

# Nuru Kenya Agriculture Impact Assessment

## Results of the 2013 Harvest Yield Survey

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### ABSTRACT

In 2013, Nuru Kenya's Monitoring and Evaluation team administered a harvest yield survey to a representative sample of farmers in Kuria West. Part of a larger impact assessment strategy for Nuru Kenya's Agriculture Program, the main purpose of this survey is to assess the percentage change in crop yield among Nuru and non-Nuru farmers between 2013 and 2011 (baseline year). In total, 642 Nuru farmers and 581 non-Nuru farmers participated in the survey. Results show that due to drought conditions in 2013, both Nuru and non-Nuru farmer yields decreased from the baseline year of 2011. Nuru farmers experienced a decrease of 49 percent, from 5.81 bags per acre in 2011 to 2.95 bags per acre in 2013. By comparison, non-Nuru farmers experienced a 62 percent decrease in bags per acre, from 7.01 in 2011 to 2.62 in 2013. The greater decrease among non-Nuru farmers indicate that the Nuru program likely contributed to a 13 percent yield advantage relative to non-Nuru farmers.





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## Abbreviations

GPS	Global Positioning System
HH/HHs	Household/Households
KSh	Kenyan Shillings
LR	Long rains farming season
M&E	Monitoring and Evaluation
NI	Nuru International
NK	Nuru Kenya



## Overview

Nuru's Monitoring and Evaluation (M&E) system is built to produce useful and relevant information that can contribute to key decision-making about Nuru's programs (i.e., whether to replicate and/or scale an intervention). With this utilization-focused approach at the center of Nuru's M&E strategy, the M&E team works to objectively monitor and evaluate the **performance** and **impact** of Nuru's Impact Programs — Agriculture, Community Economic Development, Healthcare and Education.

In service to this M&E approach, the Nuru Kenya M&E team administered a survey in September 2013 that built on similar data collections in 2011 and 2012, and aimed to answer the question: **What is the impact of Nuru Kenya's Agriculture Program on crop yield?** To contribute to answering this research question, the M&E team collected average maize harvest yield from a statistically representative sample of Nuru farmers (intervention group) and non-Nuru farmers (comparison group) for the 2013 long rains<sup>1</sup> (LR) growing season.<sup>2</sup>

It is important to note that during May-June 2013, the average precipitation across Kuria West totaled 13 mm (0.5 inches) or roughly 13 percent of the expected average. This drought occurred during the grain filling and kernel development stages, one of the most water-sensitive times for maize. Consequently, the reduction in precipitation corresponded with a reduction in crop yields throughout the region as indicated in this report.

For 2013, the results of the maize harvest yield data collected show that both Nuru and non-Nuru farmers' crop yields decreased from the baseline year of 2011. Nuru farmers averaged 2.95 maize bags per acre in 2013 LR compared to 5.81 bags per acre at baseline in 2011 LR.<sup>3</sup> Non-Nuru farmers respectively averaged 2.62 bags per acre compared to 7.01 bags per acre. The greater decrease among non-Nuru farmer crop yields indicates that the Nuru program likely contributed to a 13 percent yield advantage relative to non-Nuru farmers. This may be due to improved seed varieties used by Nuru farmers and other extension services such as farmer trainings and periodic visits by Nuru Agriculture Field Officers.

The following report presents the details of the 2013 harvest yield survey and includes the results of the decrease in crop yield on agricultural income (another core metric of the Nuru Kenya Agriculture Program). Recently collected food security data is also presented to complement the harvest yield data and paint a broader picture of the impact of the Nuru Kenya Agriculture Program.

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<sup>1</sup> In Kuria West district, Kenya, there are two main growing seasons – a short rains and long rains season. The short rains season occurs from around September–December; while the long rains season occurs from February–August.

<sup>2</sup> This report refers to the comparison group as non-Nuru farmers, while the term Nuru farmers refers to the intervention group of both new and returning Nuru farmers.

<sup>3</sup> For maize trade in Kuria West, Kenya, 90 kg bags are used as the standard unit of measurement for buying and selling maize.



## Methodology

In the 2013 LR season, 5,505 farmers participated in Nuru Kenya's Agriculture Program to cultivate maize in Kuria West District, Kenya. A representative number of new and returning farmers were surveyed to better understand the sustainability of Nuru yields over time. Of the 5,505 Nuru farmers, 3,437 (62.5 percent) were new to Nuru in 2013, while 2,068 (37.5 percent) were returning Nuru farmers.

## Sampling Frame

The survey sample incorporated data from three groups of farmers and included a comparison group. Those groups included:

- New Nuru farmers (intervention group)
- Returning Nuru farmers (intervention group)
- Non-Nuru farmers (comparison group)

Nuru Kenya's M&E team collected a statistically significant sample size of 642 farmers in the intervention group, for a 99 percent confidence level. To remain consistent with the previously conducted maize harvest yield survey in 2011 and 2012, the sample of farmers was geographically and randomly stratified by sublocation to ensure there were enough farmers in each stratum to be able to make meaningful comparisons across sublocations. An additional 10 percent was added to the sample size for each group to account for absenteeism and potential outliers.

## Data collection

For the 2012 harvest, the Nuru Kenya M&E team collected baseline data for both new Nuru farmers (intervention group) and non-Nuru farmers (comparison group) of the 2011 LR yields. After harvest, follow-up yield data were collected to assess the impact of the Nuru Kenya Agriculture Program.<sup>4-5</sup>

In 2013, Nuru Kenya's M&E team employed two full-time Field Managers (FM), two full-time Field Officers (FO) and contracted eight temporary Enumerators to carry out data collection efforts. Data were collected from farmers to calculate the number of 90 kg bags harvested per acre.<sup>6</sup> Farmers self-reported the number of bags they harvested in 2013. Acreage for each field was measured with pacing using Global Positioning System (GPS) devices. The number of maize bags was then divided by acreage utilized for Nuru farming to calculate bags per acre.

Additional data were also collected, including age, gender, educational level of each farmer, seed varieties, soil type, land drainage (water table), climate information, and the GPS coordinates of each field location. Data on alternate crop cultivation and market accessibility was also collected.

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<sup>4</sup> Yield data are collected through recall, which means that farmers report data based on what they remember harvesting. This could result in recall bias, or error in the results due to over- or underestimates of actual harvests.

<sup>5</sup> The largest study comparing crop cuts and farmer estimates to whole-plot reference harvests found that when area estimates have minimum error, "the mean farmer recall estimates not only were closer to the actual recorded production, but they also displayed less variance." From: Verma, V., T. Marchant, C. Scott. 1988. Evaluation of Crop-Cut Methods and Farmer Reports for Estimating Crop Production: Results of a Methodological Study in Five African Countries. London: Longacre Agricultural Development Centre Ltd.

<http://www.ifpri.org/sites/default/files/publications/ifpridp01097.pdf>

<sup>6</sup> For maize trade in Kuria West, Kenya, 90 kg bags are used as the standard unit of measurement for buying and selling maize.



A stratified random sample was implemented by randomly selecting Nuru farmers proportionally from the 11 sublocations in which the Nuru Kenya Agriculture Program implemented the program in 2013. The sample included a representation of new and returning farmers, to measure sustainability of yield over time. Data were collected from 398 new Nuru farmers and 244 returning Nuru farmers. The breakdown of Nuru farmers surveyed by sublocation is presented in Table 1 below.

**Table 1: Number of Nuru Farmers Surveyed in Intervention Sublocations by Year**

<b>Sublocation</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Ihore	112	166	153
Moheto	56	76	130
Komosoko	50	57	66
Ngochoni	101	137	98
Nyabikaye	12	29	10
Nyamaharaga	14	29	2
Nyametaburo	3	20	2
Nyangiti	9	38	12
Nyamaranya	14	18	21
Nyamotambe	87	85	116
Ngisiru	40	41	32
<b>Total</b>	<b>498</b>	<b>696</b>	<b>642</b>

The sampling frame for the 2013 comparison group was calculated similarly, as in 2012, to collect a statistically significant sample of the same villages<sup>7</sup> through a stratified random sampling technique. An additional 10 percent was added to account for absenteeism and potential outliers. The breakdown of non-Nuru farmers surveyed is represented in the table below.

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<sup>7</sup> Village population data are taken from 2009 Kenya Census data from the Kenya National Bureau of Statistics, Population and Housing Census. Retrieved 13 November 2013 from <http://www.knbs.or.ke/population.php>.

**Table 2: Number of farmers surveyed in the 2013 comparison group**

Sublocation	Villages	# of Farmers Surveyed 2013
Getong'anya	Nyamrarangere A	5
Getong'anya	Roturuni A	5
Masaba	Bohorera B	27
Masaba	Bohorera C	26
Masaba	Bohorera E	17
Masaba	Masaba A	29
Masaba	Masaba C	16
Masaba	Masaba E	17
Masaba	Rowambura Osinda	11
Nyanchabo	Gontatumu	14
Nyanchabo	Gosoho	132
Nyanchabo	Kwinyanki	57
Nyanchabo	Masurura A	99
Nyanchabo	Nyamekongoroto A	126
	<b>Total</b>	<b>581</b>

## Timeline

Below is the timeline carried out by the Nuru Kenya M&E team to implement the survey.

- Enumerator training: Thursday, August 29, 2013
- Data collection: Monday, September 2 – Friday, September 20, 2013
- Data entry: Monday, September 2 – Friday, September 27, 2013

## Analysis

Following data entry, data were analyzed using descriptive statistics and testing for statistical significance. Stata and Excel were used for analysis. Outliers were removed for farmers who reported more than 20 bags per acre. Such yields were not feasibly obtainable by Nuru farmers due to the drought in the 2013 LR season.

## Approach to Calculating Agricultural Income

In 2012, Nuru International developed a methodology to determine the overall increase in revenue and agricultural income for Nuru farmers due to Nuru Kenya’s Agriculture Program. With its theoretical basis on farm gross margin analysis, a tool for planning agricultural investments,<sup>8</sup> and limited to inputs costs (while excluding labor and land opportunity costs to farmers before and after farming with Nuru), this approach aims to represent the production costs Nuru and non-Nuru farmers incur from one season of maize cultivation in order to calculate the average agricultural income gains of farming with Nuru.

<sup>8</sup> Gross Margin Analysis Tools. Retrieved 31 Oct. 2013 from <http://www.dpiw.tas.gov.au/inter.nsf/WebPages/LBUN-8M589T>



More specifically, average agricultural income gains (the core metric of this approach) are calculated by comparing the income (total revenue-total costs) of farming maize with Nuru Kenya with the income (total revenue-total costs) of farming maize without. Where costs are incurred in Kenyan shillings (KSh) and revenues are earned in bags of maize, the common conversion unit of 2,430 KSh equals one 90 kg bag of maize is applied. This methodology is comparable to other organizations that measure this indicator, notably One Acre Fund.

## Results

### 2013 Maize Yield Results<sup>9</sup>

Nuru farmers, on average, harvested 0.33 more bags per acre (See Table 3 below) for a 13 percent increased yield from the comparison group in 2013 LR (p-value: 0.02) (See Table 4 below).

**Table 3: 2013 Maize Yield Results**

Population	Average 90 kg Bags per Acre	# of HHs surveyed	Margin of Error
Nuru	2.95	642	+/- 0.10
Non-Nuru	2.62	581	+/- 0.10
Difference	<b>0.33</b>		

A majority of farmers, approximately 88 percent of Nuru farmers and 97 percent of non-Nuru farmers, reported drought conditions during the 2013 LR.<sup>10</sup> This is supported by rainfall data from satellite imagery provided through NOAA and IRI.<sup>11</sup> The agricultural drought is noted throughout much of East Africa by FEWS NET.<sup>12</sup> All Nuru sublocations in Kuria West experienced drought conditions in the 2013 LR season, specifically from early May to late June.

The M&E team performed a regression analysis and determined that gender and flood-prone farming land are the most significant contributors to agricultural yields, holding other factors constant. This analysis also showed that on average, males have 0.40 bags per acre higher yields than females (p-value 0.04). Farmers who reported using flood-prone land have 0.6 bags per acre less than farmers in non-flood prone areas.

Other factors including education, drought, soil type, seed type, and participation in Nuru were not significant contributors to yield in 2013.

### Comparison with Baseline

Due to extreme adverse weather in 2013, both Nuru and non-Nuru farmers' yields decreased from the baseline year of 2011. Non-Nuru farmers' yields decreased more than Nuru farmers' yields, indicating the

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<sup>9</sup> Data sources and analysis files are available upon request.

<sup>10</sup> The basis of this question is on "perceived" drought. Additional research confirms that in fact, the full geographical area covered by this survey experienced drought.

<sup>11</sup> For additional information see: [http://www.cpc.ncep.noaa.gov/products/fews/AFR\\_CLIM/AMS\\_ARC2a.pdf](http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/AMS_ARC2a.pdf) and [ftp://ftp.cpc.ncep.noaa.gov/fews/AFR\\_CLIM/ARC2/ARC2\\_readme.txt](ftp://ftp.cpc.ncep.noaa.gov/fews/AFR_CLIM/ARC2/ARC2_readme.txt)

<sup>12</sup> [http://www.fews.net/docs/Publications/East\\_Seasonal\\_Monitor\\_07\\_2013.pdf](http://www.fews.net/docs/Publications/East_Seasonal_Monitor_07_2013.pdf)





Nuru program may have contributed to a 13 percent yield advantage relative to non-Nuru farmers. This may be due to improved seed varieties used by Nuru farmers and other extension services such as farmer trainings and periodic visits by Nuru Agriculture Field Officers.

**Table 4: Difference-in-Difference Yield Results**

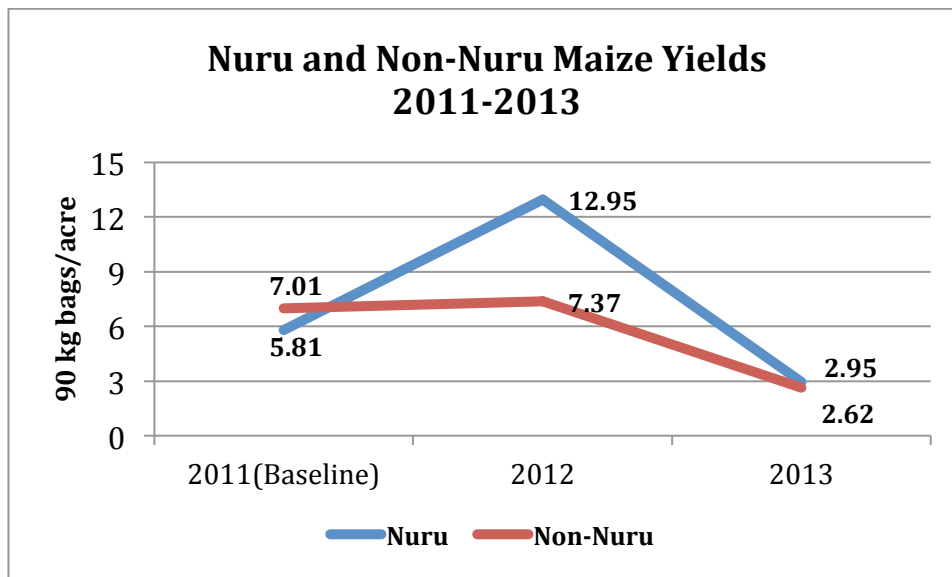
90 kg Bags/Acre	2011 Average	# Surveyed	2013 Average	# Surveyed	Difference
<b>Nuru</b>	5.81	498	2.95	642	-2.85 (-49 percent)
<b>Non-Nuru</b>	7.01	460	2.62	581	-4.38 (-62 percent)
Difference-in-Difference					<b>1.53 (13 percent)</b>

The regression analysis supports this difference when controlling for gender, age, drought, and sublocation. It was assumed that no drought occurred in 2011 for Nuru and non-Nuru farmers, based on NOAA rainfall data for the sublocations. The regression found that education levels of farmers is not a significant variable; also soil type and flood-prone land data are not available for 2011 Nuru farmers.

### Comparison to 2012

Nuru farmers had high harvest yields in 2012 LR with an average of 12.95 bags per acre in comparison to the 2011 baseline (5.8 bags per acre). In 2012, non-Nuru farmers yielded around 7.37 bags per acre. As previously noted, due to extreme adverse weather in 2013, both Nuru and non-Nuru farmers' yields decreased dramatically in 2013 (See Table 5 below).

**Table 5: Nuru and Non-Nuru Maize Yields 2011-2013**



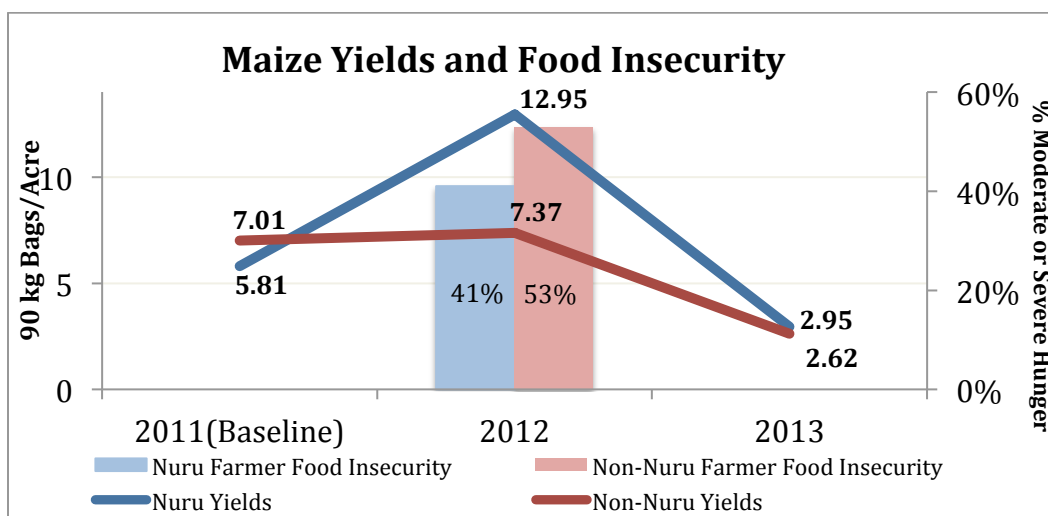


## Household Hunger

Household hunger levels were also measured in 2013 using USAID’s Household Hunger Scale<sup>13</sup> among non-Nuru and Nuru farmers during the hunger season of May-July that precedes the harvest in August.<sup>14</sup> The Household Hunger Scale captures farmers’ experiences of hunger after the previous harvest, corresponding with the 2012 short rains growing season. The non-Nuru farmers assessed for this survey became Nuru farmers in the 2013 season and had not participated with Nuru previously.

Of the non-Nuru farmers’ households, 53 percent reported “*Moderate to Severe Hunger*” while 41 percent of Nuru farmers reported “*Moderate to Severe Hunger*” (See Table 6 below). Additional details can be found in the Nuru “*Household Hunger Survey Report*” which is available upon request. The same survey will be repeated in June 2014 to understand if food security will be affected by the low 2013 maize yields.

**Table 6: Nuru and Non-Nuru Maize Yields and Food Insecurity**



## Results of Agricultural Income Calculation

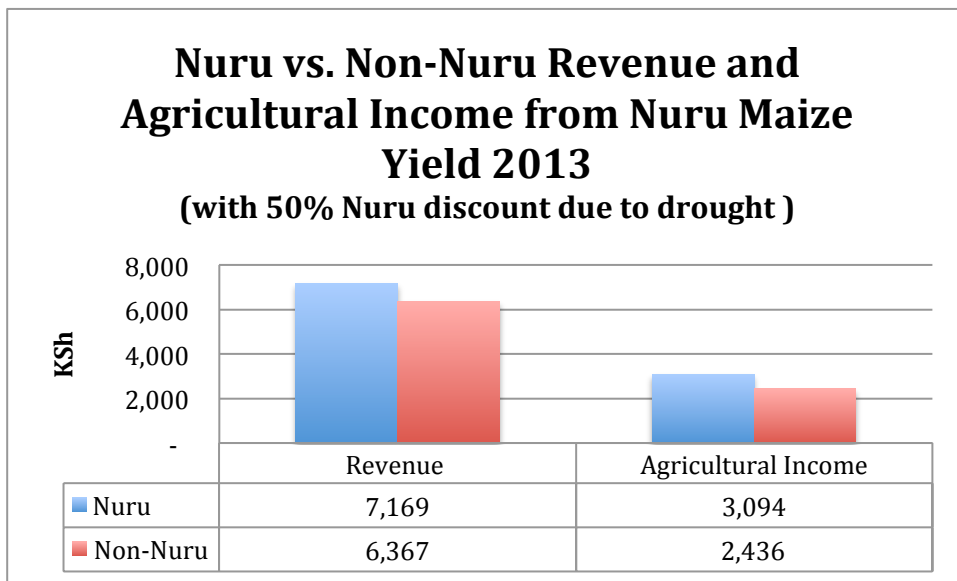
Results of the agricultural income calculation developed by Nuru International indicate a 49 percent decrease in revenue and a 70 percent decrease in agricultural income from baseline yield (2011) for Nuru farmers due to the drought. Compared to non-Nuru farmers in 2013, Nuru farmers experienced a 13 percent increase in revenue and a 27 percent increase in agricultural income with the 50 percent loan discount provided by Nuru Kenya (See Table 7 below).

<sup>13</sup> Ballard, Terri; Coates, Jennifer; Swindale, Anne; and Deitchler, Megan. Household Hunger Scale: Indicator Definition and Measurement Guide. Washington, DC: FANTA-2 Bridge, FHI 360.

<sup>14</sup> Traditional hunger seasons in Kenya span from May-July and again from November-December.



**Table 7: Nuru vs. Non-Nuru Revenue and Agricultural Income from Agriculture Maize Yield 2013**



## Limitations

Baseline yields in 2011 LR harvest were based on recall. Recall bias may have occurred as farmers may have inaccurately over- or underreported their harvest yields.

Nuru and non-Nuru farmers use different maize seed types. The large variety of non-Nuru seed types cannot be well represented in the regression model. This effect is implicit in the Nuru to non-Nuru coefficient, therefore causing some level of error in the analysis of results.

In addition to severe drought in Kuria West, all of Kenya suffered from Maize Lethal Necrosis Disease (MLND). Though the vast majority of Kenya was affected by MLND and other maize diseases, only 1.6 percent of Nuru farmers were affected. This report does not exclude data from farmers who may have slashed and burned their fields from MLND in the analysis given it was a small number.

## Conclusions and Recommendations

In 2013, Nuru farmers in Kuria West district experienced lower crop yields than at their 2011 baseline due to a drought that affected the region. Despite these conditions, evidence indicates that Nuru farmers were able to harvest 0.33 more bags per acre for a 13 percent advantage over their non-Nuru farmer comparison.

For the 2014 season, the Nuru Kenya Agriculture team is diversifying their input loan portfolio to include drought-resistant crops (see Appendix A for further detail). This diversification strategy aims to strengthen farmers’ resilience to future shocks as well as increase the sustainability of the Nuru Agriculture intervention over time.



Other recommendations for Nuru's M&E and Agriculture teams to consider in future planning in Kenya and other Nuru projects are as follows:

- Measuring the crop yields of Nuru harvests over multiple seasons to ensure yields are maintained and the Nuru Agriculture intervention is sustainable;
- Continuing to stay abreast of best practices in sustainable agriculture;
- Measuring the vulnerability of Nuru farmers to better understand how Nuru farmers cope with economic shocks, like droughts or pests, in comparison to non-Nuru farmers.

Overall, the season was a difficult one for farmers and households throughout Kuria West and East Africa generally. Farmers experienced a poor harvest which will likely result in rippling effects for months to come. Nuru Kenya will continue to monitor the situation and use its integrative community development approach to mitigate this shock.



## Appendix A: Lessons Learned for Nuru Kenya's Agriculture Program

In preparation for 2014, Nuru Kenya's Agriculture Program is implementing a multi-faceted approach to risk management incorporating best practices. This will further build the resilience of Nuru Kenya and farmers to agricultural risks. Core components of this are the following:

- *Risk reserves:* Nuru International is building an operational cash reserve for Nuru Kenya.
- *Smart risk-taking:* In 2014, Nuru Kenya is offering a significantly more drought and disease resistant crop production package (finger millet, brown sorghum, maize and grevillea trees) on loan. Crop diversification limits risks for Nuru farmers and the Nuru Kenya loan portfolio as a whole.
- *Risk reduction:* Nuru Kenya will limit the acreage of agriculture loans. Also, Nuru Kenya is promoting best agricultural practices so that crops grow better and healthier.
- *Risk transfer:* Nuru Kenya is exploring the acquisition of crop insurance for the 2014 season to transfer risk from Nuru farmers and Nuru Kenya to a third party.