Impact of social networks on cattle farmers' knowledge of animal trypanosomosis and its control

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Introduction

Knowledge and information are elements that propel an increase in agricultural productivity and rural incomes (FAO, 1995). Farmers' capacity to control their livestock production environment is the result of the resources at their disposal; among these, knowledge and skills are key components. Indeed, the evolution of farming is influenced by the information that flows into the system. It is generally assumed that the knowledge and know-how available in a poor rural population is insufficient to be of much use in their training and development (Cabero and van Immerzeel 2007). This line of thought is understandable, as very few people within the population possess exceptional knowledge and know-how. According to van Immerzeel (2006), the knowledge and know-how of the rural population can be represented by the bell-curve of a normal distribution in a graph as shown in Figure 1.

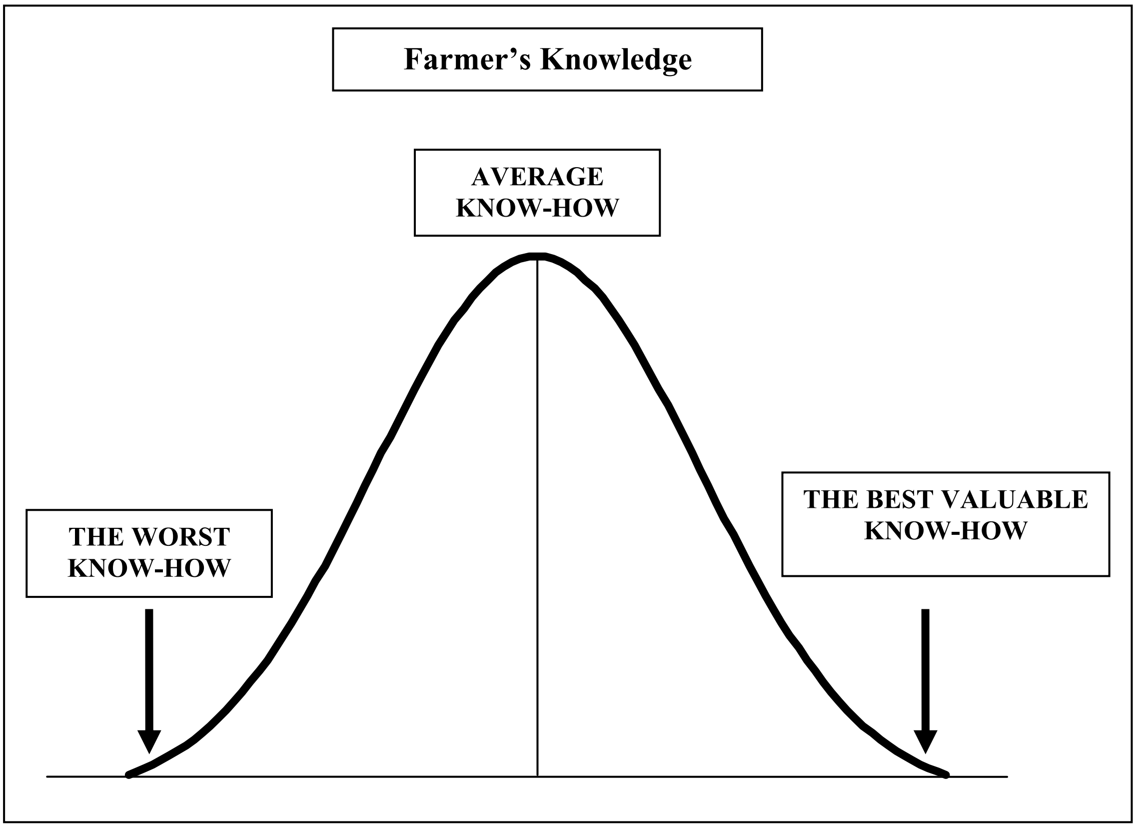

Figure 1: Normal distribution of knowledge in a large rural population
Source: Modified from Van Immerzeel (2006)

The bell-curve in Figure 1 is not static; people can learn from the "best" and the whole bell shaped curve can move towards the right. Shifting the curve to the right requires the contribution of those exceptional people that are on the extreme right of the curve, socializing their knowledge and know-how. Learning from the best implies the fact that knowledge is present in those people who know how. However, the great challenge is to find them and achieve a situation in which others can learn from them and with them. Knowledge needs to flow from the "best" to the rest of the community and one way to achieve this is through farmers' social networks. Although there is increasing emphasis on farmer-led extension in rural development and the power of the word-of-mouth for the spread of knowledge and information (Oiana and Rasul, 2006), very few studies have been done at farmers' level to understand the social processes involved and the impact a social network has on farmers' knowledge on a specific topic. The objective of the paper was to explore the relationship between a cattle farmer position in a community and his level of knowledge on animal trypanosomosis and its control in the commune of Solenzo in Burkina Faso.

Methodology

Study area and sampling

The study was carried out in the commune of Solenzo in the province of Banwa located in the North-West of Burkina Faso. Among the rural activities, rain fed agriculture is the most important, followed by livestock keeping. The main food crops are sorghum, maize, millet, cowpea and rice, while cotton is the major cash crop. The commune of Solenzo contains 2500 livestock keepers spread over 29 villages, and the majority of the households own oxen for animal traction, especially for cotton production. Four villages (Montionkuy, Sanakuy, Masso and Gnassoumadougou) were selected randomly from the 29 villages of the commune and all the cattle farmers in the four villages were included in the study in order to capture the whole picture of the social network in each village.

Data collection

We started the study by conducting a knowledge, attitude and practices (KAP) survey in the four randomly selected villages using a questionnaire. The questionnaire covered different aspects of trypanosomosis disease and its control: the cause, the signs of the disease, the prevention, and the treatment of the disease. A knowledge score was developed as a percentage of the total knowledge score. We then conducted a social network analysis in the four villages. Social network analysis is a diagnostic method for collecting and analyzing data on patterns of relationships among people and organizations (Wasserman and Faust, 1994; Scott, 1992). To understand how a social network is associated with farmers' knowledge, we constructed a social network at cattle farmers' level. Each node in the network represents a cattle farmer and each link between two nodes represents the exchange of information, including information about trypanosomosis and its control, between the two people. The information exchange can be in one or both directions. The software application Visualizer was used to derive the characteristics (the position in the community) of each node in the network.

Results

Cattle farmers' characteristics

All cattle farmers in the survey were male and are spread among eight different ethnic groups. Table 1 shows the repartition of cattle farmers in the study. Karaboro, Kado and Bozo represent less than 1% of the study population and were only found in Gnassoumadougou. The Samo which, account for almost 22%, were only represented in Sanakuy and Gnassoumadougou. The ethnic group Bobo was less represented in Masso and Sanakuy, while the Dafing were less represented in Sanakuy. However, Dafing and Mossi represent almost 50% of the study population. The Peulh or Fulani, known as livestock keepers, represent only 11% of the study population.

Table 1: Repartition of cattle farmers per ethnic groups per village

Villages	**Ethnic groups**						**Total**
	Bobo	Dafing	Mossi	Peulh	Samo	Other*	
Montionkuy	12	24	5	13	0	0	**54**
Sanakuy	5	1	22	17	62	0	**107**
Masso	1	62	64	7	0	0	**134**
Gnassoumadougou	53	19	16	11	32	4	**135**
Total	**71**	**106**	**107**	**48**	**94**	**4**	**430**

* Other include Karaboro, Kado and Bozo

Results from KAP survey in Solenzo, Burkina Faso, January to march 2009

The ages of cattle farmers ranged from 21 to 88 with an average of 47.5 (± 13.6) and the analysis of variance showed significant difference between villages ($p < 0.05$) (Table 2). Cattle farmers in the study owned an average of 13.3 (± 13.6) cattle per household, with a range of 1 to 200. There was significant difference ($p < 0.05$) between the average herd size in Montionkuy compared to other villages (Table 2). Most cattle farmers (95.3%) owned oxen and there was no significant difference between villages for the average number of oxen. While only 8.8% of the study population participated in formal education, more than half (51.6%) attended Koran study. The average number of years of Koran study was 2.7 (± 4.2) and there was significant difference ($p < 0.05$) between villages.

Table 2: Age of cattle farmers, herd size, number of oxen and number of years of Koran study

	Montionkuy n = 54	Sanakuy n = 107	Masso n = 134	Gnassoumadougou n = 135
Age (years) of cattle farmers	47.7^{ab}	44.6^{a}	47.6^{a}	49.7^{b}
Herd size (number of cattle)	25.0^{b}	10.9^{a}	11.6^{a}	12.1^{a}
Number of oxen	2.9^{a}	3.1^{a}	3.4^{a}	2.7^{a}
Number of	1.5^{a}	3.1^{b}	1.6^{a}	3.8^{b}

years of Koran study	

Values in the same row carrying different superscripts are significantly different ($p < 0.05$)
Results from KAP survey in Solenzo, Burkina Faso, January to march 2009

Cattle farmers' knowledge of animal trypanosomosis and its control

Knowledge of the cause and signs of animal trypanosomosis
Nearly all cattle farmers (98.6%) said they were able to recognize the disease. However, only 26% of cattle farmers in the study knew that animal trypanosomosis followed from bites by tsetse fly or other biting insects, and there were significant differences between villages. Also only a minority (7.2%) was able to recognize tsetse fly. Most cattle farmers (65%) in Montionkuy knew the cause of the disease, while in Masso and Gnassoumadougou few of them (14% and 10% respectively) knew that animal trypanosomosis followed from bites by insects. The proportion of cattle farmers in Montionkuy and Sanakuy that was able to recognize tsetse fly was significantly higher compared to Masso and Gnassoumadougou but there was no significant difference between Montionkuy and Sanakuy (Table 3).

Table 3: Percentage (%) of cattle farmers knowing the cause of the disease and able to recognize tsetse fly

	Montionkuy n = 54	Sanakuy n = 107	Masso n = 134	Gnassoumadougou n = 135
Knowing the cause of the disease	64.8[a]	42.1[b]	14.2[c]	9.6[c]
Recognizing tsetse fly	20.4[a]	11.2[a]	4.5[b]	1.5[b]

Values in the same row carrying different superscripts are significantly different ($p < 0.05$)
Results from KAP survey in Solenzo, Burkina Faso, January to March 2009

Cattle farmers cited 21 signs. However, only five signs were considered in the computation of the knowledge score: three signs that are always present (emaciation, enlarged lymph node and fever) and two signs that are important but not always present (pica and lacrimation). Cattle farmers reported knowing an average of 2.2 of those five signs and most (98%) were able to cite at least one sign. Most (87.7%) of cattle farmers were able to cite at least three important signs of the disease but considerably fewer (1.2%) were able to cite the five signs considered in the study for the computation of the knowledge score.

Knowledge of animal trypanosomosis prevention and control

Cattle farmers in the study cited in total 14 different strategies for the prevention of animal trypanosomosis. The strategies cited can be categorized as follows: modern medicines, traditional medicines, good husbandry, nutritional complements, avoidance of tsetse fly and control of tsetse fly by using insecticides.

Treatment methods known by cattle farmers in the study consisted of the use of modern or traditional medicines. Most cattle farmers (93.7%) used trypanocidal drugs: isometamidium chloride (ISMM) and diminazene aceturate (DIM). Only 13.5% used traditional medicine to treat the disease. Many cattle farmers (67.2%) believed that non-trypanocidal drugs (anthelmintics, vaccines and antibiotics) can also be used to treat animal trypanosomosis. Table 4 shows that there was no difference between the proportions of cattle farmers who used modern medicines (ISMM and DIM) to treat the disease in the four villages respectively. However, the proportion of livestock keepers in Montionkuy who believed that non-trypanocidal drugs can be used to treat animal trypanosomosis was significantly less than in the other three villages.

Table 4: Percentage (%) of cattle farmers using modern medicines for treatment per village

	Montionkuy n = 54	Sanakuy n = 107	Masso n = 134	Gnassoumadougou n = 135
Isometamidium chloride	3.7^{a}	3.7^{a}	1.5^{a}	3.0^{a}
Diminazene aceturate	94.4^{a}	91.6^{a}	94.0^{a}	88.1^{a}
Non-trypanocidal drugs	42.6^{a}	63.5^{b}	74.6^{b}	74.8^{b}

Values in the same row carrying different superscripts are significantly different ($p < 0.05$)
Results from KAP survey in Solenzo, Burkina Faso, January to march 2009

Impact of social networks on knowledge

We first compared cattle farmers' knowledge measured as a percentage of the total knowledge score of the villages. Table 5 shows that cattle farmers in Montionkuy know more about the disease and its control than their neighbors in other villages. However, there was no significant difference between the knowledge of cattle farmers in Sanakuy, Masso and Gnassoumadougou.

Table 5: Average knowledge score (% of total knowledge point) per village

	Montionkuy n = 54	Sanakuy n = 107	Masso n = 134	Gnassoumadougou n = 135
Knowledge score	31.8^{a}(0.8)	23.9^{b}(1.1)	24.0^{b}(0.7)	23.2^{b}(0.6)

Values in the same row carrying different superscripts are significantly different ($p < 0.05$). Values in brackets are standard errors

Empirical model and estimation procedure

We employed a linear regression model to explore the relationship between a cattle farmer's position in a community and the level of knowledge on animal trypanosomosis and its control. The dependent variable is knowledge score; two individual network characteristics were used in the regression analysis as explanatory variables: the degree centrality and the betweenness centrality. Degree centrality is defined as the number of ties that a node has. Degree is often interpreted in terms of the immediate power of a node for catching whatever is flowing through the network as information (Hawe and Ghali, 2008). If the network is directed (meaning that ties have direction) then we define two separate measures of degree centrality, namely in-degree and out-degree. In-degree is a count of the number of ties directed to the node, and out-degree is the number of ties that the node directs to others. In this study we used the degree centrality, which is the sum of in-degree and out-degree ties. Betweenness centrality is a measure based on the idea that an actor who lies on the paths connecting many other actors exerts control over the flow of information and may be in a position to filter and acquire the best information or know-how. We assume that individual actors could establish a network to exchange information and in this way increase their own knowledge in animal health and livestock production. However, being nominated by lots of others as a person to turn to for information, a concept reflected in a person's degree centrality, is not always the best guide in selecting the best and valuable knowledge champion. Indeed, a person's strategic connection to the most marginal people, but exceptional in a specific knowledge in a community, could be the most important criterion for socializing the best know-how — a concept better reflected by a person's betweenness centrality score (Hawe and Ghali, 2008).

The model to be estimated is represented by the following equation:

$$\textbf{Knowledge score}_i = \alpha + \beta_1 \textbf{Degree centrality}_i + \beta_2 \textbf{Betweenness centrality}_i + \sum_{k=3}^{n} \beta_k X_k + \varepsilon$$

Where α is the intercept, X_k represents a vector of individual cattle farmer characteristics apart from network characteristics, β_1, β_2, and β_k represent coefficients to be estimated and ε the error term. We expect the coefficient of betweenness centrality to be positive, while the coefficient of degree centrality may be either positive or negative.

Statistical methods for estimating population parameters and their associated variances are based on assumptions about the characteristics and underlying distribution of the observations. Among these assumptions are that the observations were selected independently and that each observation had the same probability of being selected. Data collected through surveys often have sampling schemes that deviate from these assumptions. For our study, cattle farmers are clustered geographically within villages and each observation had a different probability of being in the total sample. Hence, to estimate unbiased parameters and to compute an approximation of the true variance of estimates, we used the Taylor series linearization technique (Carlson et al., 1993; Rust, 1985; Kish and Frankel, 1974).

Estimation results

Results of the model in Table 5 show that being alphabetized, or having cattle farming as first activity; has a positive but not significant impact on cattle farmers' knowledge of trypanosomosis and its control. However, the age of a cattle farmer is negatively associated with the knowledge, meaning that young cattle farmers know more about the disease and its control. Receiving information about the disease from technical services, and the number of years of Koran study, are both significantly and positively associated with knowledge of trypanosomosis and its control. Cattle farmers who exchanged knowledge on the disease and its control acquired better knowledge. The number of cattle owned and the number of oxen in the herd are also significantly and positively associated with cattle farmers' knowledge. The model shows that the power of a cattle farmer for catching whatever is flowing through the network as information, measured as his degree centrality, does not have a positive association with knowledge on animal trypanosomosis and its control. As expected, betweenness centrality is significantly and positively associated with knowledge.

Table 5: Results of the empirical model

Knowledge score	Coefficients	Linearized Std. Err.
Being alphabetized	1.49	1.039
Having cattle farming as first activity	0.27	1.584
Exchange knowledge on trypanosomosis	1.85*	0.975
Receiving information on trypanosomosis from technical services	3.25**	1.536
Betweenness centrality	0.01***	0.001
Degree centrality	- 0.02***	0.004
Age of cattle farmer	- 0.05*	0.029
Number of years of Koran study	0.23**	0.089
Number of oxen owned	0.35***	0.074
Cattle herd size	0.03**	0.016
Constant	26.42***	1.659

N = 414

F(10, 401) = 13.07

R-squared = 0.1761

* = p < 0.1, ** = p < 0.05, *** = p < 0.001

Results from KAP survey and Social Network Analysis in Solenzo, Burkina Faso, January to March 2009

Conclusion

This study shows that social networks are key components of human resource development. Social networks play an important role in helping cattle farmers to access valuable information through their contacts, and to improve their knowledge on animal trypanosomosis and its control. However, the study shows that what is important in the cattle farmer's position in the social network is not the degree centrality measured as the number of people an individual cattle farmer is linked to in terms of information exchange. Instead, it is the ability of farmers to detect marginal people within the population who possess exceptional knowledge and know-how. Cattle farmers who establish strategic relationships with these people know more about animal trypanosomosis and its control.

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Abstract

Although there is increasing emphasis on farmer-led extension in rural development and the power of word-of-mouth and social networks for the spread of knowledge and information, few studies have been conducted at farmers' level to understand the impact a social network has on farmers' knowledge. This study was undertaken to explore the relationship between a cattle farmer's position in a community and his or her level of knowledge on animal trypanosomosis and its control. Data were collected through a knowledge, attitude and practices (KAP) survey by use of a questionnaire in four randomly selected villages in the commune of Solenzo in Burkina Faso. A social network at farmer level was constructed that included all cattle farmers in each village. Descriptive analysis and a linear regression model were used to analyze the data. Results showed that the power of a cattle farmer for catching whatever is flowing through the network as information, measured as his degree centrality, is negatively associated with knowledge on animal trypanosomosis and its control. However, a person's strategic connection to the most marginal people, but exceptional in a specific knowledge in a community — a concept better reflected by a person's betweenness centrality — is positively associated with knowledge.

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