts to ensure a high success rate in technology absorption among small holder farmers and therefore help to curb the vicious cycle of food insecurity.

Keywords: Network centrality; Food security; Extension officers; UCINET

Introduction

Social formation among actors is a key element towards information sharing. Social network analysis is a graphical presentation of how actors are connected by social ties [1]. Centrality measures classifies actors depending on their positional significance in a network. There are several measures of centrality that are used to describe the relevance of an actor in each net of information sharing. his study conceptualized network centrality into three major forms: degree, betweenness and closeness centralities.

Degree centrality basically describes the number of ties that a directly linked to an actor in a network [2]. The larger the number an actor in a net is connected to, the higher the probability of information dissemination. Actors who have more connection to the connected others are extremely valuable for information transmission. In sourcing of sweet potato planting materials, farmers who have many contacts of information sources were found to have a variety of potato rhizomes which acted as cautions towards each other in case of crop failure.

Another important aspect of centrality in the network is the betweenness centrality. This measures the ability of an actor to be a gate keeper in any network [3]. It describes the importance of an actor in the sense that no pair of actors can connect without passing through this actor. The high the value of this centrality the better. These actors in a network are very crucial towards information sharing and diversity among two or more pairs of networks.

The last aspect considered by this study is the closeness centrality. This a complex measure that measures the speed to which information is transferred and shared in the net. The smaller the value an actor has the better. Actors with very high closeness centrality are considered as information sunk since their ability to disseminate information across the network is vague.

Materials and Methods

This describes the pattern of resource sharing among potato farmers in study. The study revealed that farmers sourced their planting materials and market information from a range of sources. Seed acquisition by farmers through social networks is influenced by a con luence of factors. It is a continuous process involving farmers' processing information from a variety of sources including their own experiences, the experiences of other farmers, and the nature of their ties (strong or weak) with other farmers and network members [4].

he study conceptualized information sources to include farmer groups, local seed dealers, certified seed stockiest, neighboring farmers, and extension service providers. These resource centers are consequently referred to as the actors/events and the farmers were numerically coded for anonymity. This is visualized in Figure 1 using UCINET network software.

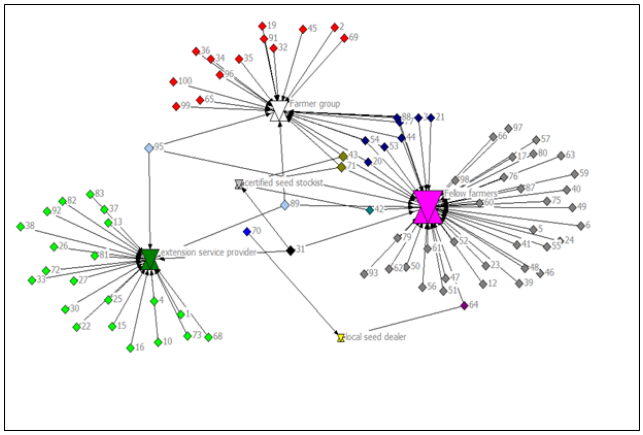

Figure 1: Network Visualization.

Results and Discussion

In the network visualization, the assumption was that any actor who failed to identify the five events as information contacts and those who had no information contacts were discarded at the visualization process during analysis. In this analysis, the size of the node is synonymous to the number of direct ties affiliated to it. From Figure 1, fellow farmers were identified to have the highest degree of centrality while local seed dealer had the least.

Network centrality

The Centrality highlights the most important actors and the strategic positions of various nodes in the network. The main question of centrality is to define what makes an actor more central than another one [5]. Different criteria have been considered to define the centrality, and the chosen criteria enable to obtain different information about the position of actors. The three main definitions of centrality are resumed by Freeman: the degree centrality, the betweenness centrality and the closeness centrality [6].

The Degree centrality considers nodes with the highest degrees (number of adjacent edges) as the most central. It highlights the local popularity of the network, actors that influence their neighborhood and ones who are highly visible in their community. As depicted below, farmers who relied on fellow farmers to get seeds had the highest in degree centrality followed by farmer groups and from extension service providers. The graph in Figure 1 above indicates that most of the farmers in the region sourced sweet potato rhizomes from fellow farmers and from farmer group while least of those farmers sourced from certified seed stockiest and local seed dealers in that order respectively.

	Fellow Farmers	Farmer group	Local seed dealer	Certified seed stockiest	Extension service provider	Farmer 89	Farmer 31	Farmer 64
Freemans Betweenness	2690	1161	86	19	1599	562	365	170
In degree centrality	48	25	2	4	24	3	3	2
Closeness centrality	161	211	327	247	213	175	201	243

Table 1: Measures of centrality.

Fellow farmers have an in-degree centrality of 48. This indicates that farmers in study relied heavily on fellow farmers as opposed to government extension officers. Conversely, certified seed stockiest have an in-degree centrality of 4. This has a great implication on the quality of sweet potato planting materials and consequently the quantity of their produce.

Betweenness centrality focuses on the ability of an actor to be an intermediary between any two other actors in the network [7]. Consequently, a network is highly dependent on actors with high betweenness centrality and these actors have a strategic advantage due to their position as intermediaries and brokers.

Farmers 31, 64 and 89 were found to be the most central due to event overlap. On the other hand, fellow farmers as an event had the highest betweenness centrality of 2690. This study emphasizes on the three individual farmers. As indicated in Figure 2 below, farmers 31, 64, 89 and 95 are crucial in terms of bridging information among the networks. The absence of these farmers in the network leads to disconnect in the network and therefore resource sharing in the net will be compromised.

The policy implication for this is that these farmers should be the target by the government. Capacity building in these actors is crucial to ensure that the absorption of new technology and resources by other farmers is maximized. In fact, these are the 'village extension officers' whom the government should engage with to curb food insecurity in the country.

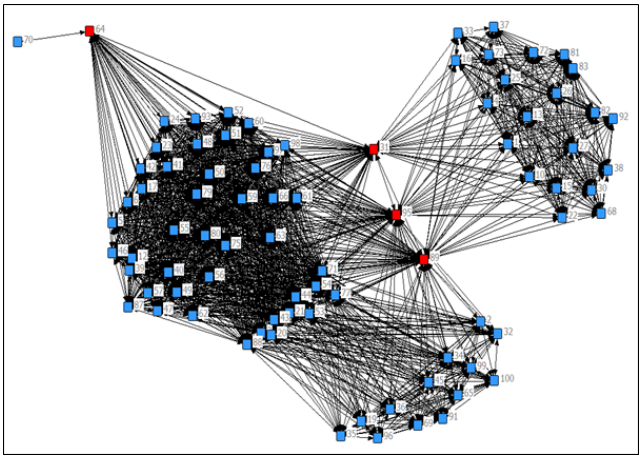

Figure 2: Betweeness centrality and event overlap.

Despite the low level of degree centrality, these actors are very crucial in information transmission among the various sets. They act a gate keeper between a pair of networks. Without these actors, circulation of information across the entire network is impossible.

Closeness centrality considers the centrality as a measure of closeness in the social graph. The closeness centrality reveals the ability of a node to quickly connect with all the other actors of the network [8]. The smaller the number, the more closeness a node is in the net. As illustrated in the Table 1 above, affiliation to fellow farmers has the least centrality measure of 161. This means that affiliation to this actor increases the probability of resource sharing since it has the shortest geodesic distance in the net. Farmers 31, 64 and 89 are affiliated to all resource centers due to events overlap.

Field suggests that individuals whose activities are organized around the same focus (for example voluntary, workplaces, hangouts, family, etc.) frequently become interpersonally connected over time [9]. Affiliations can be presented inform of a social graph in which nodes correspond to entities (such as farmers and events) and lines correspond to ties of affiliation among the entities. One justification for relying on co-affiliation is the idea that co-affiliation provides the conditions for the development of social ties of various kinds [10]. For example, the more often people attend the same events, the more likely it is they will interact and develop relationship.

Sweet potato farmers tend to source their information from five distinct sources. Why they tend to be in division on this is a question of their social economic difference and attributes. Figure 2 capture member who share a common event. Social network theories argue that affiliation to similar events leads to development of social ties [11]. The farmers indicated in red act as a bridge between the farmers and events and therefore act as bridges between the sub-graphs as depicted above.

The intuition in event overlap means that the farmers who source their information from a similar event tend to access a common trend of seeds and a replication of the same in the output. Fundamentally, if there is a disorder in the sweet potato traits, it will be replicated among the sets of sub-graphs visualized in Figure 2 above.

Conclusion and Recommendations

Farmers have been identified to bestow more confidence on successful fellow farmers. Under the axiom of rationality, every farmers aim is to maximize his output and therefore his or her food security. Developing countries still rely on extension officers with a complete disregard of the human capital with the farmer. A paradigm shift aimed at specifics in information sharing is required as opposed to the traditional method of entirely relying on extension officers who seem not to be successful in information dissemination due to their ratio.

To achieve food security, the Kenyan government should identify and target the most central farmers in technology dissemination. Their inherent characteristics and abilities should be tapped and therefore guarantee a replication of the same with minimum cost. The policy directions should be narrowed to the most central farmers and empower them with modern technologies and resources to achieve food security both in the short run and long run.

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