11-14-2012

Food Security Monitoring and Evaluation in Rural Mali: Preliminary Findings

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November 14, 2012 · Original Research

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Abstract
African Sky is a non-profit organization that has been continuously involved in community development efforts in the Sikasso, Koulikoro, and Segou regions of Mali since 2001. To inform these efforts, an assessment of survey and census data was conducted focusing on the rural village of Dissan, in the Sikasso region. During the evaluation period between 2001-2010 Dissan experienced highly variable rainfall. We hypothesized these conditions would negatively impact farming output, and as a result, nutritional status of the people living in Dissan. Our analysis shows that while land use did not change significantly, by household the variety of sorghum crops increased and non-sorghum food crops decreased. Farmers in Dissan are changing crop distribution due to an increased availability of new sorghum seed and in response to a variety of environmental factors.

Introduction
African Sky is a 501(C)(3) charitable non-profit organization that promotes and initiates community-based solutions for eradicating extreme poverty in rural Mali. The organization has been working in Mali since 2001, with relationships stemming back to 1994. Long-term relationships with the Malian side of the African Sky "family" have resulted in tremendous access and response to local data collection requests and efforts.

African Sky seeks to improve community capacity in Mali across four categories: education, community health, food security and community arts. Recent examples of African Sky Initiatives include school development, empowering women's groups, soap making workshops, water pump maintenance, and introduction of moringa plants to farmers. In concert with thousands of NGOs throughout the world, the organization is specifically addressing two Millennium Development Goals in this study:

- Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger [1].

- Target 8.B: Address the special needs of least developed countries [2].

The United Nations proposed these goals to eradicate poverty through a data-driven, holistic approach that targets specific drivers of extreme poverty. Many African Sky projects, and Targets 1.C and 8.B, address the problem of food insecurity, including the myriad burdens and consequences that result from hunger and under-nourished families and communities.

In rural Mali land use is a primary source of livelihood and sustenance for rural communities[3]. The yearly food crop cycle typically begins in March. Fields are cleared and fertilized with manure and ash. In May, livestock are sent away, and farmers await the first rainfall. Food crops like sorghum and millet are planted first, and the entire village takes part in these plantings. Depending on the consistency of additional rainfall, crops may need to be replanted multiple times. Additional crops are planted after sorghum and millet, and rainfall through June and July provides vital water for these crops. By August, the rainy season is waning and efforts turn to weeding and tending the growing crops. Harvesting of crops takes place between August and December, contingent on rainfall and replanting that may have been required.

Broken into household labor groups, the entire village is involved throughout the farming season, involving men, women and children. Most of the work is done by hand, or occasionally with the assistance of oxen. Low population density is a limiting factor in growing crops needed for both food and trade [4]. For any given household, the issue of available labor is compounded by biophysical constraints, such as rainfall and soil fertility, and by socioeconomic resources [5]. Sorghum crops are a primary food source in rural Africa, and represent over 25% of crops farmed by area in Mali [6].

Understanding the dynamic factors influencing sorghum production is vital to understanding food security in the region. Farmers consider all of these factors when choosing the crops and crop varieties they grow. For most Malians, deciding which crops to grow is a risk-laden wager; the decisions made at planting time determine the nutritional and economic security of one’s household. Based on the data and analysis reported here, African Sky is developing a culturally-appropriate assessment tool to launch a rigorous monitoring and evaluation mechanism for food security and community health issues in Dissan and other project communities.

Methods

Data Collection

Between 2001 and 2010, African Sky Executive Director Scott Lacy conducted ethnographic field research to document how Dissan farmers manage to feed their families. As part of this research, Lacy conducted two censuses and two surveys that included all households living in Dissan (2001, N=66; 2010, N=73). Common variables in both surveys included household crop varieties and land usage; these variables track household food production and farming trends from 2001 to 2010. This report uses data from household censuses and surveys to determine if local farming habits have changed over the survey period, and if those changes in

farming habits have had an impact on food security in the region. Farming habits are used as a proxy for nutritional status.

Measures

The census data recorded neighborhood, household head, members of each household, marital status, spousal relations, parental information, birthplace and date of birth of each member of the household. Gender and age were derived using date of birth, translation of names, parental and spousal data.

The surveys recorded responses to questions about household farming systems, crop choices, and various economic and religious practices. It is important to note that the two surveys were not originally designed to capture time-stamped assessment data. Nonetheless, both surveys collected data on the number and types of sorghum crops grown, the number and types of thirteen non-sorghum crops grown, and the number of sorghum hectares and non-sorghum hectares grown.

Data Analysis

Cross-sectional group level analysis was done to compare means of variables that capture the farming activities of each household. Differences in means that are non-normally distributed were computed using the Wilcoxon-Mann-Whitney test for two independent samples. Differences in normally distributed means were computed using a two-sample t-test. Analysis was done for overall changes (in Dissan) and neighborhood specific (labeled A through E) changes from 2001 baseline measures compared to 2010. Analysis of qualitative responses was not conducted for this report.

Results

Census Data

Sixty-six households in five neighborhoods, containing 882 individuals were recorded in 2001. In 2010, Seventy-three households in all five neighborhoods were recorded. At the time of publication, census data was available for thirty-four households in four neighborhoods containing 455 individuals. In 2010, 15 new households were identified in census data. 10 of these households emerged when larger existing households splintered, and the other 5 new households moved to Dissan from other communities. During the time of data collection six households either disbanded or left the region. The census data shows a similar distribution of gender in 2001 and 2010. There was a shift in age group distribution, with the population aging from 2001 to 2010. Birth and death rates were not taken into account because some census data was unavailable prior to publication. (See Fig. 1).

Demographic	2001	2010
Total Individuals	882	455
Households	66	34 of 73*
Sex [n(%)]		
Male	411 (47)	220 (48)
Female	445 (50)	231 (51)
Age Group Distribution [n(%)]		
< 20	527 (60)	188 (41)
≥ 20 and < 30	119 (13)	98 (21)
≥ 30 and < 40	98 (11)	62 (14)
40+	138 (16)	107 (24)

Percentages may not sum due to rounding.

**Not all household data was available at the time of analysis for 2010.*

Fig. 1: Demographic Distribution in Dissan

Survey Data

In 2001, 66 unique households provided responses. In 2010, 73 unique households provided responses. Between 2001 and 2010, Dissan experienced a net increase of seven households. Eight households moved out or disbanded, five new households moved in, and another 10 new households emerged when several established households splintered. In aggregate, over the period from 2001 to 2010, 81 unique respondents were interviewed, of which 61 were identified as the same household in both years. Matching households were identified based on matching the names of household heads, census records, and neighborhood.

Overall results for Dissan are summarized in Figure 2 across all neighborhoods. The population is reported as unique respondents in each year. Number of crops grown decreased from 7.0 in 2001 to 6.0 2010 ($p = 0.0363$). The number of varieties of sorghum grown increased from 1.3 to 3.9 ($p < 0.0001$). No other significant differences were found between 2001 and 2010.

Variable	2001	2010	p-Value
	n=66	n=81	
Hectares of Sorghum (mean, SD)	2.3 (1.5)	2.4 (2.1)	0.5462
Number of Crops Grown (mean, SD)*	7.0 (2.8)	6.0 (3.0)	0.0363
Overall Hectares Cultivated (mean, SD)	5.3 (3.8)	5.4 (3.5)	0.6043
Non-Sorghum Hectares (mean, SD)	2.9 (3.1)	2.5 (2.5)	0.4129
Sorghum Varieties (mean, SD)*	1.3 (0.7)	3.9 (2.1)	<0.0001
Sorghum Cultivated (% clutivating)	89.40%	90.00%	0.8844

** rows indicate significant change ($p < 0.05$).*

Fig. 2: Overall Cross Sectional Survey in 2001 and 2010 in Dissan

The analysis demonstrated a significant increase in varieties of sorghum grown across each neighborhood (see Fig. 3). Only neighborhood “B” showed a significant difference in crops grown; no other significant results were found for neighborhood-specific analysis.

Neighborhood	Households [n(%)] 2001	Households [n(%)] 2010	Sorghum Variety [mean(SD)] 2001	Sorghum Variety [mean(SD)] 2010
A*	18 (27)	18 (22)	1.2 (0.6)	4.6 (3.4)
B*	11 (17)	16 (19)	1.1 (0.7)	4.2 (1.3)
C*	11 (17)	13 (16)	1.4 (0.7)	4.0 (1.0)
D*	17 (25)	27 (33)	1.5 (0.5)	4.4 (1.9)
E*	9 (14)	7 (10)	1.0 (1.5)	4.4 (1.0)

** Denotes neighborhood with significant change ($p < 0.05$).*

Fig. 3: Sorghum Variety Changes by Neighborhood in Dissan

The number of households growing each of thirteen selected crops were recorded in 2001 and 2010. When compared across the whole village from 2001 to 2010, 7 crops showed no significant change in the number of households planting the crops. For the same time period, 6 crops significantly decreased in utilization, and 3 crops experienced a significant increase in utilization by farmers. (See Figure 4).

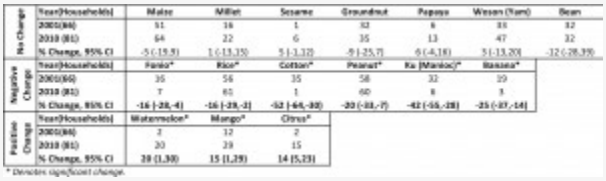

Fig. 4: Number of Households Growing Selected Crops in 2001 and 2010

Discussion

The census and survey data in this report were culled from two survey and census tools constructed for specific research purposes. The 2001 survey focused on planting and farming habits in the village of Dissan, while the 2010 survey focused on sorghum obtainment, distribution methods and farming habits. This report was designed with the goal of evaluating current abilities of African Sky to assess food security issues in Dissan given the data currently available. The results reported here will inform the creation of a tool for consistent future community assessment.

The increased sorghum variety at the household level is likely attributable to work in the Dissan region that has focused on participatory plant breeding (PPB). This is an outcome of interest given Lacy's PPB research with Dissan farmers. Increased use of multiple sorghum varieties suggests that PPB programs are effective at increasing the varieties of sorghum farmed at the household level. PPB programs decentralize seed testing and development through collaborations with farmers; PPB promotes the development and adoption of useful crop varieties in the communities that need them [7]. The Seeds of Choice Project has been engaging in these activities in the Sikasso region, and the increase of sorghum varieties in Dissan provides additional support for using the PPB approach to spread useful crops in the Dissan region. As there appear to have been both quantitative and qualitative impacts due this PPB research, African Sky may include PPB efforts in

future projects.
The reasons for change in non-sorghum crop choices are not as easy to identify. It is likely that the increased emphasis on the sorghum varieties, and the influx of donated seeds de-motivated farmers from planting non-sorghum crops, as seen in the data from 2010. PPB educational efforts may have also impacted the number of non-sorghum crops grown. Previous work has shown that sorghum adoption influences farming of crops such as cotton [8]. Farmer preference for flavor and other non-nutritional also plays a part in determining the varieties chosen [3].

The comparison of information gathered across the two surveys shows respondents are willing to discuss farming practices and habits in detail. Respondents were also willing to discuss motivations behind such practices in a qualitative manner. Future work by African Sky will aim to increase the amount of qualitative data gathered. This will provide more insight regarding reasons for crop utilization. In large part, this willingness to share farming practices can be attributed to long-term relationships between the community and African Sky staff members. Fostering such connections in the community is crucial, as without such connections it may be difficult to gather accurate and locally salient data.

Limitations

The census data from 2010 was incomplete at the time of writing. The statistical analysis of demographic data is presented in this report, but should not be regarded as definitive. Once the entire 2010 population data set becomes available, analysis will be conducted again to ensure validity of the reported results.

Caloric data and farmland quality were not collected as part of the research the data sets were culled from. Future investigation would benefit from collecting this data in order to paint a more complete picture of the impact of crop changes over time. As there is an increase in number of varieties of crops consumed, the nutritional resources of the community will increase, and it is likely that this will positively impact the nutritional status down to the individual level.

Conclusions

The census data indicates a shift in age distribution in the Dissan region. The data for the 2010 census were not available for analysis at the time of publication, so these data were not analyzed for significance. The authors expect that the age distribution will show less variance once the full data set is analyzed. The findings from the survey of farming practices show that crop choice in both sorghum crops and other crops is changing over time. Households were growing a greater number of varieties of sorghum in 2010 than in 2001. The opposite is true of non-sorghum crops. However, overall land use remained constant between the two survey periods. These outcomes validate previous research indicating the importance of crop and seed choices, as land use is not limited by availability but by the labor required to utilize the land.

As land use remains consistent in rural Mali, the type of crop grown is of more importance than how much land is used because crop variety will determine the

nutritional resources available to the community. Determining how crops are used after harvest(either for household consumption, trade, or sale) informs analysis of the nutritional impact of crop choice. Increased understanding of individual and household consumption habits (and production resources) will allow for a more accurate profile of nutrition. Based on the findings from this study, African Sky is developing a culturally-appropriate assessment tool to establish a rigorous monitoring and evaluation mechanism for food security and community health issues in Dissan and other project communities.

Acknowledgements
The authors would like to express their gratitude to the farming families of Dissan, Mali. These families, including the households of Burama Sangare, Bakari Jakite, and Sedu Sangare, shared their homes, fields, food, labor, and knowledge to teach us how to produce grain despite some of the most difficult growing conditions (environmental and socio-economics) in the world. The authors also thank plant breeders Dr. Eva Weltzien and Dr. Fred Rattunde for serving as technical advisors for Lacy's field research since 2001.

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Tags:

agriculture . census . crop variety . Dissan . food security . Mali . public health . rural community . sorghum