Working Paper No. 01-14 **July 2014**

Agricultural Actors and Networks in the Sahel:

Examining the Potential for Scaling-up Conservation Agriculture in Dogon Country, Mali

Authors:

Matt Fornito, Keith M. Moore, and Moussa Keïta

Prepared by:

Sustainable Agriculture and Natural Resource Management Innovation Laboratory (SANREM)

Office of International Research, Education, and Development (OIRED)
Virginia Tech

E-mail: sanrem@vt.edu
On the Web: www.oired.vt.edu/sanremcrsp/

This research was made possible by the United States Agency for International Development and the generous support of the American people through the Sustainable Agriculture and Natural Resource Management (SANREM) Collaborative Research Support Program (CRSP) under terms of Cooperative Agreement EPP-A-00-04-00013-00.

Agricultural Actors and Networks in the Sahel:

Examining the potential for scaling-up Conservation Agriculture in Dogon Country, Mali

Matt Fornito, Keith M. Moore, and Moussa Keïta

Introduction

This working paper is the last in a set of three investigations led by the Sustainable Agriculture and Natural Resource Management (SANREM) Cross Cutting Research Activity 8 (CCRA-8) on technology networks. Each paper has worked in collaboration with a CAPS research project developing and promoting CAPS adapted to their particular locales. In this case, our collaborative partnership is with the SANREM Long Term Research Activity 8 (LTRA-8): "Improving soil quality and crop productivity through CAPS in West Africa", managed by the Kansas State University. The survey for this analysis was only conducted with targeted villages in one of LTRA-8's research sites in Mali, locally led by the *Institut d'Economie Rurale* (IER).

Scaling up conservation agriculture production systems (CAPS) for smallholders often requires major changes in household production systems. In the West African Sahel, conventional wisdom suggests that low rainfall and limited biomass production constrain the physical potential for introducing CAPS practices and make these changes even more difficult, if not impossible to achieve. Integrating the three conservation agriculture principles (reduced tillage, maintaining a permanent crop cover, and crop rotations/associations) into local production practices is expected to face considerable resistance.

The Dogon people, who are the population targeted in this study, have survived severe resource limitations. Conditions on the Dogon Plateau where the Dogon people were driven during the wars of the 19th century are even worse than the average Sahelian growing conditions, given their thin rocky soils (Woodhouse et al. 2000). Nevertheless, these severe conditions induced creativity among the Dogon to manage and increase their agricultural productivity (FAO 1991). Changes in production systems did occur and as tensions eased at the end of the 19th century many Dogon moved down off the plateau to the Seno Plain, bringing with them these adapted practices. Dogon conservation practices in the Plateau emphasized control of soil and water erosion, in particular, the use of shallow basins (commonly called *zaï*) where manure and seeds are concentrated (Bayala et al. 2011). *Zaï* do not involve the use of special equipment, but they are labor intensive.

Given this local knowledge and adaptation, it would appear that the Dogon farmers of the Seno may be receptive to improved conservation practices. We explore this hypothesis with the intent

of better understanding of how local knowledge and information resources are interconnected and can be used for the introduction of CAPS. Entering into the dialogue necessary to achieve these changes will depend on the capacity of CAPS promoters to interact and communicate effectively with the existing network of farmers, agricultural service sector providers, and community agents. Effectively negotiating these interactions to create innovative ways to integrate the three conservation agriculture principles will require: (1) an understanding of the current (local and scientific) knowledge and perspectives concerning best agricultural norms and practices; and (2) identifying the relevant actors and their resource and communication channels in the local agricultural production network.

Field Research and Sampling Methodology

The research was conducted in the villages of Koporo-pen and Oro in the *Cercle* of Koro and the villages of Diallassagou and Lagassagou in the *Cercle* of Bankass. The agroecology of this region is characterized by a relatively flat plain of largely sandy soils with a uni-modal rainfall regime of 500-600 mm between June and October (Spiekermann 2013). The Dogon constitute the dominant ethnic group in the zone of study, followed by the Peul (who are predominantly herders). The main economic activities are dryland farming, herding livestock, and commerce. Agriculture remains rudimentary and the principal crops are millet, peanuts, cowpeas, and Bambara nuts (Bayala et al. 2011). Introduced cultivation techniques are limited to the use of early maturing varieties and intercropping (millet with cowpeas). Farm equipment is limited primarily to the traditional short-handled hoe and occasionally an animal drawn plow and cart. Livestock is composed of cattle, horses, camels and small ruminants, with some chickens around the house. Manure is predominantly used, as mineral fertilizers are expensive and difficult to access.

The sampling methodology for this research involved a two-phase process: the first consisting of the farm household survey targeting the ego-networks of farm men and women; and the second based on a snowball sample of the agricultural service providers and other relevant community actors identified by interviewed farm men and women as part of their agricultural production, information and resource network contacts.

The farm household baseline survey was conducted in July 2011 and targets the *Cercles* of Koro and Bankass in the Seno Plain. Two of the villages were selected because they were involved in conducting CAPS research trials (Koporo-pen and Diallassagou) and the other two (Oro and Lagassagou) as local controls, respectively. All four villages are generally representative of villages across the Seno Plain along the border with Burkina Faso. The villages of Koporo-pen and Oro (*Cercle* of Koro) are situated near an all-weather gravel road within a couple of miles of an agricultural research station. Further south beyond the town of Bankass, Diallassagou and Lagassagou (*Cercle* of Bankass) are more isolated, accessible by sandy pathways.

In each village, samples of 30 men and 30 women were selected from lists of farming households provided by the village chief in each village (see Table 1). These four cluster samples covered from 25 to 80 percent of household heads and their spouses in the four villages and can be considered opportunistic saturation sampling as no statistically based random sampling was done. Occasional single-headed household heads were matched with a household head of the opposite sex; two men interviews were not completed, one each in Koporo-pen and Oro (Sow, 2011).

A team of 6 men and 4 women interviewers conducted the household surveys after training on the survey instruments was conducted at the IER/Mopti *Centre Régionale de la Recherche Agronomique (CRRA).* The men's household survey instrument contained more detailed information on the production systems (not reported here). Interview instruments were translated and the interviews conducted in Bambara, the *lingua franca* of Mali. Interviews with men lasted between 45 minutes to over an hour each covering agricultural production and practices as well as network and mindset indicators; interviews with women covering only network and mindset indicators were not more than 15-20 minutes long. The household surveys were completed within a week during the month of July, just as the planting rains arrived to the great joy of the villagers.

Table 1: Sampling distribution for farmers by sex

Site	Men Farmers	Women Farmers
Koporo-pen (n=59)	29	30
Oro (n=59)	29	30
Diallassagou (n=60)	30	30
Lagassagou (n=60)	30	30
Total (N=238)	118	120

Once the initial household survey had been completed, network contacts were listed and counted across all questionnaires. Thirty-eight individuals who were mentioned by men and/or women farmers at least five times were included on a short-list (with contact information) for the snowball sample of agricultural service sector providers and other community actors (see Table 2). Sometimes these actors were identified in more than one village, suggesting key persons linking village networks within the *Cercles*. Two of these individuals were not able to be found for the follow-up interviews.

Table 2: Sampling distribution for farm household and service sector/community agents surveys

Site	Farm Households Interviewed	Service Sector /Community Agents Interviewed
Koporo-pen (n=68)	59	9
Oro (n=65)	59	6
Cercle of Koro (n=5)	0	5
Diallassagou (n=67)	60	7
Lagassagou (n=66)	60	6
Cercle of Bankass (n=3)	0	3
Total (N=274)	238	36

Studying Networks and Beliefs: Research Methods

Data on social networks were collected using egocentric methods that measure relative network strength based on individual reporting of their direct contacts in social networks. To construct farmer networks, a position generator network survey instrument was used. The position generator method, developed by Lin and Erickson (2008), asks respondents to identify their interaction with individuals of various occupations -- in this case, those with occupations relating to agriculture. In this way, the position generator provides a structured method for inquiring about the professional network related to farming. The notion of the professional network represents the relationships between individuals engaged in various aspects of agricultural production for their livelihood (Wolf, 2006). Specifically, we were interested in the network for the exchange of agricultural information, ideas, and resources. Examining the professional network related to farming involves a wide range of individuals beyond the researchers, extension agent, and farmers identified by the technology transfer model.

Developing a locally adapted list that is meaningful to the local people is crucial to the survey. In order to do this, focus groups had been held in March 2010 to generate a list of supporting agricultural sector and community actors. The list was then validated by members of survey team during the training at the IER/CRRA-Cinzana (Moore and Christie 2010). The focus groups indicated that a wide variety of individuals often contribute to providing agricultural information, advice, and resources, which extends well beyond the typically studied technology transfer network of extension agents, agricultural researchers, and farmers. These included members of the local community such as shopkeepers, market vendors, government parastatals, NGO and project agents, teachers, religious leaders, and local community group leaders. The module included in the 2011 household baseline survey asked farmers about different aspects of their relationships with these agents. Farmers were asked about whether they exchanged or acquired information and/or resources, as well as questions about the quality and frequency of exchange with each category of individual contact. The full list of actors identified can be viewed in Appendix 1.

The technology networks research project is interested in two key themes: 1) knowledge and beliefs about agricultural production and 2) size, composition, and structure of farmer and agricultural service sector networks. This implies the utilization of two different types of statistical analysis.

In order to examine agricultural knowledge and understandings on the Seno Plain, farmers and non-farm agents were compared with respect to a list of 20 attitudinal statements referencing various production practices. These statements were hypothesized to characterize agricultural production perspectives in our target communities along the lines of three ideal types of agricultural norms and practices (technological frames): conservation agriculture, conventional agriculture, and risk averse agriculture[1]. Respondents were asked about the extent to which they

[1] ***Conservation Agriculture:*** Conservation agriculture producers are concerned with controlling erosion and maintaining the health of their soils while improving yields. The ideal type producer is fully committed to the three principles of Conservation Agriculture Production Systems (CAPS): minimizing soil disturbance, maintaining a permanent vegetative cover, and rotating crops. Conservation agriculture producers are also willing to experiment with different mixes of fertility inputs and methods for weed and pest management to find optimum yield outcomes. ***Conventional Agriculture:*** The conventional agricultural producer is motivated by the need to maximize profit and/or yields. As a result, producers are committed to specialization in particular commodities and base their

agreed or disagreed with each statement. Responses were recorded on a 5-point Likert scale: (1) disagree strongly, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree. Data from the household and technology networks service sector/community actor surveys was entered in the traditional cross-sectional format in order to conduct basic statistical analysis. Factor analysis (principal components) was conducted to determine the underlying patterns of co-variation among the items, in order to identify more robust and reliable measures of farmer mindsets (IBM® SPSS®, 2011). Compare means testing was performed to examine differences in mindsets between agents and farmers, and between men and women farmers. Mean comparisons were conducted using analysis of variance (ANOVA), which unlike a t-test, allows for simultaneous testing of multiple groups. A t-test on multiple groups results in the increased chance of committing a statistical type 1 error; ANOVA accounts for these errors so that significant results are less likely due to chance. Levine's homogeneity of variance test indicated that the group variances were systematically different. As such, we used the Welch F-statistic and the Games-Howell post hoc test, both of which are the recommendations to use when equal variances are not assumed. Several key factors were controlled for in these analyses: locality, extension agent contact, and gender.

Second, egocentric network analysis was used to describe connectivity in farmer networks for accessing agricultural information and resources and to identify the most common contacts of farmers by locality. Much of the focus centered on the importance of the individuals and their occupational roles for accessing information and resources. We were interested in examining the density of a network and the centrality of members within that network. Density is the proportion of existing ties (connections) between actors (individual nodes) of the total available potential ties. Centrality is a measure of how important an individual node is within a network.

Individuals were aggregated to the occupational role level. For instance, all farmers were aggregated to represent a single actor in the network. This aggregation was conducted, primarily because we did not have full network data available. As time constraints reduced the ability to track down each farmer leveraged for information and resources and our focus is on highlighting non-farm roles, it was more efficient and effective to cluster individuals with similar roles.

Analyses were conducted using Gephi, a tool that allows for exploration, computation, and visualization of social networks. Data were imported from excel spreadsheets and analyses were

---

planting decisions on the marketability of their final crop. Often accomplished through large-scale monocultural production systems, conventional agriculture producers will apply fertilizer, chemical pesticides, and herbicides up to the point it is profitable for them to do so. Conventional agricultural methods also emphasize mechanization of land preparation and harvest. This includes tilling the soil before, and often during, production. These producers will be interested in the development of labor saving technologies to lower input costs and will advocate the use of science to improve yield and profit margins.

Risk Averse Agriculture: The risk averse producer strives for autonomy and independence in agricultural production for food security. This involves a careful balancing of productive activities to ensure the sustainability of the farm household. Characteristics of different risk averse producers are highly contextualized, but often involve smallholder systems in some form of multi-functionality or co-production, often mixed livestock-crop systems. However, this may also include reliance on off-farm income in addition to farming, a decision to spread crops and or inputs across different locations, or the use of intercropping systems. To access resources necessary for production, risk averse producers prefer to rely on their personal networks for exchange rather than purchase their goods from the open market.

conducted to obtain degree, weighted degree, density, and various centrality measures. Graphs used the Force Atlas 2 algorithm and were revised by hand for clarity.

Comparing Knowledge and Beliefs

Using factor analysis we investigated local mindsets and perspectives. The hypothesized frameworks failed to emerge, shifting the analysis to investigate the empirically emergent factors. Two dimensions of agricultural production mindsets were identified. They were considered relatively robust as they cut across localities and various roles in agricultural production. The first factor can be summarized as "output-oriented farming" and is composed of the unweighted addition of the Likert scores of agreement/disagreement for the following statements:

- Farm labor should be replaced by more efficient herbicides and machines
- Inorganic fertilizer is best to improve soil quality
- Crop residues should only be fed to livestock and poultry
- One should strive to grow the most on one's fields

Once this variation is accounted for, a second factor emerged "market-driven livelihoods". This factor is composed of the following statements:

- Planting decisions are always based on current market prices
- Crops should only be grown for sale
- Earning off-farm income is more important than a large harvest

No Conservation Agriculture (CA) factor emerged from the analyses.

The 'output-oriented farming' and 'market-driven livelihoods' factors have eigen values of 1.99 and 1.90 respectively. The factors account for 50 and 63 percent of co-variation among the items which compose them, respectively. Further analysis examined the reliability of these factors using Cronbach's alpha. Although the alpha for the output-oriented farming factor (at .61) indicates low reliability, the alpha for market-driven livelihoods factor is modestly respectable (at .69). The face validity of the items makes them meaningful indicators of underlying patterns of agricultural mindsets.

Using these factors and individual conservation agriculture indicators, we compared the perspectives of farmers and agents in the Seno Plain through the construction of cross tabulations to examine distributional patterns within different groups and through compare means testing to highlight significant differences.

Agents appear to hold very different beliefs than the farming populations that they serve (Table 3). Support for output-oriented agriculture based on modern inputs and livestock is consistently high for farmers in the agro-ecology of the Seno Plain, but much lower for the community agents and agricultural service providers supporting them. Conversely, community agents and agricultural service providers have much stronger market-driven livelihoods than do farmers in these villages. The pattern does not vary when direct contacts with extension agents is accounted for (Table 4), although extension contact with farmers may have some effect on the market-driven livelihoods perspectives of Koporo-pen and Oro farmers. This latter seems to be gender-biased as men farmers are not statistically different from non-farm agents who are predominantly

men (Table 5). Most important, however, is the major divide between the perspectives of men and women to be explored later in the paper.

Table 3: Mean scores for Mali farmers and service sector/community agents level of agreement on basic farming perspectives

	Koro Farmers	Bankass Farmers	Service Sector/ Community Agents
Output-Oriented Farming**	3.9123 [a]	4.0945 [a]	2.6319 [b]
Market-Driven Livelihoods**	1.5128 [a]	1.4274 [a]	1.8241 [b]
N	114	119	36

Notes: Different letters within the same row are significantly different.
Rows marked by ** signify that ANOVA scores are significantly different at $p < .01$
Higher composite scores signify greater levels of agreement with the technological frame concept indicated by the factor.

Table 4: Mean scores for Mali farmers with and without contact with extension, and service sector/community agents level of agreement on basic farming perspectives

	Farmers with Contact	Farmers w/o Contact	Service Sector/ Community Agents
Output-Oriented Farming**	4.17 [a]	3.9856 [a]	2.6319 [b]
Market-Driven Livelihoods**	1.5067 [ab]	1.4657 [a]	1.8241 [b]
N	25	208/209	36

Notes: Different letters within the same row are statistically different.
Rows marked by ** signify that ANOVA scores are significantly different at the $p < .01$
Farmers with contact did not significantly differ from the service sector/community agents on the market-driven livelihoods factor (p=.105).

Table 5: Mean scores for Mali farmers by gender, and service sector/community agents' level of agreement on basic farming perspectives.

	Women	Men	Service Sector/ Community Agents
Output-Oriented Farming**	4.156 [a]	3.8534 [b]	2.6319 [c]
Market-Driven Livelihoods**	1.709 [a]	1.7797 [b]	1.8241 [b]
N	117/119	116/115	36

Notes: Different letters within the same row are statistically different. Production F = 120.54; Cash F = 50.90.
Rows marked by ** signify that ANOVA scores are significantly different at $p < .01$
Higher composite scores signify greater levels of agreement with the technological frame concept indicated by the factor.

Beliefs about CA follow a distinctively different pattern. Analysis of Tables 6 through 8 allows us to consider the sources of variation separately. Of the three CA principles, rotating crops enjoys the most universal support among farmers and agents (Table 6). The strong support for crop rotation is an important foundation for building broad based support of CA, as other principles are likely to be more controversial. Interestingly, although the differences are minor and not substantively significant, it is the farmers who are more supportive of maintaining a permanent crop cover (Table 7). This, despite repeated concerns in the Sahel that farmers are averse to maintaining soil cover. Tillage practices causing land degradation is by far the most divisive principle of CA (Table 8). While nearly a majority of farmers agree that tillage is harmful (just over fifty percent in Koro), a solid majority of community agents and agricultural service providers disagree. Nevertheless, all categories are divided on this issue, with the fewest remaining undecided.

Table 6: Percentage of and mean score for level of agreement or disagreement with the statement that: Rotating crops is always best practice

a. Koro and Bankass farmers compared to service sector/community actors	Agree	Uncertain /Neutral	Disagree	Mean Scores
Koro Farmers (n=116)	91.4	5.2	3.4	4.76 [a]
Bankass Farmers (n=119)	95.0	4.2	.8	4.88 [a]
Service Sector/Community Agents (n=36)	100	0	0	5.00 [a]
b. Effect of extension contact on farmers				
Farmers w/o Extension Contact (n=210)	93.3	5.2	1.4	4.84 [a]
Farmers with Extension Contact (n=25)	92.0	0	8.0	4.68 [a]

Notes: No significant differences were identified in testing.

Table 7: Percentage of and mean score for level of agreement or disagreement with the statement that: One should maintain a permanent crop cover

a. Koro and Bankass farmers compared to service sector/community actors	Agree	Uncertain /Neutral	Disagree	Mean Scores
Koro Farmers (n=116)	95.7	4.3	0.0	4.91 [a]
Bankass Farmers (n=118)	93.2	5.1	1.7	4.83 [a]
Service Sector/Community Agents (n=35)	85.7	5.7	8.6	4.54 [b]
b. Effect of extension contact on farmers				
Farmers w/o Extension Contact (n=209)	93.8	5.3	1.0	4.86 [a]
Farmers with Extension Contact (n=25)	100	0	0	5.00 [a]

Notes: $F = 4.086$, $p = .018$
Different letters indicate that the ANOVA tests for differences in means are statistically different at $p < .05$
Koro – Service Agents ($p=.013$); Bankass – Service Agents ($p=.069$).

Table 8: Percentage of and mean score for level of agreement or disagreement with the statement that: Tillage causes land degradation

a. Koro and Bankass farmers compared to service sector/community actors	Agree	Uncertain /Neutral	Disagree	Mean Scores
Koro Farmers (n=116)	51.7	14.7	33.6	3.36 [a]
Bankass Farmers (n=119)	44.5	14.3	41.2	3.07 [a]
Service Sector/Community Agents (n=36)	25.0	5.6	69.4	2.11 [b]
b. Effect of extension contact on farmers				
Farmers w/o Extension Contact (n=210)	47.1	14.8	38.1	3.18 [a]
Farmers with Extension Contact (n=25)	56.0	12.0	32.0	3.48 [a]

Notes: F = 6.431, p = .002
Different letters indicate that the ANOVA tests for differences in means are statistically different at $p < .05$
Koro – Service Agents (p=.001); Bankass – Service Agents (p=.017)

Tables 9 and 10 suggest that women farmers are more likely to be supportive of CA principles than men farmers or community actors and service sector agents. The differences for maintaining crop cover on the soil are not substantively significant, but do demonstrate a full unity of opinion among women. The patterns shows significant differences of perspective on whether tillage causes land degradation. Women farmers are clearly in agreement that tillage is detrimental to the land, whereas a plurality of the men disagree, or are neutral. However, the community and agricultural service sector agents are most unified in their disagreement. A table for crop rotations was not presented because there was no variation in findings to report.

A look at Table 11 provides a number of significant differences in perspective among farmers. These differences do not appear to be related to differences between villages. Rather, the differences are between men and women farmers. A majority of women farmers in each village agree that tillage causes land degradation. Also striking about these findings is that men farmers are much more likely to vacillate on the issue, registering significant levels of uncertainty. Women farmers, on the other hand, are less likely to vacillate. However, only men farmers in Lagassagou have a majority who fully disagree that tillage causes land degradation.

Table 9: Percentage of and mean value for farmers based on region and sex compared to service sector/community actors by level of agreement or disagreement with the statement that:

One should maintain a permanent crop cover	Agree	Uncertain/ Neutral	Disagree	Mean Scores
Koro Men (n=58)	91.4	8.6	0	4.83 [ab]
Koro Women (n=58)	100	0	0	5.00 [a]
Bankass Men (n=59)	86.4	10.2	3.4	4.66 [b]
Bankass Women (n=59)	100	0	0	5.00 [a]
Service Sector Agents (n=35)	85.7	5.7	8.6	4.54 [b]

Notes: Different letters indicate that the ANOVA tests for differences in means are statistically different at $p < .05$

Table 10: Percentage of and mean score for farmers based on region and sex compared to service sector/community actors by level of agreement or disagreement with the statement that:

Tillage causes land degradation	Agree	Uncertain/ Neutral	Disagree	Mean Scores
Koro Men (n=58)	31.0	24.1	44.8	2.72 [ab*]
Koro Women (n=58)	72.4	5.2	22.4	4.00 [c]
Bankass Men (n=59)	27.1	20.3	52.5	2.49 [a]
Bankass Women (n=60)	61.7	8.3	30.0	3.63 [bc*]
Service Sector Agents (n=36)	25.0	5.6	69.4	2.11 [a]

Notes: F = 6.431, p = .002
Different letters indicate that the ANOVA tests for differences in means are statistically different at $p < .01$
Bankass Women – Koro Men (p = .04)

Table 11: Percentage of and mean score for farmers based on village and sex compared to service sector/community actors by level of agreement or disagreement with the statement that:

Tillage causes land degradation	Agree	Uncertain /Neutral	Disagree	Mean Scores
Koporo-pen Men (n=29)	37.9	20.7	41.4	2.93 [ab]
Koporo-pen Women (n=29)	55.2	6.9	37.9	3.34 [abc]
Oro Men (n=29)	24.1	27.6	48.3	2.52 [ab]
Oro Women (n=29)	89.7	3.4	6.9	4.66 [c]
Diallassagou Men (n=29)	31.0	31.0	37.9	2.86 [ab]
Diallassagou Women (n=30)	53.3	13.3	33.3	3.40 [abc]
Lagassagou Men (n=30)	23.3	10.0	66.7	2.13 [a]
Lagassagou Women (n=30)	70.0	3.3	26.7	3.87 [bc]
Service Sector Agents (n=36)	25.0	5.6	69.4	2.11 [a]

Notes: F = 6.431, p = .002
Different letters indicate that the ANOVA tests for differences in means are statistically different at $p < .01$

Comparing Network Structure and Composition of Agricultural Production across Sites

Understanding network structure and composition requires multiple steps for analysis. First, we were interested in identifying the range and average number of contacts amongst farmers in each locality. It also was important to learn whether farmers leveraged these contacts as sources of information or resources. Lastly, we wanted to examine the network structure of each locality to identify how specific actors are leveraged and the role they play in each region.

The Composition of Farmer Networks

Interactions among actors in a given locality are likely to vary by the type of relationship, local cultural history, occupational roles and proximity to others in that locality. Moreover, the specific actors and amount of contact differ as a function of the village and its people. In this

section, we identified how often farmers leveraged non-farm agents as sources of information and for agricultural resources across villages. We further analyze the locations to test for gender differences within and across sites.

Actors in these villages often communicate as a means to obtain information or material resources. An information contact is an individual one connects with to exchange advice, consult with, or receive information for agricultural production. Resource contacts are individuals who provided farmers with seeds, fertilizer, pesticides, herbicides/weedicides, tractors, crop finance/loans, vet services, land, cash or similar materials.

Table 12: Farmer information and resource contacts across sites

Location	Average Number of Contacts		Range of Number of Contacts	
	Information	Resource	Information	Resource
Koporo-pen (n=59)	3.58[b]	1.69[a]	0-6	0-5
Oro (n=59)	4.05[b]	2.73[b]	0-8	0-6
Diallassagou (n=60)	3.73[b]	2.83[b]	0-7	0-7
Lagassagou (n=60)	2.35[a]	2.10[ab]	0-7	0-6
Service Agents (n=36)	3.78[b]	2.08[ab]	1-8	0-6

Note: Different letters in the same column are significantly different from each other at p<.01

Across all sites, farmers systematically leverage non-farm agents for information more than for resources (Table 12). Perhaps information is seen as less tangible and more freely-given in these communities. Farmers also may not feel indebted by learning about farming practices, but would feel obligated to repay a contact if given resources such as seed, fertilizer, or cash. Farmers in Lagassagou have the fewest information contacts and are significantly different than farmers in all of the other sites. Resource contacts were low for farmers in Lagassagou. However, members of Koporo-pen had the fewest resource contacts, significantly less than farmers in Oro and Diallassagou.

Simple statistics reveal significant gender differences for both average number of resource contacts and average number of information contacts. Women average 3.06 resource contacts, whereas men average only 1.70 contacts. The same pattern appears for information contacts with women averaging 4.47 contacts, while men average 2.66 contacts. To understand further if this is a simple function of gender or a more complex matter, additional analyses were conducted to observe location by gender differences.

Farmers in Koro leveraged some of the same contacts across villages and similar non-farm agent contacts existed in Bankass. As such, it was useful to combine the sets of villages and check for regional differences. In addition, men and women often communicate in different ways and leverage contacts differently. Thus, we also observed the role gender has on information and resource contacts.

Farmers from Koro have equivalent numbers of resource contacts (Table 13). Both are significantly different from the men and women from Bankass. It is interesting that men and women farmers in Koro have equivalent resource contacts, as the two villages themselves were

significantly different from one another. Even more remarkable are the significant differences in Bankass men and women. The Bankass man:woman ratio for average number of resource contacts is almost 1:4. The differences is so large that the men have significantly lower resource contacts than men farmers in Koro and the women farmers are significantly higher than women farmers in Koro.

Table 13: Farmer information and resource contacts across regions by gender

Location		Average Number of Contacts		Range of Number of Contacts	
		Information	Resource	Information	Resource
Women	Koro (n=60)	4.37[c]	2.23[b]	1-6	0-5
	Bankass (n=60)	4.70[d]	3.93[c]	0-7	1-7
Men	Koro (n=58)	3.24[b]	2.19[b]	0-8	0-6
	Bankass (n=60)	1.38[a]	1.00[a]	0-7	0-6

Note: Different letters in the same column are significantly different from each other at p<.001

Information contacts are a function of gender in both *Cercles*. Men are significantly less likely than women to access non-farm agents for information. However, this fails to explain the extremely large differences between men and women in Bankass. This region has the same gender pattern for farmers' information and resource contacts. This suggests that informal village support mechanisms operate through women in these more remote villages due to the lack of opportunity for more formal external linkages involving information and resources.

The range in quantity of resources leveraged across sites and gender was quite similar. Every woman in Bankass had at least one resource contact. This same range and patterning occurs with Koporo-pen's women maintaining at least one non-farm agent as a source of information. This confirms findings elsewhere in West Africa that information sharing is more frequent and effective among women than men (Moore et al. 2001).

As will be seen below in the network analysis, an analysis by village provides further insights. In general, women are more likely to have more information and resource contacts. For instance, *all* Oro and Diallassagou women had at least three non-farm agents as a source of information. Women in Oro, Diallassagou, and Lagassagou had one to seven resource contacts – none had 0, unlike the men. These same Diallassagou women averaged the most information and resource contacts across all locations and had significantly higher number of contacts than all groups except the Lagassagou women's resource contacts.

Another relationship that bears explaining are the men farmers in Oro. They held significantly more information contacts than the Bankass men. Moreover, the Oro men held significantly more resource contacts than all other men. They averaged greater resource contacts than both Koro women.

The low number of contacts in previous Bankass analyses appeared to be caused by Lagassagou men. These men farmers averaged less than one information contact and one resource contact.

Unsurprisingly, this is due to the amount of contacts leveraged; Lagassagou men only had a maximum of two contacts accessed.

Many non-farm agents hold important relationships with farmers. These individuals act as useful agricultural information and resource agents and the frequency of contact with farmers can reveal those that hold important roles in the network. Family and friends are the top agricultural information and agricultural resource agents for farmers across all four sites (Table 14-15). Veterinary service providers are one of the most critical agents across all locations, acting as a resource and information provider for approximately fifty percent of farmers in each village. Only Koporo-pen has a reduced number of farmers reporting contact with veterinary agents (just over thirty percent) and has fewer farmers reporting agricultural resource contact than the other villagers.

Village chiefs tend to be utilized for information and resources in Oro, Diallassagou, and Lagassagou, but not necessarily so for Koporo-pen. Sellers in the weekly market and boutique sellers are important contacts across all four sites for both resources and information, although each vendors' importance tends to be dependent on their locale.

There tend to be some notable differences across regions as well. Oro farmers capitalize on the relationship with the IER agent in the region. This is likely due to Oro's proximity to the research station. Koporo-pen is the only location where farmers discriminated in leveraging their relationships, using the NGO agent for resources and their extension agent for information. Farmers in Koporo-pen tend to access information through the women's organization leader and IER agent. Lastly, farmers in Diallassagou and Lagassagou hold the women's organization leader in high regard, as this agent is accessed for resources and information.

Table 14: Top information contacts and percentage of farmers reporting contact by village

Rank	Koporo-pen	%	Oro	%	Diallassagou	%	Lagassagou	%
1	Family/Friend	83	Family/Friend	92	Family/Friend	73	Family/Friend	52
2	IER Agent	46	Vet Service Provider	58	Vet Service Provider	52	Vet Service Provider	47
3	Vet Service Provider	34	Woman's Organization Leader	47	Woman's Organization Leader	43	IER Agent	40
4	Seller in Weekly Market	32	Village Chief	34	Village Chief	42	Woman's Organization Leader	35
5	Woman's Organization Leader	29	IER Agent	31	Boutique Seller	42	Boutique Seller	15
6	Extension Agent	20	Seller in Weekly Market	19	Seller in Weekly Market	27	Village Chief	12

Table 15: Top resource contacts and percentage of farmers reporting contact by village

Rank	Koporo-pen	%	Oro	%	Diallassagou	%	Lagassagou	%
1	Family/Friend	41	Family/Friend	76	Family/Friend	53	Family/Friend	48
2	Vet Service Provider	31	Vet Service Provider	56	Vet Service Provider	52	Village Chief	48
3	Seller in Weekly Market	24	Village Chief	32	Village Chief	48	Vet Service Provider	47
4	Seller of Pharmaceuticals	12	Seller in Weekly Market	27	Boutique Seller	43	Woman's Organization Leader	15
5	Boutique Seller	10	Boutique Seller	20	Seller in Weekly Market	28	Boutique Seller	13
6	NGO Agent	8	IER Agent	15	Woman's Organization Leader	20	Seller in Weekly Market	10

Total Network Structure

Network analyses allow for the examination of network structures and the relationships between members (Scott and Carrington, 2011). These analyses are useful for examining the individual nodes that facilitate information sharing and are critical to the network structure. Information from these individuals often will spread or diffuse to the rest of the network. The network structure we examine in this analysis is directed. That is, it indicates which actors request information and resources, and from whom. Nevertheless, it is likely that some degree of information is accessed and received in both directions as information sharing is not unilateral.

Centrality is an important component to networks as individuals highly central to a network are considered to hold power and influence through the network. Our analysis focuses on degree centrality, betweenness centrality, authorities, and hubs. Each is described below.

Degree centrality counts the number of times a node in the network is accessed or accesses others for information or resources. Degree centrality is an important indicator to identify actors that have many relationships within in a network.

Betweenness centrality facilitates understanding a node's importance and strength as a purveyor of information in a network. This measure of centrality is calculated by assessing the number of paths (degrees of separation) required for any actor to communicate with another actor when going through an individual node.

Our final analyses focus on assessing both authorities and hubs in a network. Individual nodes who are **authorities** are perceived to hold information and resources as measured by the number of other actors that seek them out. **Hubs** are individuals who act as connectors; they do not necessarily hold information or resources, but they are knowledgeable about the individuals who do. In short, authorities are individuals who should be highly targeted when attempting to change

agricultural production mindsets and hubs should be leveraged to help diffuse information by connecting authorities with others in the network.

Calculations were conducted in Gephi using weighted analysis (Vimeo, 2014). Each network calculates weights based on the number of individuals within a given occupational role. Weighted degree centrality is an additive combination of the number of in-degree ties (others accessing a specific node) and out-degree ties (specific node accessing others). Using weighted degree centrality also helps eliminate bias in determining the importance of actors by essentially treating degree centrality as an undirected measure. This is important because data collection was done through stratified sampling and a total network survey was not collected.

For the most part, weighted degree and unweighted degree centrality rank individual nodes in the same order (Table 16). As can be seen, farmers, family, and friends have high degree centrality because there are a large number of farmers that access family and friends. This is due to the nature of proximity and the intimate relationships formed at the village level compared to contacts with non-farm agents. While this is normal and disguises a certain amount of internal village network dynamics, the focus of our analyses is on the significance and roles of more formalized non-farm agents who interact with and gate-keep for farming communities.

There is some variability among the degree centrality ranks of non-farm agents across these villages. Village chiefs are accessed in each network, but are considerably more important as a non-farm agricultural agent in the more isolated and traditional villages of Diallassagou and Lagassagou compared to Koporo-pen and Oro. Veterinary service providers hold critical roles in each of the four sites as well. Though accessed to varying degrees, women's organization leaders, vendors in weekly market, and boutique sellers are accessed across locations, except for Koporo-pen which does not; it's most leveraged agents are the IER researchers. However, only Lagassagou contains an IER agent with high degree centrality.

It is clear that the village chiefs play an important role for accessing other individuals within the network. Thus, researchers and other external agents should form relationships with these village chiefs in order to connect with other members in the network. On the other hand, village chiefs may have artificially inflated betweenness centrality because external agents are required to seek the chiefs' approval to access the network – meaning the non-farm agents form relationships with the chief because it is necessary for any work to be conducted in the community.

Betweenness centrality seems to be dependent on location as well (Table 17). For instance, in Oro and Lagassagou, only the woman's organization leader, village chief, and other farmers have any degree of betweenness centrality. This analysis suggests these two villages only value village members. If these networks are closed off from external agents, there is limited opportunity for shifting agricultural production mindsets. Koporo-pen and Diallassagou have more actors with high betweenness centrality. These actors are distinct across these two sites suggesting that betweenness centrality is a function of the community and specific individuals, not on the occupational roles.

Table 16: Rank-ordered weighted (unweighted) degree centrality by village

Rank	Koporo-pen		Oro		Diallassagou		Lagassagou	
1	Family/ Friend	324 (20)	Family/ Friend	350 (18)	Family/ Friend	328 (20)	Family/ Friend	245 (16)
2	IER Agent	48 (12)	Vet Service Provider	34 (1)	Village Chief	41 (10)	Village Chief	47 (10)
3	Seller in Weekly Market	24 (3)	Woman's Org. Leader	30 (3)	Vet Service Provider	39 (9)	Vet Service Provider	35 (6)
4	Vet Service Provider	21 (2)	Village Chief	29 (8)	Boutique Seller	35 (7)	Woman's Org. Leader	30 (6)
5	Woman's Org. Leader	20 (4)	Seller in Weekly Market	22 (4)	Woman's Org. Leader	33 (7)	IER Agent	26 (2)
6	Village Chief	19 (11)	Boutique Seller	21 (4)	Seller in Weekly Market	25 (1)	Boutique Seller	16 (5)

Table 17: Rank-ordered betweenness centrality by village

Rank	Koporo-pen		Oro		Diallassagou		Lagassagou	
1	Family/ Friend	56.58	Family/ Friend	38	Family/ Friend	46.83	Family/ Friend	29.5
2	Village Chief	16.75	Village Chief	8.5	Extension Agent	6.58	Village Chief	5.5
3	Farmer's Org. Leader	14.17	Woman's Organization Leader	.5	Village Chief	4.83	Woman's Organization Leader	4
4	IER Agent	10.75			Vet Service Provider	1.58		
5	Project Agent	2.75			NGO Agent	1.25		
6					Boutique Seller	1.08		

Non-farm agents facilitate access to non-village information and resources. Though it might be expected, external agents such as project agents, NGO agents, extension agents, and IER agents are recognized as authorities in each site (Table 18). These external agents are often introducing new knowledge and new resources to farmers and local agents. Less easily explained are the local community agents' place in the network. Further exploration is needed as role importance is village-specific. For example, woman's organization leaders are authorities in Koporo-pen, Diallassagou, and Lagassagou, but not Oro. While woman's organization's leaders appear important, farm organization leaders and youth organization leaders are not authorities in each network. Lastly, veterinary service providers hold authority in Bankass, but not Koro. There is little information that indicates the *why* of these network structures, only that they exist in their current form.

Hubs are the connectors that provide actors with access to authorities. They are bridges to knowledge holders. Hubs themselves hold knowledge about which authorities contain which information. Beyond the family, friends, farmers, and village chiefs, there exist both marked similarities and differences across villages (Table 19). In addition, hubs and authorities share some similarities (same actors) while others serve as connectors between other nodes. For instance, the farmer's organization leader in Koporo-pen emerges as a hub, though he is not an authority. He knows which actors in Koporo-pen possess information and resources, but he does not actually maintain knowledge nor resources. Vendors tend to emerge much more prominently as hubs than as authorities. Those in the weekly market or running boutiques are likely to have interactions with diverse members of the population and therefore, will know who to reach out for information transfer.

One important note: multiple individuals in the same box (within Tables 17-19) indicate that those non-farm agents are equally connected or leveraged. Whether each of these non-farm agents are connected to the same or different actors is an issue that should be examined further in future research. This would reveal if researchers should target the population at large for greater knowledge sharing and information diffusion or if only a small portion of individuals maintain contact – and these individuals could be targeted for interventions at a reduced cost to resources.

There are distinct differences between the extension agents and their contacts in each village (Table 20). Oro and Lagassagou only have one actor that connects to extension agents. Low extension agent contact in these two villages indicates that they do not reach out to farmers. To change agricultural mindsets, we need these agents to connect more frequently with farmers by being accessible, acting as a point of contact for information and resources, and fostering relationships to build trust. Koporo-pen's extension agent has slightly greater network connectivity with a degree centrality of 3 (weighted 14). However, this is still a small portion of the village population. This agent did not connect with farmers to share information and resources, a missed opportunity. The most successful extension agents were from Diallassagou. They were sought out by farmers (albeit at a low percentage) and also sought out opportunities to be in contact with them. This even generated a positive betweenness centrality score for extension agents within that village network.

Table 18: Rank-order of actors' authority by village

Rank	Koporo-pen		Oro		Diallassagou		Lagassagou	
1	Family/ Friend	.11	Family/ Friend	.15	Family/ Friend	.15	Family/ Friend	.15
2	Village Chief	.08	Village Chief	.10	Village Chief	.13	Village Chief Vet Service Provider	.13
3	Woman's Organization Leader	.08	Project Agent NGO Agent Seller in Weekly Market IER Agent	.075	Vet Service Provider NGO Agent Council Leader	.09		
4	Project Agent NGO Agent Extension Agent Council Leader	.06					Woman's Organization Leader	.10
5							IER Agent	.08
6					Extension Agent Woman's Organization Leader	.07		

Table 19: Rank-order of hubs by village

Rank	Koporo-pen		Oro		Diallassagou		Lagassagou	
1	Family/ Friend	.26	Family/ Friend	.35	Family/ Friend	.22	Family/ Friend	.27
2	Village Chief	.19	Village Chief	.24	Village Chief	.19	Village Chief Vet Service Provider	.23
3	Project Agent	.15	Seller in Weekly Market	.18	Vet Service Provider NGO Agent	.14		
4	Farmer's Organization Leader IER Agent Seller in Weekly Market	.11	Woman's Organization Leader Boutique Seller	.12			Woman's Organization Leader	.18
5					Woman's Organization Leader Extension Agent	.11	Boutique Seller	.09
6								

Table 20: Degree, in-degree, out-degree, and betweenness centrality of extension agents by village

Village	Degree	In-Degree	Out-Degree	Betweenness Centrality
Koporo-pen	14 (3)	14 (3)	0	0
Oro	1 (1)	1 (1)	0	0
Diallassagou	17 (8)	12 (3)	5 (5)	6.58
Lagassagou	1 (1)	1 (1)	0	0

Mapping Information and Beliefs about Tillage

The greatest diversity of opinion within each village involves whether or not tillage causes land degradation (Figure 1). Multiple agents in the same occupational node had their scores averaged. In addition, the ties (lines) between nodes are weighted according to degree centrality. For instance, because the farmers, family, and friends are combined into a single node, ties leading to non-farm agents are likely to be thicker than between non-farm agents. This weighted relationship shows, for example many farmers connecting with the village chief (thick line), but very few farmers connecting with the youth organization leader (thin line).

The same analyses and coding scheme were conducted across localities for comparison and consistency. Individual nodes were color coded on a sliding scale from strongly disagree (red) to strongly agree (green) with the statement tillage causes land degradation. Non-color coded nodes were only identified, but not interviewed. Nodes are sized according to betweenness centrality or the strength of information control an individual holds in a network. Ties that are darker and denser indicate more individuals within that occupational category access the other actor for information and resources.

In Diallassagou, relationships were sparse. Farmers access a number of individuals for information and resources, but none more so than other farmers, family, and friends. Farmers are highly split on the issue so appear as a group to be neutral awaiting the influence of non-farm agents who are not all of one mind themselves. Only the woman's organization leader and NGO agent agreed that tillage causes land degradation. The remaining agents with multiple relationships appear to disagree with the idea that tillage causes land degradation.

Lagassagou farmers and non-farm agents expressed similar perceptions as in Diallassagou. As noted earlier, Lagassagou had many fewer relationships and the graph shows little connectivity. There are no positive sentiments for tillage causing land degradation, as all non-farm agents hold negative perceptions.

The Oro and Koporo-pen farmers and non-farm agents in the *Cercle* of Koro exhibit more diversity. Farmers and NGO agents agree that tillage causes land degradation. Other agents with less network influence disagree with this perception. The village chief of Oro strongly agrees, as does the woman's organization leader. This chief is highly connected. It bears questioning how Oro's village chief may hold such strong opinions compared to others in the area, but has not steered these non-farm agents to agree with his viewpoint.

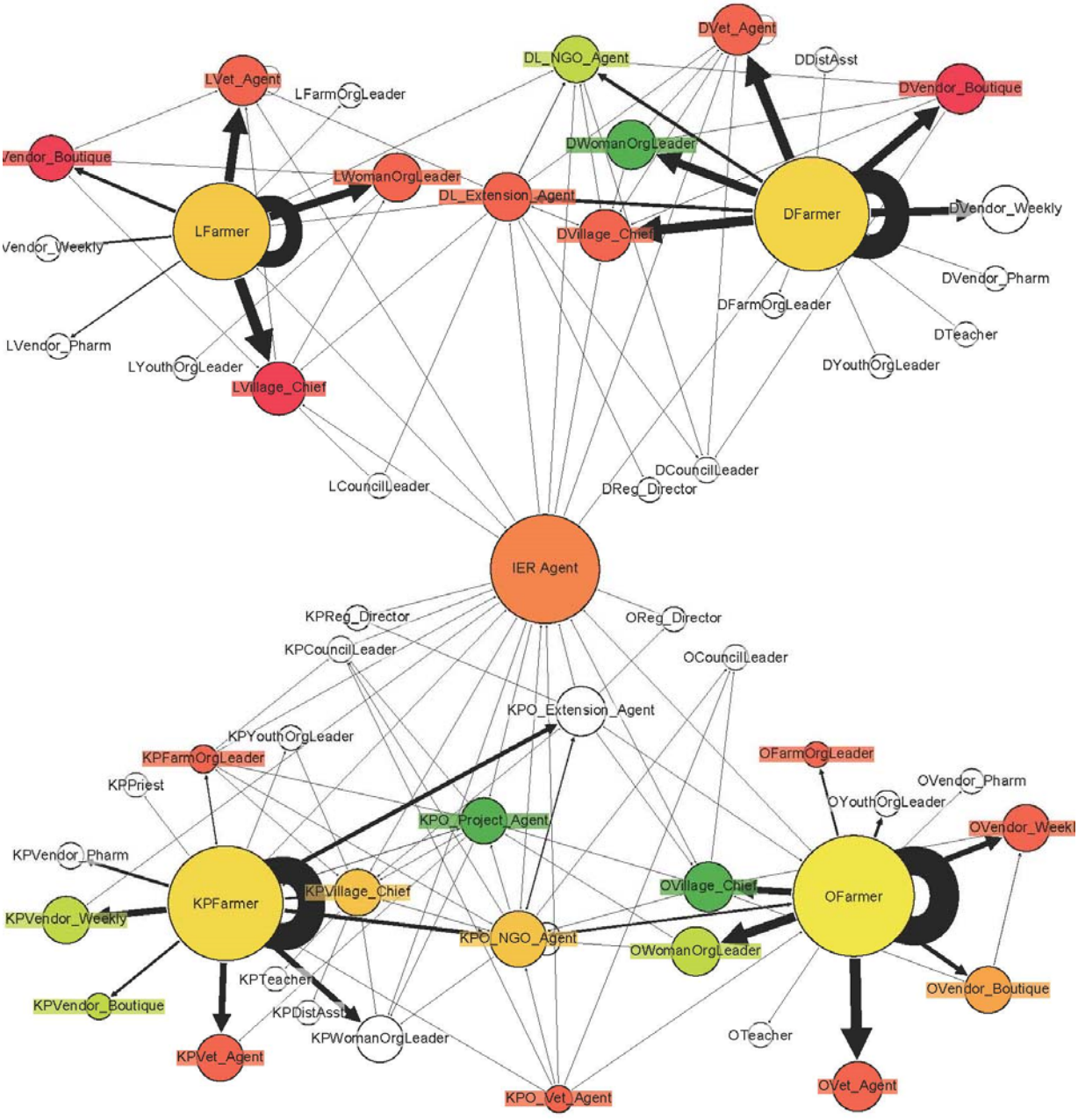

Figure 1: Total Network of Farmers and Non-Farm Agents across Four Villages Indicating Degree Centrality and Perspectives on whether Tillage causes Land Degradation

Koporo-pen has a diverse and networked community. Here, the village chief is neutral, a stark contrast to that of Oro. Greater diversity of opinions and a higher number of relationships make meaningful interpretation more complex than our survey was able to penetrate. For instance, the project agent, village chief, and farmer's organization leader have high betweenness centrality, but opinions on tillage among them range from strong agreement to moderate disagreement.

Summary of Key Findings

1. In general, farmers and non-farm agents have different perceptions about agricultural production.
2. Farming perspectives are dependent on occupational role and gender.
    a. Koro and Bankass farmers share the same mindset about output-oriented and market-driven livelihoods. The non-farm agents significantly disagree with output-oriented farming and significantly agree with market-driven livelihoods, as compared to farmers.
3. Conservation Agriculture does not emerge as a mindset, for farmers nor for non-farm agents.
    a. There is a shared consensus between farmers and non-farm agents that rotating crops is the best practice.
    b. There is a high consensus that a permanent crop cover should be maintained. However, non-farm agents, though agree to a large degree, are significantly lower in agreement than farmers on this practice.
    c. Tillage causes land degradation is a divisive topic.
        i. Farmers have a significantly higher perception that tillage is damaging.
        ii. Among farmers and among non-farm agents this topic is polarizing.
        iii. There's no clear pattern of agreement and disagreement, but men are slightly more likely to disagree that tillage causes land degradation than women.
4. Farmers contact other farmers and non-farm agents for information and resources.
    a. Farmers go to individuals for information over resources at approximately a 1.5-2:1 ratio, except in Lagassagou, 1:1.
    b. Women contact individuals for information much more than men.
    c. The men in Bankass appear to have extremely little contact with others for information or resources.
    d. Koro men and women leverage individuals for resources at the same rate.
    e. Bankass women leverage individuals for resources four times as much as men.
5. Farmers are linked to similar occupational roles across villages.
    a. Family, friends, veterinary service providers, woman's organization leaders, village chiefs, and vendors are used as informational sources in all villages.
    b. The veterinary service provider is a top resource, perhaps as they are always around to help maintain the health of livestock.
    c. Village chiefs and vendors tend to be accessed for resources across all villages.
    d. Koporo-pen is the only village that used external information for information (extension agent) and resources (NGO agent).
    e. The IER agent is important for information but not used often for resources.
6. Diallassagou's extension agent is important for connecting individuals in that village

7. Village chiefs tend to hold high importance by connecting individuals within a network (high betweenness centrality). They also have the greatest authority and are the largest hubs within each village.
8. The external (NGO, project, IER, and extension) non-farm agents tend to have high network authority across villages. This means they were a primary source of information and resources.
9. External agents, vendors, and farm/woman organization leaders are most likely to connect individuals in need of information and resources with other individuals who can provide them.
10. It would appear that extension agents need to reach out to farmers much more often.
    a. The control villages of Oro and Lagassagou had essentially no extension agent contact.
    b. Koporo-pen and Diallassagou had more farmers going to the extension agent, but the extension agent did not spend time connecting with farmers.
11. The CAPS villages of Koporo-pen and Diallassagou are much more networked than the control villages.

References

Bayala, Jules, Antoine Kainganire, Zac Tchoundjeu, Fergus Sinclair, and Dennis Garrity. 2011. Conservation Agriculture with Trees in the West African Sahel – A review. ICRAF Occasional Paper No. 14. Nairobi: World Agroforestry Center.

Food and Agriculture Organization (FAO). 1991. "Tradition soil and water conservation on the Dogon Plateau". In Looking After Our Land. Found on 9 February 2014 at: http://www.fao.org/docrep/x5301e/x5301e08.htm

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Moore, Keith M., and Maria Elisa Christie. 2010. Trip Report: Mali and Ghana. SANREM CRSP. OIRED/Virginia Tech. Captured on the web on 17 June 2014 at: http://www.oired.vt.edu/sanremcrsp/wp-content/uploads/2013/11/Moore-and-Christie-Mali-and-Ghana-March-2010.pdf

Moore, Keith M., Sarah Hamilton, Papa Sarr, and Soukèye Thiongane. 2001. "Access to Technical Information and Gendered NRM Practices: Men and Women in Rural Senegal", Agriculture and Human Values, Vol. 18(1): 95-105.

Scott J.P., and P.J. Carrington (eds). 2011. *The Sage Handbook of Social Network Analysis.* Sage Publications, Inc. Los Angeles.

Sow, Penda Sissoko. 2011. *Rapport de Mission: 7-18 juillet 2011*. *Centre Régionale de Recherche Agronomique.* Bamako: *Institut de l'Economie Rurale*.

Spiekermann, Raphael. 2013. Change of woody vegetation and land cover using high resolution images on the Dogon Plateau and Seno Plains (Mali). Master's Thesis in Geography. University of Vienna. Captured on the web on 17 June 2014 at: http://www.klimatologie.uni-bayreuth.de/pdf/theses/Spiekermann_2013.pdf

Vimeo. 2014. Gephi 0.7. accessed on the web on 28 June 2014 at: http://vimeo.com/9726202

Woodhouse, Philip, Pippa Trench, and Moussa Dit Martin Tessougué. 2000. A very decentralized development: Exploring a new wetland on the sourou Valley, Mali. In Woodhouse, Philip, Henry Bernstein, and David Hulme (eds.) African Enclosures?: the social dynamics of wetlands in drylands. Oxford: James Currey Publishers.

Appendix 1:

Network and Perspectives Data Collection Module

Identification des qualités des relations dans le réseau de la production agricole

Demander à chaque ménage de parler de leurs réseaux pour acquérir les ressources agricoles, entrées, et information, en énumérant les noms et les contacts des personnes identifiées. Rassurer le répondant que des informations sur leurs contacts ne sera pas partagées et sont totalement confidentielles.

Personnes à contacter pour le démarrage des activités de production agricole	Quelles ressources sont accédées par l'interaction ?	Quels types de renseignements avez-vous accédées par l'interaction ?	Qui débute le contact le plus souvent ?	Endroit et événements : Où agissez-vous l'un sur l'autre ?	Fréquence : Combien de fois agissez-vous l'un sur l'autre ?	Qualité : Pouvez-vous faire confiance à des ressources échangées ?	Genre des personnes identifiées
	0. Rien 1. Intrants 2. Pesticides/ herbicides 3. Accès à la terre 4. Transport 5. Equipement (tracteur/traction animale/semoir) 6. Service vétérinaire 7. Prête 8. Main d'œuvre 9. Utiles 10. Autre_____	0. Rien 1. seulement l'information sur la disponibilité du produit 2. l'information sur les prix et les quantités des produits 3. autre information (à préciser) 4. Appui – conseil	1. Toujours eux 2. La plupart du temps eux 3. 50/50 4. La plupart du temps moi 5. toujours moi	1. Champs 2. Boutique 3. Bureau 4. Marché hebdomadaire 5. En ville 6. Centre social du village 7. Jour de démonstrations 8. Foires agricoles 9. Autre _____	1. Journalière 2. Hebdomadaire 3. Bihebdomadaire 4. Mensuel 5. De façon saisonnière 6. Annuel	1. Toujours 2. Le plus souvent 3. Légèrement 4. Rarement 5. Jamais	1. Tous mâles 2. La plupart du temps mâle 3. 50/50 4. La plupart du temps femelle 5. Toutes femelles
Chef de village							
Membre de la famille							
Voisins/Amis							
Vendeur dans le marché hebdomadaire (premier)							
Vendeur dans le marché hebdomadaire (deuxième)							
Vendeur dans une boutique en ville							

Personnes à contacter pour le démarrage des activités de production agricole	Quelles ressources sont accédées par l'interaction ?	Quels types de renseignements avez-vous accédées par l'interaction ?	Qui débute le contact le plus souvent ?	Endroit et événements : Où agissez-vous l'un sur l'autre ?	Fréquence : Combien de fois agissez-vous l'un sur l'autre ?	Qualité : Pouvez-vous faire confiance à des ressources échangées ?	Genre des personnes identifiées
	0. Rien 1. Intrants 2. Pesticides/ herbicides 3. Accès à la terre 4. Transport 5. Equipement (tracteur/traction animale/semoir) 6. Service vétérinaire 7. Prête 8. Main d'œuvre 9. Utiles 10. Autre_____	0. Rien 1. seulement l'information sur la disponibilité du produit 2. l'information sur les prix et les quantités des produits 3. autre information (à préciser) 4. Appui – conseil	1. Toujours eux 2. La plupart du temps eux 3. 50/50 4. La plupart du temps moi 5. toujours moi	1. Champs 2. Boutique 3. Bureau 4. Marché hebdomadaire 5. En ville 6. Centre social du village 7. Jour de démonstrations 8. Foires agricoles 9. Autre _____	1. Journalière 2. Hebdomadaire 3. Bihebdomadaire 4. Mensuel 5. De façon saisonnière 6. Annuel	1. Toujours 2. Le plus souvent 3. Légèrement 4. Rarement 5. Jamais	1. Tous mâles 2. La plupart du temps mâle 3. 50/50 4. La plupart du temps femelle 5. Toutes femelles
Vendeur dans une boutique pharmacologique							
Enseignant							
Agent de vulgarisation							
Agent d'ONG-1 (à préciser)							
Agent d'ONG-2 (à préciser)							
Agent de l'IER							
Agent d'autre projet (à préciser)							
Leader de l'Organisation paysanne							
Leader de l'Organisation des femmes							

Personnes à contacter pour le démarrage des activités de production agricole	Quelles ressources sont accédées par l'interaction ?	Quels types de renseignements avez-vous accédées par l'interaction ?	Qui débute le contact le plus souvent ?	Endroit et événements : Où agissez-vous l'un sur l'autre ?	Fréquence : Combien de fois agissez-vous l'un sur l'autre ?	Qualité : Pouvez-vous faire confiance à des ressources échangées ?	Genre des personnes identifiées
	0. Rien 1. Intrants 2. Pesticides/ herbicides 3. Accès à la terre 4. Transport 5. Equipement (tracteur/traction animale/semoir) 6. Service vétérinaire 7. Prête 8. Main d'œuvre 9. Utiles 10. Autre_____	0. Rien 1. seulement l'information sur la disponibilité du produit 2. l'information sur les prix et les quantités des produits 3. autre information (à préciser) 4. Appui – conseil	1. Toujours eux 2. La plupart du temps eux 3. 50/50 4. La plupart du temps moi 5. toujours moi	1. Champs 2. Boutique 3. Bureau 4. Marché hebdomadaire 5. En ville 6. Centre social du village 7. Jour de démonstrations 8. Foires agricoles 9. Autre _____	1. Journalière 2. Hebdomadaire 3. Bihebdomadaire 4. Mensuel 5. De façon saisonnière 6. Annuel	1. Toujours 2. Le plus souvent 3. Légèrement 4. Rarement 5. Jamais	1. Tous mâles 2. La plupart du temps mâle 3. 50/50 4. La plupart du temps femelle 5. Toutes femelles
Leader de l'Organisation des jeunes							
Leader religieuse							
Membre du Conseil Communal							
Autre (à préciser)							

Section 4: Partagez-vous svp l'information de contact avec ceux que vous avez mentionné ci-dessus ?

Position	Nom et prénoms	Endroit ou Contact : (téléphone mobile préféré)
Chef de village		
Membre de la famille		
Voisins/Amis		
Vendeur-1 dans le marché hebdomadaire		
Vendeur-2 dans le marché hebdomadaire		
Vendeur dans une boutique en ville		
Vendeur dans une boutique pharmacologique		
Enseignant		
Agent de vulgarisation		
Agent d'ONG-1 (à préciser)		
Agent d'ONG-2 (à préciser)		
Agent de l'IER		
Agent d'autre projet (à préciser)		
Leader de l'Organisation paysanne		
Leader de l'Organisation des femmes		
Leader de l'Organisation des jeunes		
Leader religieuse		
Membre du Conseil Communal		
Autre (à préciser)		

2. Connaissances, perceptions et croyances par rapport aux pratiques agricoles

Constat sur les pratiques agricoles	Convient fortement - 5	Convient - 4	incertain/ neutre – 3	Désaccord - 2	Désaccord fortement - 1
La terre est un héritage à être préserver pour des générations futures					
La main d'œuvre de la ferme devrait être remplacée par des herbicides et des machines plus efficaces					
S'engager dans des activités productives multiples est toujours meilleur que faisant une seule					
Le revenu agricole devrait toujours être réinvesti pour relever les affaires					
On devrait maintenir une couverture végétale permanente					
il vaut mieux de relever ou d'augmenter les productions alimentaires au sein du ménage ou de la communauté que de les acheter					
L'application des pesticides chimiques est toujours nécessaire					
La production de ferme est nécessaire pour alimenter la famille					
L'engrais inorganique est le meilleur pour améliorer la qualité de sol					
La répartition des cultures et des intrants sur plusieurs parcelles est toujours nécessaires.					
La décision de faire une culture est toujours basée selon les prix du marché courant					
Le labour opportun est important pour une bonne récolte					
Les cultures devraient seulement être destinées pour vente					
Des résidus de récolte devraient seulement être donnés au bétail et à la volaille					
Le labour des terres amène la dégradation					
On devrait toujours essayer de maximiser la production dans une ferme					

Constat sur les pratiques agricoles	Convient fortement - 5	Convient - 4	incertain/ neutre – 3	Désaccord - 2	Désaccord fortement - 1
Les cultures destinées à l'alimentation devraient être semées sur la majorité des champs chaque saison					
La rotation des cultures est toujours la meilleure pratique					
La préparation de la terre pour la production végétale commence par le labour					
le revenu qui provient des activités hors ferme est plus important qu'une grande récolte					