Impact Assessment Report[1]

Raising the Incomes of Smallholder Farmers in the Central Highlands of Angola:

A Model Project for Improving Agricultural Value Chains in Post-Conflict Nations

ProRenda Project

Report to World Vision

2013

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[1]This report was written under contract for World Vision Incorporated (WVUS), as a subcontract under PRORENDA project, funded by the Bill and Melinda Gates Foundation (BMGF). The document does not reflect the views of WVUS nor of BMGF. It also does not reflect the official views of Michigan State University.

Acknowledgments

The authors would like to thank the staff of World Vision Angola in Huambo and in Luanda for all the support and encouragement. Moises Lima and his team in Huambo, especially the Monitoring and Evaluation team led by Jose Amandio Paulino, provided excellent input and assistance in completing the training and implementation of the survey. Thanks also go to Luis Lopes from Mozambique, who designed and help to train and implement the data entry system, based on systems designed at the Ministry of Agriculture in Mozambique.

Most of all, thanks for the farm families that gave their time and shared knowledge of their lives as Angolan agriculture moves forward.

Executive Summary

World Vision implemented the ProRenda project in the Highlands area of Angola from late 2008 until early 2013. To assess the impacts of this project, a baseline survey was conducted in 2009 and then an end of project (EOP) survey was conducted in early 2013 with the same households. The surveys were designed to capture household and individual level characteristics in two periods to assess the impact of the ProRenda project. Community level surveys were also conducted to identify changes in infrastructure and other aspects between the two periods.

A key challenge in the surveys is the sampling in a country with no census and little administrative information available, where landmines restricted access to villages, and where skilled human resources for survey implementation were extremely limited in Huambo and the central Highlands. The sampling realization in 2009 showed limited numbers of participants, and then in the EOP survey in 2013, the numbers continued surprisingly low. While the EOP survey had attrition in the sample that diminishes the number of observations that we could use for comparison, there was no sign of attrition bias and we did not require inverse probability weighting or other analytical methods to adapt the analysis to such bias. The consequences of attrition on analytical power are strong, especially for aspects with high variability, such as incomes. A relatively rare drought event occurred during the 2011/2012 cropping year, adding yet another aspect to confound impacts and attribution of changes.

The analysis here uses a difference in differences (DID) approach, comparing the changes from 2009 responses to 2013 responses at the household level between households in the various strata. This approach is based on the idea that ProRenda and non-ProRenda households may have experienced overall improvements due to changes in the economy or other factors; thus, the see the differential impact of ProRenda (or gender of head or participation in a farmer organization), it is necessary to evaluate how the changes experienced by ProRenda households differ from the changes of other households. The limited number of cases for participating ProRenda farmers and for farmers marketing production in both years of the survey constrains our ability to use more advanced econometric methods for estimating impacts, although additional analysis is ongoing.

For the communities, between 2008 and 2012 cropping seasons was a period of heavy public investment in infrastructure, especially roads. Road rehabilitation might play a role in access to inputs and commercialization of agricultural products, and primary villages clearly benefited from investments, with 40% of primary villages along rehabilitated roads (gravel or paved) compared to 14% of control villages along rehabilitated gravel roads and none along paved roads at all. Secondary villages benefited from road rehabilitation, mostly gravel. Many villages benefitted from access to input and output markets, with primary villages generally showing higher rates of access to inputs for potatoes and potato output markets.

As mentioned above, a key factor in production is weather and in 2011/2012 production cycles, a rare major drought occurred in much of the highlands of Angola. As community leaders indicated, losses were felt for all the crops evaluated here, and losses in beans were often catastrophic. Since the drought affected all types of villages, the impact is expected to lower production and income across the region, and reduce the production potential for all farmers, regardless of ProRenda. There remain challenges: ProRenda activities to promote market development may have resulted in changes benefitting many farmers, not just ProRenda farmers. For example, if ProRenda extension agents facilitated more traders arriving in a market to establish greater competition in prices, all farmers in that market benefit. The same is true for access to inputs in local markets. Ideally, comparing farmers in ProRenda primary villages (or primary and secondary villages) to the famers in control villages would provide this analysis, but the control villages faced road and other constraints making them less comparable to ProRenda villages than should be the case. Thus, spillovers

may reduce the estimated effects of ProRenda, while the use of the control villages may over-estimate the effect of ProRenda.

Using the difference in difference approach to control for the general economic and environmental shifts between 2008 and 2012, we found evidence of ProRenda having impacts on production, marketing and incomes of households, especially in the primary villages, in spite of the 2011/2012 drought. A review of the gross crop margins for potatoes, onions and beans combined shows that households throughout the region were able to increase their total gross margins dramatically (by over 250%) in real 2012 kwanzas, thus accounting for inflation, based on the households remaining in the sample between 2009 and 2013 surveys. While increases for ProRenda participants were an average of 430% of the 2009 estimate, nonparticipants also increased gross margins an average of 340%, such that the changes do not show a significant difference. Women-headed households significantly increased their total costs with investments in seeds and fertilizers across these crops, although the increases in receipts and in gross margins were not significantly different from the male headed households.

In general, ProRenda and other farmer organizations contributed to the increase in production of potatoes for participating farmers, in spite of the drought. By 2012, ProRenda participants averaged almost 1400 kgs of potatoes per households, with nonparticipating households at 628 kgs, however the increase did not show a significant DID as both groups had increased production from 2008. ProRenda participants had significantly larger increases in production costs than nonparticipants, as well as obtaining a significantly greater price increase per kg of potatoes. ProRenda farmers also saw a significant growth in percentage of the potato production that was marketed compared to nonparticipants. Female-headed households achieved higher prices (increasing prices significantly more) and significantly larger positive change in costs of production per kg of potatoes compared to male-headed households, indicating increasing access to purchased production inputs. ProRenda literacy and numeracy programs may have played a role in those achievements.

The drought strongly affected beans and so the results show overall reductions in bean production per household across the region. Participation in ProRenda or in farmer organizations generally did not demonstrate significant differences in the changes between 2008 and 2012 production years for beans.

ProRenda sought to improve production technologies for the key crops and that included improved access to and knowledge of purchased inputs, including fertilizer, pesticides, and seeds. Since improving access to these inputs in the markets contributes to higher potential use by all farmers, it was difficult to attribute changes at the household level. The average quantity of fertilizer used by potato farming households increased across the types of farm households, as well as the percentage of farmers using, especially among the nonparticipants in ProRenda as a result of access changes. Given the drought and its effects on beans, it was surprising to see an overall increase in farmers using fertilizers for beans, especially among the ProRenda farmers. Use of fertilizers and pesticides on onions continued among participants and nonparticipants. In a related aspect, credit use remained very low between 2008 and 2012 and the drought could be an exacerbating factor, reducing demand for inputs and labor. ProRenda participants were more likely to obtain credit than other farm households, although credit constraints were high in the latter period.

Marketing strategies for the three key crops changed between 2008 and 2012, as fewer households used traders as their primary source of market information. A few households indicated that radio and farmers associations were their primary source of information, but these sources are relatively new and likely to be considered secondary sources until their reliability is well known. More farmers established relationships with traders that enabled

them to sell potatoes and onions directly from their fields and still get a good price, whereas for beans, farmers tended to shift from local selling to sales in more distance markets for a better price. These are the types of marketing strategies that ProRenda sought to develop. While marketing tends to occur directly after harvest, it appears that farmers are using planting and other management practices to ensure harvest at the time of high prices. For example, onion sales in December increased, responding to seasonal demand, even though farmers indicate selling timing due to harvest, not prices.

When households were asked to assess the impact of the drought, it was clear that beans were the most heavily affected crop, followed by potatoes and then onions. Reductions in labor, fertilizers and pesticides were reported as responses to the drought, with 50% or more of households reporting lower harvest in 2012 compared to 2011 for each of the three crops. While the drought negatively affected overall agricultural production, the majority of households still reported that food consumption remained the same or improved. In ProRenda primary villages, when asked to compare 2012 to 2011, 45% of households said that food consumption was better in 2012, compared to 23% of control households indicating 2012 was better, although the difference was only significant when comparing ProRenda participants to nonparticipants. For those indicating that 2012 was better, households indicated better nutrition through increased staples and more protein (meat and fish).

The overall noted increases in gross margins led many households to invest. Assessing the percentage of households investing in different aspects, we find that ProRenda participants were more likely to invest in agriculture, vehicles, electronics and food/diet than nonparticipating households. The estimated impact on investment decisions of ProRenda participants was significant, with participation generating a 19% increase in the likelihood of investing in agriculture.

Female-headed households and individuals demonstrated several positive trends in this research. Women were more active as sellers for all the crops, especially in the primary villages where ProRenda operated. In ProRenda primary villages, women were the primary sellers of potatoes by 2012. Women also gained more control over the sales of beans in the primary and secondary villages between 2008 and 2012. They tended to increase their use of purchased inputs in each of the crops, and were able to see higher increases in prices obtained than male-headed households. For beans, female-headed households significantly increased their seeds planted compared to male households and increased their prices received more than male-headed households.

Given the challenges to the sampling and survey implementation, as well as programmatic changes and drought, a large investment in a post-project impact survey in 2015 may not be justified. High attrition rates, especially among those households that were participating farmers for ProRenda, could threaten the ability to determine significant impacts of the project over the longer term. Research methods on impact evaluation are evolving rapidly and additional analytical work may be merited, with care taken based on the sample numbers. DID approach taken in this report should be complemented by more multivariate analysis to determine impacts, and that requires an increased investment in analytical time.

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ACRONYMS

ATT	Average Treatment Effect on the Treated
DEFF	Design Effect
DID	Difference in difference
EOP	End of Project Survey
FO	Farmer Organization
Kgs	Kilograms
Kw	Kwanzas (Angolan currency)
MINAGRI	Ministry of Agriculture
MSU	Michigan State University
NGO	Non-governmental organization
TLU	Tropical Livestock Unit
WV	World Vision

1. Introduction

In 2008, the Highlands area of Angola, known as the Planalto Region, was recognized as a potential source of agricultural growth for smallholder farmers, with fertile lands, rainfall and above ground water availability to cultivate two or three seasons per year given flood recessional lowlands, uplands and the sloped areas. In this context, World Vision received support from the Bill and Melinda Gates Foundation to develop the ProRenda Value Chain program in the Planalto Region over a period of five years.

A key component of the project was to develop systems for impact evaluation of program activities based on current research methods and empirical approaches. This report provides a summary of the results of the End of Project (EOP) rural household survey conducted in early 2013 and compares those results to the Baseline survey undertaken in 2008/2009. The key objective of the combined surveys is to evaluate the change in selected indicators to understand the impacts of ProRenda on rural households and learn the lessons for such work in Angola and elsewhere. The changes observed between 2009 and 2012 at the household level for households that participated in World Vision activities are compared to nonparticipants, based on primary, secondary and control villages. A gender lens is also applied in the comparisons.

The report has the following structure. This brief introduction is followed by a background chapter on project objectives and indicators. It is followed by Chapter 3 with an overview of the survey design and challenges. The remaining chapters present comparative survey results, challenges and recommendations.

2. Background on Angola and the ProRenda Project[2]

As stated in the initial project documents, World Vision ProRenda sought to ensure that "smallholder farming families in the central highlands of Angola will increase their incomes from potatoes and other high-value crops by establishing and maintaining competitive value chains through (1) improved marketing of produce for major urban markets, (2) improved organization of farmer associations to operate as a business, and (3) increase yields, quality, and the regularity of production" (World Vision 2008)[3].

The ProRenda project evaluated the value chain for the selected crops of Irish potatoes, beans, and onions to identify the interventions needed to remove constraints and increase efficiencies in the key segments of each value chain. Based on that, the project focus on key constraints and opportunities common to the targeted value chains: 1) market information (wholesale/retail constraint; 2) product quality enhancements to meet market demand; 3) access to inputs through formal sector supply contracts; and 4) access to improved production technologies[4]. For the farm households, literacy and numeracy were also important areas for improvement.

The goal was to reach 100,000 smallholder-farming families in Angola's central highlands, increasing their annual income from potatoes and other high-value crops. Based on the program of activities, ProRenda worked to assist a minimum of 27,000 smallholder families, (22,000 primary beneficiaries in directly-assisted villages and 5,000 of secondary

[2] This section relies heavily on the World Vision ProRenda Project (WV 2008) document submitted to the Bill and Melinda Gates Foundation.

[3] See pages 12 and 13 of the ProRenda Grant Proposal for details.

[4] For a list of additional key constraints and opportunities, see Table 8 of the ProRenda Grant Proposal.

beneficiaries in villages indirectly assisted by the project), with women beneficiaries projected to be 60 percent of the beneficiaries. They sought to double household incomes[5] by establishing competitive value chains for these crops. When projected over the economy, the proposal stated that "the project would generate an additional gross income of US$50 million for 22,000 [directly assisted] farmers by the end of project"[6].

Project performance indicators

Appendix A of the ProRenda Project document includes a listing of the Performance indicators for which the project will be evaluated. With the household surveys, the following key indicators were to be evaluated:

1) Farmer value of cash sales and gross cash income and margins.[7]for the selected crops
2) Increase in farmer production for the market for selected commodities
3) Household expenditures on health and education, as well as assets
4) Farmer capacity building in marketing and access to market information
5) Farmer access to farmer associations, technology, and credit
6) Gross margins for the selected commodities (potatoes, beans, onions)
7) Secondary benefits on food security, assets, nutrition
8) Women's participation in marketing decisions

The indicators will be assessed for male and female headed households, and selected indicators will involve intra-household determinations. The survey was not designed for detailed intra-household gender assessments on all components.

3. Overview of the Baseline and End of Project surveys

3.1. Survey objectives

The Baseline survey and the End of Project (EOP) survey were designed as tools to complement and add value to other monitoring and evaluation tools used by the ProRenda project. The principal purpose of the two surveys is to measure change in key indicators for assessing impact, and those indicators are detailed above. The Baseline Survey was conducted in 2009 prior to major project activities in the zone, and the EOP Survey was conducted in Feb-March 2013, two months after the end of most project activities under ProRenda. Comparative analysis of results for the 2008 agricultural year and the 2012 agricultural year for each household were conducted based on three strata of villages and two sub-strata of households (male and female headed households; households participating or not in farmer organizations), although analysis may be limited by sample numbers. Community level surveys were conducted in 2009 and 2013 to capture information on basic infrastructure and other characteristics, as well as to get perceptions of local leaders concerning the drought which occurred in 2011/2012.

[5] Actual percentages based on initial baseline income survey.

[6] See ProRenda Grant Proposal, Appendix A: Project Objectives and Outcomes.

[7] The terminology in this and other project documents is not consistent with respect to these income variables as the "gross margins" are sometimes referred to as "net crop income". Gross margin is a better term to use as what we are subtracting out as costs are only the costs of variable inputs (primarily seed, fertilizer, pesticides, and marketing costs). These gross margins can be viewed as the returns to family labor, land, and equipment investments; strictly speaking, "net income" would reflect the amount of income left after also subtracting these latter costs from gross receipts.

In the impact evaluation analysis, to be able to attribute results to ProRenda activities, the panel data collection is critical to control for the unobserved heterogeneity in the households, while the counterfactual of "without the project" outcomes will be identified with secondary and control villages compared to primary villages, as well as participants and non-participants. There will still be limitations in the analysis due to possible problems with selection of control villages, externalities of the project on nonparticipants, and other aspects. This will be discussed further in the brief methodology section after the discussion on the sample design and realization and under research results.

3.2. Sample design

The baseline sample was designed in 2008/2009 by first purposively selecting target geographic areas (Provinces, Communes, and Municipalities), developing village lists for these target areas, classifying villages into categories required by the primary sample stratification design (see below), randomly selecting the required number of villages for each sample strata, development of a farm family listing for each selected village, classifying families into categories required by the secondary sample stratification design (see below), and random selection of families from this last list for each secondary strata. The EOP Survey revisited the same households, where possible, in 2013.

The geographic areas of interest for this survey are those in or near the ProRenda project area in the provinces of Huambo (Caala, Bailundo, Londuimbali, Katchiungo, Ekunha, and Tchicalachuluanga municipalities[8]), Bie (Chinguar municipality) and Benguela (Babera municipality). For both the Baseline and the EOP Survey, community-level surveys were conducted by supervisors in each village and include information on infrastructure, economic activities, and other key aspects. These surveys help to control for changes in the overall environment for households and were conducted at the same time as the household surveys.

As described in the baseline report, the surveys focused on farming families producing horticultural crops, particularly potatoes, common beans, onions, carrots, and cabbages. The sample was stratified based on three criteria[9]. Primary stratification was based on a classification of villages into three categories:

- Primary Villages[10]: Villages expected to be direct participants in the early phases of the ProRenda project, many of which had already established WV producer associations in 2009
- Secondary Villages: Villages expected to be indirect beneficiaries of the ProRenda project due to smaller scale interventions during project years 2 and 3 and spillover benefits from the direct participants; the expectation was that these villages would have few, if any, producer associations at the time of the survey and no WV associations, although increasing the potential as the project moved forward.

[8] A municipality in Angola is an administrative term similar to districts in Mozambique or counties in the United States. It does not refer to a solely urban area, although the name of the municipality is usually the same as the key urban area in that administrative area. For example, Caala municipality has the city of Caala as its main urban center and place of government offices for the municipality.

[9] See point 3.2 of this document for details.

[10] The terms "primary" and "secondary" are often used with sample selection, but here we use the terms relative to World Vision's use of primary villages as those with direct WV intervention and "secondary" villages as those who would only indirectly benefit from WV interventions, with farmer to farmer contact. WV will have direct efforts in one set of villages (primary) and anticipates more indirect impact through farmer to farmer contact for the secondary villages.

Table 1 Sampling design and realization, by gender of household head, village type and participation in farmer organizations

Village type	Ag. Year	Classification	Num. of villages	Female-headed households		Male-headed households		Total
				Partici-pants	Non-partici-pants	Partici-pants	Non-partici-pants	
				(sample numbers)				
Primary								
	2008	Proposed	16	64	64	64	64	256
		Realized	16	16	108	22	110	256
		Valid Surveys	-	16	102	22	107	247
	2012	Proposed	16	64	64	64	64	256
		Realized	15	19	77	34	67	196
		Valid Surveys		19	76	34	67	195
Secondary								
	2008	Proposed	16	64	64	64	64	256
		Realized	17	14	121	23	114	272
		Valid Surveys	-	14	112	22	110	258
	2012	Proposed	16	64	64	64	64	256
		Realized	17	14	80	34	87	215
		Valid Surveys		14	76	34	84	208
Control								
	2008	Proposed	8	0	80	0	80	160
		Realized*	8	0	64	0	64	128
		Valid Surveys[1]	-	0	57	0	58	115
		Valid surveys reclassified[1]		12	45	9	49	115
	2012	Proposed	8	0	80	0	80	160
		Realized	7	1	42	2	38	83
		Valid surveys		1	42	2	38	83
Total								
	2009	Proposed		128	208	128	208	672
		Realized	41	30	293	45	288	656
		Valid Surveys	40	30	271	44	275	620
	2012	Proposed		128	208	128	208	672
		Realized						495
		Valid Surveys	39	34	194	70	189	487

Source: ProRenda survey, 2009 and 2013

NOTE: 12 observations correspond to village 1512012 QUINZE II, which was not included in the analysis for 2009 but are included for analysis for 2009 and 2013 with imputed weights.

- Control Villages: Villages where no WV activities are planned and WV staff felt there were few, if any, functioning producer associations at the time of the survey.

There were two additional criteria for sampling: sex of household head and whether or not the household participated in producer associations. These criteria were used to ensure sufficient numbers of households for analysis, based on the project objectives. Thus, with the village listings, the second level of stratification simultaneously took into account sex of

household head and whether or not the household participated in producer associations. There was no random assignment of participants to the program and this was not designed as a fully randomized control experiment.

3.3. Realization of sampling strategy

As was discussed extensively in the Baseline Report, the proposed sampling strategy was not fully achieved in 2009 and then in 2013 there were additional challenges. Since the EOP Survey revisited the households from the Baseline, it is important to revisit the sample as it was achieved at the time of the Baseline. Table 1 shows the different sub-populations of interest and anticipated number of respondents in each category as well as what was achieved in 2009 and then in 2013 with the revisit. In particular, in 2009, we were unable to meet fully the proposed secondary strata composition in most of the villages due to insufficient numbers of female-headed households and of households with participating association members.[11]Then in 2013, when participating farmer numbers were expected to have substantially increased, especially in the primary villages, we find moderate increases. Only a total of 21 percent of sample households (104 out of 487) households reported participation in ProRenda. Therefore, it is not surprising that for the primary villages there are a total of only 3 more female-headed participant households and 12 more male-headed participant households in 2013 compared to 2009. For the secondary villages we have no change in the number of female-headed participant households and just an increase by 11 households for male-headed households. This could have happened for various reasons. First, the interviewed households in 2013 did not know that ProRenda (World Vision) was the organization promoting the groups and activities in which they were participating. Second, problems out of the control of ProRenda (e.g. drought) made it difficult to implement project activities and this is reflected in the sampling realization.

There were cases in which the gender of the household head changed or the participation status changed and analysis takes that into account when analyzing. In 2012 we use the information on the stated participation in ProRenda by farmers in the survey, and the stated gender of the household head in 2012[12].

While it was hoped to evaluate households based on both primary and secondary stratification, the data will not provide reliable information when disaggregated to that level. We will be able to look at male versus female households overall, or participating versus nonparticipating households, or households by type of village (primary, secondary or control), but more detailed disaggregation (combining these criteria for example) was severely constrained by sample numbers. Figure 1 indicates where the sample villages are located in the ProRenda zone of activities.

In Table 2, we present information for the panel, on whether farmers included in the panel of 487 households, who grew potatoes, one horticultural crop or beans in 2008, still did in 2012. This information is relevant to determine whether we have enough observations to conduct the analysis of impacts between 2008 and 2012. Looking at Table 2, we present the number of household who grew the key crops identified by ProRenda during the 2008 agricultural year and if they grew these crops in the 2012 agricultural year. We include as well information for bean sellers, since in the EOP survey, data on production were not collected

[11] See the Baseline Report of 2009 for greater detail.

[12] There were 35 changes in household head gender between 2009 and 2012, but the changes do not affect the overall initial distribution of gender for household heads in the same, which remains practically the same.

for households who did not sell beans. This seems to be due to a misunderstanding by field officers of the need to collect data on production even if farmers did not sell.

As shown in Table 2, 55percent of the sample households grew potatoes, 62percent grew beans, 56percent grew and sold beans, and 40percent grew onions, carrots and cabbage in both 2008 and 2012. The information is also disaggregated by stated participation in ProRenda, and by stated gender of household head. For the 104 participant households, 80percent grew potatoes, 65percent grew beans, 66percent sold beans, and 65percent grew onions, carrots and cabbage in 2008 and 2012. For the non-participants we have lower percentages of households who grew the crops in both years; however the absolute numbers are higher than the ones for participants. This is a consequence of having only 21percent of participant households in the sample. For male and female household comparison, we have a total of 54 percent male and 46 percent female-headed households. More than 40 percent female households grew potatoes, beans, sold beans in both years, however only 21 percent grew onions, carrots and cabbage in both years (only 21 households).

The information on Table 2 indicates that due to the number of observations for participants and nonparticipants, male and female headed households, we will be able to conduct analysis in the comparison of the changes that took place between 2008 and 2012 for potatoes and beans, and some analysis with some caveats for onions, due to the fewer observations that we have for those crops.

Population weights were developed for the sample, based on village listing information for the region and observed cases in each selected village. The weights are used to extrapolate out to the population level for the World Vision areas of implementation and almost all reported statistics are based on the extrapolation, unless sample number indicated. Population weights were adjusted after the EOP Survey to reflect removal of Palestina and Kamembua in the sampling. Attrition will be discussed in greater detail below.

Table 2 Sample number and sample percentages of households growing key crops, per participation in ProRenda and sex of household head for 2008 and 2012 agricultural years

Crops grown				2012 Totals per crop			2012 ProRenda Participants			2012 ProRenda Non-participants			2012 Male headed households			2012 Female headed households		
				Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Potatoes	**2008**	**Yes**	freq	148	119	267	55	14	69	93	105	198	99	53	152	49	66	115
			percent	55	45	55	80	20	66	47	53	52	65	35	59	43	57	50
		No	freq	50	170	220	14	21	35	36	149	185	32	75	107	18	95	113
			percent	23	77	45	40	60	34	19	81	48	30	70	41	16	84	50
		Total		198	289	487	69	35	104	129	254	383	131	128	259	67	161	228
Beans (growers)	**2008**	**Yes**	freq	266	161	427	59	32	91	207	129	336	150	75	225	116	86	202
			percent	62	38	88	65	35	88	62	38	88	67	33	87	57	43	89
		No	freq	23	37	60	6	7	13	17	30	47	14	20	34	9	17	26
			percent	38	62	12	46	54	13	36	64	12	41	59	13	35	65	11
		Total		351	236	487	65	39	104	224	159	383	164	95	259	125	103	228
Beans (sellers)	**2008**	**Yes**	freq	119	92	211	25	13	38	94	79	173	79	46	125	40	46	86
			percent	56	44	79	66	34	64	54	46	84	63	37	83	47	53	74
		No	freq	27	28	55	14	7	21	13	21	34	13	12	25	14	16	30
			percent	49	51	21	67	33	36	38	62	16	52	48	17	47	53	26
		Total		146	120	266	39	20	59	107	100	207	92	58	150	54	62	116
Onions, carrots, cabbage	**2008**	**Yes**	freq	83	127	210	33	18	51	50	109	159	62	61	123	21	66	87
			percent	40	60	76	65	35	96	31	69	71	50	50	90	24	76	62
		No	freq	50	227	277	14	39	53	36	188	224	32	104	136	18	123	141
			percent	18	82	57	26	74	51	16	84	58	24	76	53	13	87	62
		Total		133	354	487	47	57	104	86	297	383	94	165	259	39	189	228

NOTES: The information corresponds to sample numbers. "Yes" indicates they grew the given crop in the indicated year and "No" indicates that they did not grow the crop in the indicated year.

Source: ProRenda survey 2009 and 2013

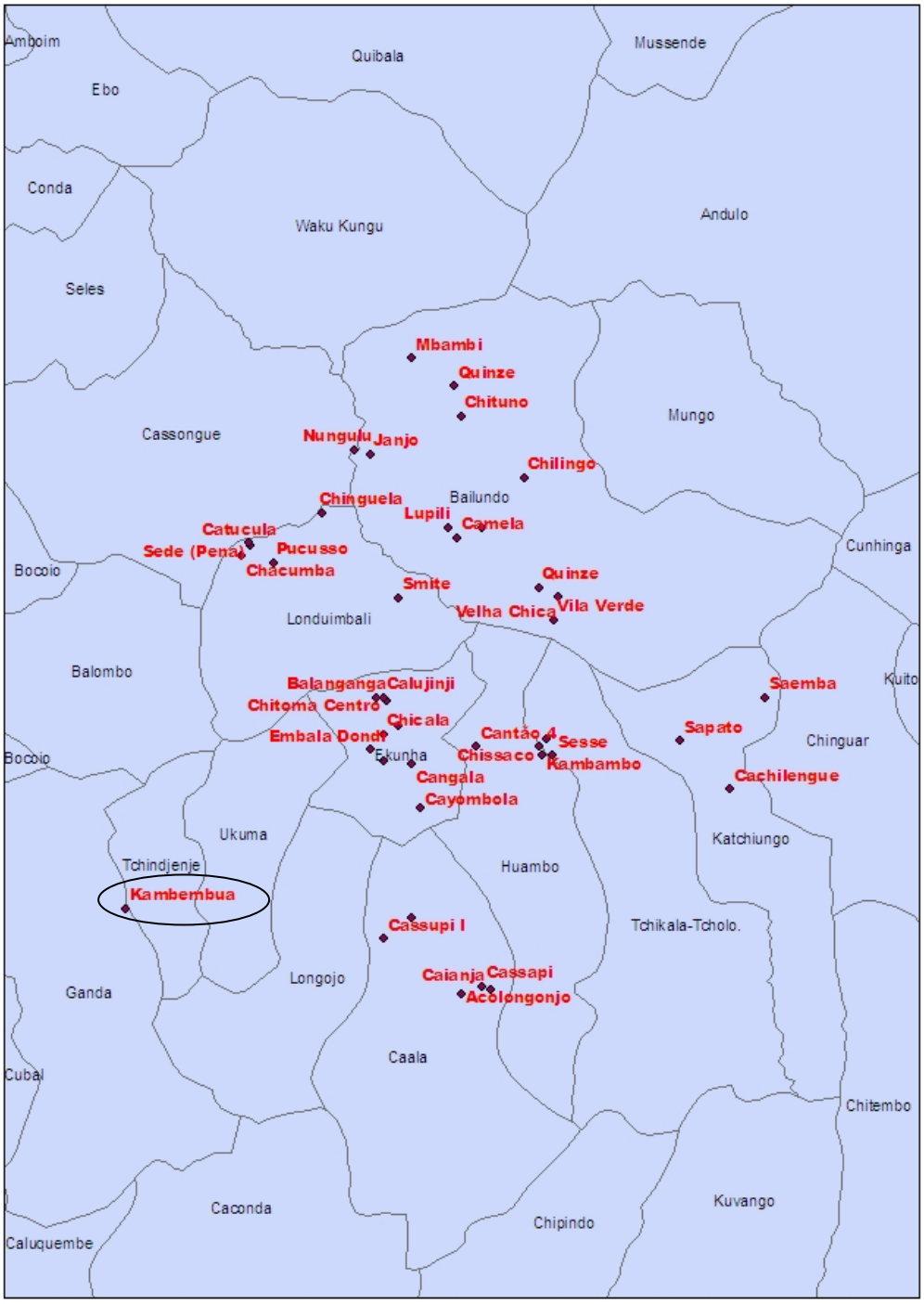

Figure 1 Map of community locations in survey sample

Table 3 Reasons for Attrition (Not re-interviewed) of Households in 2013

Sample attrition reasons	Number of households	% of attrited households
Lack of permission by authorities	16	15
Moved from the region	34	31
Death or illness of heads	8	7
Alcohol related issues	2	2
Declined to participate	2	2
Dissolved (unknown reasons)	4	4
Not found or unknown reason	42	39
Total	108	100
Attrition as a % of 620 total completed interviews in 2009		17

Source: ProRenda surveys: Baseline 2009 and End of Project 2013.

3.4. Attrition and the End of Project (EOP) survey sample

The sampling for the EOP was strictly a revisit of the households from the Baseline 2009 survey. As shown in Table 3, enumerators were unable to re-interview all households from the 2009 survey. This occurred for a variety of reasons: 1) exclusion of one village (Kamembua) due to administrative constraint; 2) households moving from the zone; 3) illness or other reason for heads to be unavailable; 4) death of head(s); 5) dissolution of the household; and 6) inability to locate the household. It was expected that there would be attrition of households based on household migration to other zones, refusal to participate, major changes in household composition such that the household could no longer be considered the same household as occurs with catastrophic loss of life, and other reasons. There were some changes in households heads, with marriage and deaths but the gender of the head of household at the time of the 2013 EOP survey was used in analysis, unless otherwise stated. There were 11 households in which a male head was replaced by a female head, and another 12 households in which a female head was replaced by a male head. It was expected that there would be changes in participation of households in farmer organizations, and this will be discussed more fully below.

One unexpected problem was the lack of administrative permission to enter one village in Bie Province (Kamembua) for the EOP survey. One of the control villages, Palestina, was dropped from the survey for two key reasons: 1) residents from other villages arrived in Palestina and were interviewed, but later identified as non-residents in Palestina; and 2) the residents suffered catastrophic losses in farming due to livestock invasion from a neighboring large farm, such that their situation was desperate and it no longer reflected economic conditions similar to other villages in the region. Thus it is not considered attrition in the sample but rather unrepresentative and population weights were adjusted to reflect that. Palestina responses are excluded from both 2009 and 2013 analyses in this document.

Various analyses have been carried to understand if the not re-interviewed households tended to have different characteristics than the re-interviewed households. If there are important differences, unadjusted analytical results may be biased. Following work by other researchers, we first look at the basic characteristics of the households comparing re-

interviewed and not re-interviewed households. We then analyze several key outcome variables in 2009 to understand if there are differences there. This initial work provides insight but may be followed by more detailed regression evaluation on differences, controlling for a range of characteristics.

3.4.1. Attrition analysis of basic characteristics

Based on the survey sampling strategy in 2009 and an attrition rate at 20 percent in 2013, it was important to compare the re-interviewed households to the non-re-interviewed households to understand the potential for bias. Using STATA Software package and various methods for sampling under stratified clustered designs, means and hypothesis testing were conducted using linearized estimators and two-sample approach with unequal variance. As indicated in Table 4, there are only a few significant differences between the re-interviewed and non-re-interviewed households on key household characteristics. The re-interviewed households are slightly less likely to be headed by females than the households that were not re-interviewed. They are more likely to have plows and bicycles than those who were not re-interviewed.

On the potential outcomes of interest, there were only two outcomes with significant differences (expenses in horticultural crop production and marketing, and total kilograms of beans sold), with re-interviewed households having higher values in both cases. The relatively small samples of households participating in production and sales of each of the commodity in 2009 means that there were fewer cases in the comparison.

Researchers estimated the probability of re-interviewing using a survey adjusted Probit model. Selected results can be seen in Annex 1. Given the poor explanatory power, researchers agreed that bias based on observables was not likely, as few variables were significant in the regressions. While Inverse Probability Weighting could be used to attempt to avoid bias, given the limited number of significant variables and other aspects, this report will use adjusted survey weights without IPW. The adjustments to the survey weights are described above, accounting for the exclusion of Palestina as a control village and the inaccessibility of Kamembua as a primary village.

3.5. Survey questionnaire design

The Baseline Survey was designed to capture the information needed for the key indicators, as well as capture data on aspects that were important factors in changes in the environment and ones that might influence the household changes. Examples of the latter are road access, health centers, schools for the macro level and demographics and other aspects at the household level. As the Baseline Survey report indicated, the major issues that were addressed in the design of the Baseline Survey instrument included:

- Understanding how rural families in the sample area are organized in terms of gender roles and the extent to which intra-family gender differences in income can be captured by a one-shot survey;
- Ability of farmers to recall a full year of production, input, and sales information by crop for the target crops;

Table 4 Comparison of characteristics re-interviewed and not re-interviewed households

	Unit	Not re-interviewed Mean	Not re-interviewed SE (mean)	Re-interviewed Mean	Re-interviewed SE (mean)	Difference between means[1]	
Household characteristics							
Participation in association	0=no; 1=yes	0.06	0.03	0.06	0.03	0.00	
Female headed households in 2009	0=no; 1=yes	0.35	0.26	0.31	0.25	0.03	*
Age of Household head	years	39	3	44	1	-5	
Household Asset Ownership							
Cell phone	0=no; 1=yes	0.11	0.06	0.06	0.01	0.05	
Plow	0=no; 1=yes	0.06	0.02	0.10	0.03	-0.05	**
Backpack sprayer	0=no; 1=yes	0.02	0.01	0.03	0.01	-0.01	
Motorcycle	0=no; 1=yes	0.09	0.04	0.08	0.02	0.00	
Bicycle	0=no; 1=yes	0.09	0.03	0.24	0.09	-0.15	*
Radio	0=no; 1=yes	0.41	0.11	0.41	0.09	0.01	
Table	0=no; 1=yes	0.50	0.09	0.47	0.11	0.03	
Well (household)	0=no; 1=yes	0.24	0.06	0.21	0.03	0.02	
Latrine	0=no; 1=yes	0.87	0.08	0.87	0.06	0.00	
Zinc roof on home	0=no; 1=yes	0.37	0.02	0.47	0.08	-0.10	
Household characteristics: Sample numbers		N=120		N=487			
Outcome variables							
Potatoes							
Gross Margin	Kwanzas	11487	2619	12853	5420	1367	
% sold of total produced	%	84%	3%	85%	2%	1%	
Total quantity produced	kg	319	147	359	137	40	
Total quantity sold	kg	220	84	328	134	108	
Total value of sales	Kwanzas	16455	4102	20929	7948	4474	
Expenses	Kwanzas	4969	2078	8076	3206	3107	
Sample number of observations		N=46		N=175			
Horticultural crops:							
Gross Margin		14627	13553	45487	22813	30861	
% sold		0.79	0.09	0.80	0.01	0.01	
Total quantity produced		69.37	37.42	86.94	15.53	17.58	
Total quantity sold		62.21	37.74	78.01	15.45	15.80	
Total value of sales		15441	13999	48536	22189	33095	
Expenses		815	512	3049	1066	2234	***
Sample number of observations		N=24		N=113			
Bean Sellers							
Gross Margin		39448	27819	61914	21020	22466	
% sold		64%	2%	66%	3%	3%	
Total quantity produced		120	20	167	28	47	
Total quantity sold		73	13	102	20	29	***
Total value of sales		40964	27791	63060	21327	22096	
Expenses		1516	164	1145	375	-370	
Sample number of observations		N=48		N=200			

Source: ProRenda 2009 and 2013. Survey weights were used, adjusted for two excluded villages.
*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level
1 Mean (Not re-interviewed) - Mean (re-interviewed)

- Ability of farmers to report information in standardized units (hectares, kilograms, etc);
- Understanding how Farmer Organizations function (including gender dimensions) and the role they currently play in farmers' access to credit, inputs, markets, and various types of training;
- Testing the appropriateness of nutrition, health, education, and asset indicators suggested on the first page of Appendix A in the ProRenda grant proposal.

In the EOP Survey, the aspects related to drought arose. Drought is not a common occurrence in this location of Angola, but during the 2011/ 2012 cropping year, drought was felt throughout the Planalto region. This poses a challenge for the impact evaluation, as the project was not designed specifically to address drought impact and the drought could result in high losses to crops and incomes, in spite of the ProRenda project. Thus, in both the community surveys and the household surveys of 2013, new questions were included to assess the drought. This will be discussed more fully in the community survey results and household survey results.

All of the questions in the surveys were field-tested and many modified a number of times to improve both interviewer and interviewee comprehension. As we collected information relevant to the issues listed above, we made a number of key decisions that affected the survey design; these decisions are summarized in pages 5-7 of Donovan and Kelly 2009. Annexes 3 – 4 to this report include the final household level survey questionnaires and community level surveys, respectively.

4. Methodological approaches: Simple difference in difference for impact assessment

As was mentioned earlier, impact evaluation research must be designed such that results can be attributed to ProRenda investments and activities. Given that we cannot observe the same households both with and without the program, the sample was designed to have control and participating communities, as well as participating and non-participating households in the villages. Panel data collection for the households contributed to the analysis, as it helps to control for the unobserved heterogeneity in the households.

There will still be limitations in the analysis due to possible problems with selection of control villages, externalities of the project on non-participants, and other aspects. Within the participating villages, participants selected themselves into the ProRenda program, and there was no random allocation to participation, so issues of self-selection into program arise. This is not a case of experimentation with random assignment to treatment, and so the power of the analysis and attribution of causality is weakened.

The difference in differences (DID) approach is used to look at changes between different populations. Thus, for example, we compare the changes on total gross margins for the main crops grown by farmers between before the project (2008) and after the project (2012). We take the 2012 observation on gross margins for participating farmers and subtract the original 2008 observation to get the first difference for the participating farmers. Then we estimate the same value for non-participants. It is the difference between these differences that helps identify impacts. Total gross margins may increase for both sets of households, but if the participants' total gross margins change significantly more than the nonparticipants, it is a

sign of positive contributions of project participation. To estimate whether this difference in difference is statistically significant we conduct a t-test for equal means The difference in difference (DID) is defined as follows:

$$DID = (Y_{2012} - Y_{2008})_S - (Y_{2012} - Y_{2008})_{1-S}$$

Where:

Y: Indicates the outcome variable of interest

S: indicates the stratum, which takes the value of 1 whenever it means participant, male or participant in FO.

We will compare the difference between ProRenda participants and non-participants, between households with female and male household head, and between participants in FO and non-participants in FO, before and after ProRenda was implemented. Due to the small sample numbers that we have for project participants (104 out of 487), as well as for farmers who grew potato, onions and beans in 2008 and 2012 (see Table 2), we are not disaggregating the information for primary, secondary and control villages, and rather we are disaggregating by participation in ProRenda, using self-reported participation in the project by interviewed farmers.

Multivariate analysis is needed for the impact research but cannot be accomplished without additional time and resources. Only in the case of investment decision-making, research using propensity score matching was developed by Dulys-Nusbaum (2013), who estimated the effects of ProRenda participation on the investment decisions among the participants. This methodological approach may prove useful in future analysis of the ProRenda panel data, although the constraints on the sampling may frustrate analysts using such approaches.

5. Characteristics of the communities

We revisited four categories of community-level characteristics in 2012: (1) basic services, (2) transportation infrastructure, (3) local agricultural input/output markets; and 4) impact of the drought. Our initial assumption was that primary villages would have greater access to services. This expectation was realized in 2009 and has been confirmed in 2012, with one exception. Bus stations were the only category that primary villages held a disadvantage.

5.1. Basic Services

Table 5 displays that electricity remained generally stable. Public power supply increased by 6 percent in secondary villages, but primary villages still held the advantage over all groups at a constant 13 percent. Both primary and secondary villages saw increases in access to private generators by 6 percent and 7 percent, respectively. Electricity remained absent in control villages, and the presence of private generators actually declined by 7 percent.

Information access improved overall, with variations by village classification. Primary village national radio access increased and provincial radio access decreased. Television access rose across all types of villages by large margins: in the case of primary villages this was as large

Table 5 Percentage of villages with access to basic services within their village, per village type

Basic services (% YES)	Type of village						Total	
	Primary		Secondary		Control			
	2008	2012	2008	2012	2008	2012	2008	2012
Electricity:								
Power supply	13	13	0	6	0	0	5	8
Private generators	94	100	75	82	50	43	78	82
Information:								
National radio	94	100	94	94	100	86	95	95
Province/local radio	88	80	94	94	100	100	93	90
Television	56	100	38	82	38	57	45	85
Communication:								
Radio communication	6	7	31	6	38	0	23	5
Telephone network	0	7	0	6	0	0	0	5
Cell phone network	56	87	56	94	38	86	53	90
Credit institutions:								
Traditional banks	44	20	63	12	63	14	55	15
24 hr access banks	31	13	25	12	25	0	28	10
Education:								
Elementary school	94	60	75	82	63	57	80	69
Middle/high school	19	27	31	6	0	57	20	23
Health services:								
Health center	38	40	19	41	0	0	23	33
Hospital	6	7	13	0	13	0	10	3
Extension services:								
IDA offices	13	7	19	0	0	29	13	8
Markets:								
Grocery shop	19	33	25	18	13	29	20	26
Public market for consumption	38	20	19	18	0	14	23	18
Number of sample observations	16	15	16	17	8	7	40	39

Source: ProRenda survey, Angola, 2009, 2013

as 44 percent. This explosion in television access even occurred in control villages, where overall electricity access declined. Radio communication decreased substantially in secondary and control villages. This could be explained by the 38 percent and 48 percent respective increases in cell phone use in these types of villages. Primary villages saw increases in both: a 1 percent margin for communication radios and 31 percent for cell phones. Access to banks fell across all villages and categories. Control villages saw the most severe decline in banking: traditional banks declined 49 percent and 24-hour banks decreased 25 percent (Table 5).

Education access changes were consistent for elementary schools and variable for middle schools across strata. The presence of primary schools decreased across all villages by as much as 16 percent (Table 5, secondary villages, primary schools). Access to middle/high schools increased by a substantial 57 percent in control villages and 8 percent in primary villages, whereas secondary villages saw a 25 percent decrease (Table 5).

Only primary villages preserved, and even increased, their hospital access. Primary villages also slightly increased health center availability. Secondary and control villages lost their hospital access, though secondary villages were 10 percent more able to reach health centers. IDA offices increased only in control villages, declining in both other types of villages (Table 5).

Lastly, control villages' access increased for both grocery shops and public markets. Primary villages saw a tradeoff: grocery shop access rose and public market access fell. Secondary villages saw a small decline in both types of markets (Table 5).

Table 6 Percentage of villages with different road types and access to bus service within their village, per village type

Detail	Type of village						Total	
	Primary		Secondary		Control			
	2008	2013	2008	2013	2008	2013	2008	2013
State of roads to main commercial town (% YES)								
Gravel road, not rehabilitated	87	53	62	47	100	86	79	56
Gravel road, partially rehabilitated	13	0	13	6	0	0	10	3
Gravel road, rehabilitated	0	20	6	29	0	14	3	23
Paved road, not rehabilitated	0	7	0	6	0	0	0	2
Paved road, partially rehabilitated	0	0	13	6	0	0	5	3
Paved road, rehabilitated	0	20	6	6	0	0	3	4
Have bus station in the village (% YES)	6	0	6	6	0	0	5	3
Number of sample observations	16	15	16	17	7	7	39	39

Source: ProRenda survey, Angola, 2009, 2013

5.2. Transportation Infrastructure

In order to measure transportation infrastructure, we gathered information (1) on road quality connecting markets, and (2) on whether or not a bus station was present in the village. Table 6 shows that road rehabilitation and improvements were common across all villages. Primary and secondary villages, in particular, saw dramatic improvements in gravel roads. This is apparent first by the decline in non-rehabilitated roads and second by the increase in rehabilitated gravel roads. This increase is manifest as a generous 20 percent for primary and 23 percent for secondary villages. Even the control villages saw a similar improvement at 14 percent, but there remained no control villages along paved roads. Primary villages lost all bus station access, leaving secondary villages as the only type with this service (Table 6).

5.3. Local Input and Output Markets

Availability of input and output markets saw marked improvements. Primary villages still held a distinct advantage with greater local access to input and output markets, but the gap is closing. Primary villages saw substantial increases in the possibility to locally purchase fertilizer, certified potato seed, and all onion seed. Secondary and control villages realized

modest increases in almost all input categories, the exception being non-certified bean seed for secondary villages.

Table 7 Percentage of villages with access to input and output markets within their village, per village type

Detail	Type of village						Total	
	Primary		Secondary		Control			
	2008	2012	2008	2012	2008	2012	2008	2012
Purchase these inputs in the village (% YES):								
Fertilizer (whole sacks)	19	40	0	12	0	14	8	23
Fertilizer (small quantities)	19	40	0	18	0	0	8	23
Certified potato seed	0	20	6	12	0	14	3	15
Non-certified potato seed	50	53	38	41	14	14	38	41
Certified onion seed	13	27	0	6	0	14	5	15
Non-certified onion seed	50	67	38	53	14	29	38	54
Certified bean seed	13	20	6	12	0	29	8	18
Non-certified bean seed	63	67	50	47	14	57	49	56
Sell these outputs in the village (% YES):								
Potatoes	25	40	13	25	0	29	15	36
Onions	38	40	19	29	0	29	23	33
Beans	38	40	31	29	0	43	28	36
Other vegetables	38	50	25	25	0	29	26	36
Number of sample observations	16	15	16	17	7	7	39	39

Source: ProRenda survey, Angola, 2009, 2013

Every type of village experienced improvement or consistency in each type of output market produce. By 2012, around half of respondents indicated that there were output markets in the primary villages to sell crops. These are, for the most part, still the highest figures. However, control villages had a higher proportion of local markets for bean sales, and other categories in these and secondary villages are approaching primary village figures as of the latest survey (Table 7).

The overall expansion of input and output markets across all villages in 2012 may be explained by nearly universal transportation infrastructure, information, and communication improvements since 2008. Primary villages remain at a distinct advantage over other villages.

5.4. Presence and Impact of Drought, Community Level Assessment

As an adjustment to the 2008 community survey, we added an inquiry of community leaders regarding drought in order to understand variation in crop production that would be attributable to weather rather than the program. An extremely high proportion of the population in every village expressed having experienced a drought between February 2012 and January 2013.The incidence of drought seemed to be relatively consistent and high across all village types (Table 8).

Crop losses occurred in every village, with 15 percent of the control village experiencing total losses. The most common level of loss seemed to be a "large portion," which lies between "small," and "total," portions. Over half of all villages claimed this level of severity (Table 8). Potatoes, onions, and beans all experienced losses, mostly "large." Beans experienced the greatest "total" losses for villages overall across all villages, with 20 percent of primary villages with total loss. Onion losses seemed to be somewhat reduced, but they were still greatly impacted. We note that the responses to the drought question should be treated with care, as community level respondents might have had some expectation of support in the event that drought was considered a disaster in the community, although household level questions appear to be consistent with the community level assessment.

6. Characteristics of farm families

In this section we examine the demographic characteristics of the farm families (age and marital status of the family head, family size and dependency ratios, and adult literacy). At the end of the project, we did not expect to see major changes in the underlying demographic characteristics of the farm families across the village types (primary, secondary, and non-beneficiaries of ProRenda activities), but we did anticipate some differences between the male- and female-headed families. In general, the data confirmed the expectations, although secondary villages, compared to primary and control villages, tended to experience major changes in some of the demographics, such as separated marital status of the heads and share of literate adults.

6.1. Demographics

Demographic variables examined include age, sex, and marital status of the household head, family size and composition, and the number and percent of adults who are literate in the family. Table 9 summarizes the results of baseline and EOP surveys by village type and sex of the household head. Due to the brief lapse of time between the two surveys and that the same households were visited we did not expect to see major changes in demographic characteristics.

At the end of the project (2012) there were slight changes in demographics from baseline (2008). As at the baseline, at the end of the project the primary villages had the youngest average age (45 years) for family heads compared with secondary and control villages. Regarding the sex of the household head, although there was a slight decrease in the percentage of male household heads from 71 percent to 67 percent, male heads continue to be the majority. Marital status also was not profoundly changed from baseline. Overall, a slight increase occurred in percentage of single and widow heads of households. Nevertheless, there was a reduction for separated female heads, which suggests a possibility of women sharing household responsibility with a partner, and eventually improving women's well-being, provided that within the household activities are shared and decision making is made jointly by women and men.

There were also slight changes in average family size. At the end of the project, average family size was 5.6 for the entire sample. This value represents a slight increase of family size of 5.3 at the baseline. Nevertheless, a comparison based on sex showed that average family size and family composition did not change. At the end of the project female head households tended to have lower family size and fewer adults male than male headed households, and male headed households tended to have more male adults and children younger than 5, as was the situation at the baseline.

Table 8 Reported presence of drought effects in 2012 per village type.

Detail		Type of village			
		Direct	Indirect	Control	Total
Had drought in past year (Feb 2012-Jan 2013) (% YES):		93	94	86	92
If yes, the extent by which total crop was affected (% of village type):	Lost a small portion of crop	7	36	0	18
	Lost a large portion of crop	79	53	71	65
	Lost all of the crop	7	6	15	8
To what extent was potatos were affected (% of village type):					
	Lost a small portion of crop	14	12	28	16
	Lost a large portion of crop	72	71	58	68
	Lost all of the crop	7	12	0	8
To what extent was onions were affected (% of village type):					
	Lost a small portion of crop	29	24	28	27
	Lost a large portion of crop	50	65	58	58
	Lost all of the crop	14	6	0	8
To what extent was beans were affected (% of village type):					
	Lost a small portion of crop	7	18	28	6
	Lost a large portion of crop	66	65	58	63
	Lost all of the crop	20	12	0	13
Did families receive aid in the community (% YES):		7	0	0	3
Number of sample observations		13	16	6	36
Source: ProRenda survey, Angola, 2013					

Dependency ratios also changed slightly. In the primary villages the dependency ratio increased (from 1.38 at the baseline to 1.68 dependents to support per adult over 17 years of age at the end of project), while in control villages there was a decrease in dependency ratio (from 1.63 at the baseline to 1.54 at the end of the project). The difference in dependency ratio between male and female headed household, continues to exist at the end of the project, with male headed households having high dependency ratio (1.64 vs 1.53). Compared to baseline values (1.59 vs. 1.53) the dependency ratio at the end of the project (1.64 vs 1.53) increased slightly for male headed households and did not change for female headed households.

As presented in Table 9, average share of literate adults increased from 39 percent at the baseline to 41 percent at the end of the project. Therefore, in general there is an indication of improvement of knowledge and skills of producers. However, female headed households experienced a decrease in the percentage of literate adults while male headed households increased their share of all adults who are literate. The lack of detailed demographics limits our ability to track progress on literacy with more precision.

6.2. Schooling participation rates (5 – 17 years old).

Children's education was one of the indicators of household well-being in smallholder farming families in the central highlands of Angola. Table 10 presents the data on schooling participation rate of children (5-17 years). Household average schooling participation rate increased from 85 percent at baseline, to 88 percent at end of the project. Farmers in the secondary villages experienced a large increase in the percentage of children between 5-17 years old that were enrolled in school. In contrast, households in the primary and control villages experienced a decrease in the percentage of children between 5-17 years old that were enrolled in school. In Angola, low schooling participation rates are associated mainly with lack of access to education and drop out due to low quality of education (Unicef Angola, 2010). Therefore, the reduction in percentage of villages with access to elementary school (as indicated in Table 5) might have contributed to the decrease of the percentage of children between 5-17 years old that were enrolled in school in the primary and control villages. Female headed households experienced significant increases in the percentage of children between 5-17 years old that were enrolled in school.

Overall, there was a slight increase in the days children missed school because of sickness. The average number of days children missed school varied across villages with primary villages experiencing a reduction of number of days children missed school. In contrast, secondary and control villages experienced an increase in the number of days children missed school. At the end of project, children in female headed households missed fewer days compared to children in male headed households. This indicates improvement of wellbeing of the children in the female head households, with higher attendance percentages and lower missed days.

6.3. Participation in training programs for adults

Under ProRenda, participation of farmers in adult literacy and other educational programs was an important indicator for measuring the capacity of farmers to develop business relationships that ensure access to credit, inputs, and output markets during and

Table 9 Summary of family demographics by village type and sex of household head

	Village Type						Sex of head					
Household demographics	**Primary 2009**	**Primary 2013**	**Secondary 2009**	**Secondary 2013**	**Control 2009**	**Control 2013**	**Male 2009**	**Male 2013**	**Female 2009**	**Female 2013**	**Total 2009**	**Total 2013**
Age of head (years)	41	45	44	48	45	46	43	48	43	44	43	47
Sex of head: % male	69	65	72	68	65	61					71	67
Marital status of head:												
Married	69	67	76	76	68	73	96	93	25	34	73	73
Single	6	8	1	3	3	4	1	2	7	8	3	4
Widow	19	19	16	19	23	18	3	4	48	46	17	19
Separated	6	6	7	2	6	6	0	1	20	10	6	4
Household size	5.0	5.4	5.4	5.8	5.0	5.3	5.7	6.2	4.3	4.5	5.3	5.6
No. males older than 17	1.0	0.9	1.0	1.1	0.8	0.9	1.2	1.3	0.5	0.6	1.0	1.1
No. females older than 17	1.1	1.1	1.1	1.1	1.1	1.2	1.0	1.1	1.2	1.1	1.1	1.1
No. children younger than 5	1.2	1.2	1.2	1.1	1.0	1.2	1.4	1.3	0.9	0.9	1.2	1.2
No. boys 5-17 yrs of age	0.8	1.1	1.2	1.4	1.0	1.0	1.2	1.4	0.8	0.9	1.1	1.3
No. girls 5-17 yrs of age	0.9	1.2	0.9	1.0	1.1	1.0	0.9	1.1	0.9	0.9	0.9	1.1
No. family members older than 17 who are literate*	1.0	0.8	0.9	0.9	0.8	0.7	0.9	1.0	1.0	0.6	0.9	0.9
Share of all adults who are literate (%)	43	40	37	42	34	32	38	43	41	36	39	41
Number of sample observations	227	196	223	208	103	83	296	259	257	228	553	487

* Literacy refers to people who were self-reported to be able to read and write.

Source: ProRenda survey, Angola, 2009, 2013. Estimates weighted to reflect population.

after the project. The EOP survey collected information on the participation in various adult training programs offered by ProRenda and other agencies. The participation information here is not intended to estimate the population attending these trainings, but rather to understand the extent to which our households had training which can contribute to understanding the changes that may be observed, as with marketing strategies.

As Table 11 shows, farmers participating in ProRenda were significantly more likely to have received literacy and extension advice in 2012 on agricultural production, agricultural marketing and health than nonparticipating farmers. Male-headed households were still more likely than female headed households overall to have obtained these services, but for gender analysis, this does not take into account the gender of the person who obtained the services. ProRenda targeted its literacy programs to women. An expected result was that farm households in the primary villages had better access to the services and those households were significantly more likely to receive agricultural production and marketing services from associations compared to Secondary and Control villages.

7. Household gross margins

While we will go into greater detail later in this report on the production and gross margins for the specific crops under study here, it is valuable to take a quick look at the gross crop margins to get a broader view. Household gross margins include receipts, costs and margins of sales of potatoes, beans and onions only, and are based strictly on marketed quantities and cash expenses. In general, receipts, costs and gross margins increased dramatically between 2008 and 2012 (see Table 12), in spite of the drought.

Disaggregating these changes between participants and non-participants in ProRenda, we do not find any statistically significant increases (see Table 13). Comparing female and male headed households (Table 14), we find that there was a significant increase in costs for male headed households, although there was no significant difference in gross margins. The sources of the margin differences can be found in the following sections, which discuss the incomes from the individual key crops under study here.

Table 10 Average schooling participation rates of children between five and seventeen years of age, per village type and sex of household head

	Village type						Sex of head					
Schooling participation rates	**Primary 2009**	**Primary 2013**	**Secondary 2009**	**Secondary 2013**	**Control 2009**	**Control 2013**	**Male 2009**	**Male 2013**	**Female 2009**	**Female 2013**	**Total 2009**	**Total 2013**
Children in school in 2008 (% of school age children)	90.6	90.1	81.6	88.2	98.0	81.9	85.5	88.8	83.7	87.3	85.0	88.4
Number of days missed because of sickness in 2008	5.7	2.7	5.0	7.1	2.7	2.2	5.1	5.5	5.0	6.0	5.1	5.7
Number of days missed because of sickness in 2008 per child per year	2.7	1.4	2.3	3.4	1.1	1.3	2.2	2.4	2.7	3.7	2.4	2.8
Number of sample observations	183	196	156	208	79	83	226	259	192	228	418	487

Source: ProRenda survey, Angola, 2009, 2013. Estimates weighted to reflect population.

Table 11 Household participation in association training or extension advice, by gender of head, type of village and participation in ProRenda, 2012

Type of Household	Literacy programs	Sig	Agricultural Production Extension	Sig	Ag. Marketing Extension	Sig	Health	Sig
	(% of households within type who attended/received advice)							
Overall	7%		12%		9%		6%	
Strata								
Primary	10%		21%	**	15%	*	7%	
Secondary	6%		8%		7%		7%	
Control	4%		5%		4%		5%	
Gender of HH Head								
Male	9%	***	14%	**	12%	**	7%	
Female	3%		6%		4%		4%	
Participating in Prorenda								
Participating households	25%	***	37%	**	34%	***	22%	***
Nonparticipating households	2%		5%		3%		2%	

Source: ProRenda survey, Angola, 2013. Sig=Significance of differences in proportions.

Table 12 Total receipts, costs and gross margins of households growing key crops

	Total		
	2008	2012	diff
Detail			
Receipts (Kw)	8,175	29,633	21,458
Total Costs (Kw)	5,128	15,448	10,320
Gross margins (Kw)	3,047	14,185	11,138
Number of sample observations	328	328	328

NOTES: Key crops include potatoes, onions and beans. Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. The data is at real prices of December 2012. Variables are at the household level. Estimates weighted to reflect population.
***1%, **5%, *10% significance levels
Source: ProRenda survey, Angola, 2009 and 2013.

Table 13 Total receipts, costs and gross margins of households growing key crops1, per household participation in ProRenda in 2012

	Participation in ProRenda						
	2008		2012		difference		DID
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**	
Receipts (Kw)	14,781	5,780	42,237	25,064	27,455	19,284	8,171
Total Costs (Kw)	10,876	3,044	21,563	13,231	10,687	10,187	500
Gross margins (Kw)	3,905	2,736	20,674	11,833	16,769	9,097	7,672
Number of sample observations	84	244	84	244	84	244	

[1] Key crops include potatoes, onions and beans.
NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. The data is at real prices of December 2012. Variables are at the household level; classification of participation in ProRenda based on 2012 self-declared status. Estimates weighted to reflect population.
Source: ProRenda survey, Angola, 2009 and 2013. ***1%, **5%, *10% significance levels

Table 14 Total receipts, costs and gross margins of households growing key crops[1], per gender of household head in 2012

	Gender of household head							
	2008		2012		difference		DID	
Detail	Male	Female	Male	Female	Male	Female		
Receipts (Kw)	10,341	2,729	35,763	14,220	25,422	11,491	13,931	
Total Costs (Kw)	6,520	1,628	17,896	9,292	11,376	7,664	3,712	**
Gross margins (Kw)	3,821	1,101	17,867	4,928	14,046	3,827	10,218	
Number of sample observations	199	129	199	129	199	129		

[1] Key crops include potatoes, onions and beans.

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. The data is at real prices of December 2012. Variables are at the household level; classification of gender of household head based on 2012 observation. Estimates weighted to reflect population.

Source: ProRenda survey, Angola, 2009 and 2013. ***1%, **5%, *10% significance levels

8. Potato production and potato farmers

ProRenda was designed based on an assessment that potatoes have excellent potential for development as a smallholder income crop. Research indicates that consumer demand is strong and the agro-climatic conditions are good. Some farmers were already producing and selling potatoes for income with the earlier World Vision project, but ProRenda provided more market and production extension services to expand potato production and marketing, as well as investments in community seed production systems to ensure quality seed.

Table 15 Potato production: Average household production (kg) and estimated planted area (ha)

	Total		
	2008	2012	Diff
Detail			
Production (kg)	449	966	517
Quantity of seed planted (kg)	87	133	45
Estimated planted area (ha)	0.03	0.05	0.02
Number of sample observations	129	129	129

NOTES: One ha = 10,000 square meters; FO = Farmer Organization. Planted area estimated using a seeding rate of 2,750kg/ha. Variables are at the household level. Estimates weighted to reflect population. "Diff" = Difference between 2012 and 2008.

Source: ProRenda survey, Angola, 2009 and 2013.

8.1. Potato Production

Potato production was calculated at the household level and included the latest full year of data for each household. As indicated in Donovan and Kelly (2009), planted area is a very difficult aspect to assess, and thus it was decided to estimate area based on typical seeding rates and quantity of seed potato used, assuming 2750 kg per hectare as a seeding rate. [13] Production, quantity of seeds planted and estimated planted area were higher for participants in ProRenda, for male headed households and for participants in FO in 2008 (see tables 16, 17 and 18). In general total production, total quantity of seed planted and total estimated planted area for potatoes increased between 2008 and 2012 (see Table 15) On average, there were not statistically significant increases in production for participants in ProRenda compared to non-participants. Although the changes between the two periods appear positive and the DID indicator is positive as well, these differences are not significant (p-value less than 0.10) (see Table 16). For female headed households as compared to male-headed households, we also find no statistically significant differences for production between 2008 and 2012 (see Table 17), due to variability among the households.

However participation in FO indicates that there were significant changes in production for participants in FO with respect to non-participants. On average, production increased by 383 kg, and this DID indicator is significant at 5 percent level (see Table 18). One might expect that participation in FO is related to participation in ProRenda, but it seems this was not the case. Two possible explanations to this are that when farmers where asked on their participation in ProRenda/World Vision projects they did not know that the projects they were participating in were linked to ProRenda and World Vision; if this is the case, the value of participation in ProRenda is underestimated. It is also possible that the groups that were promoted in the study area were not necessarily WV or ProRenda groups and we are capturing not only the treatment effect of ProRenda, but also other projects combined. In general for all the crops analyze here, potato, bean and onion, there were problems of small sample numbers for ProRenda participants that might have affected the population estimates. In addition, the ProRenda marketing promotion activities may have developed opportunities that could be used by many farmers within organizations. More traders, higher quality standards and grading for better prices, all might have attracted more farmers to potatoes and increased. Such externalities might be evaluated using a comparison of households from control communities versus primary and secondary communities, but the sample numbers are quite low for enabling such a comparison.

8.2. Sales receipts and margins

Prices that farmers receive may differ for a variety of reasons, and obtaining recall on prices obtained for each sale in each season has proven to be unreliable. To overcome this, farmers were asked the price they received for the largest quantity of potatoes they sold, and receipts and gross margins were estimated based on this information (tables 19, 20, 21 and 22). A total of 108 households sold potatoes in both 2008 and 2012 and generally total potato sales, costs and receipts increased (Table 19). Participants in ProRenda received a higher price per kilogram in 2012, the price received by ProRenda participants increased 49 kw/kg while the price increase for non-participants was 28

[13] Ideally both seeding rates and fertilization rates can be used to estimate area, but there were insufficient cases to use fertilization rates here.

kw/kg, with a significant DID of 29 kw/kg (Table 19). This increased price for the output did not translate into statistically significant higher gross margins for project participants, and this might be explained by the increase in production costs per kilogram produced. Participants in ProRenda have significantly larger increase in costs between 2008 and 2012, compared to non-participants (Table 19).

Table 16 Potato production: Average production (kg) and planted area (ha) per participation in ProRenda farmer organizations

	Participation in ProRenda						
	2008		2012		difference		DID
Detail	Partic	Non Partic	Partic	Non Partic	Partic	Non Partic	
Production (kg)	738	289	1,366	744	628	456	172
Quantity of seed planted (kg)	124	67	182	106	57.8	38.5	19
Estimated planted area (ha)	0.05	0.02	0.07	0.04	0.02	0.01	0.01
Number of sample observations	50	79	50	79	50	79	

NOTES: One ha = 10,000 square meters; Planted area estimated using a seeding rate of 2,750kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

Table 17 Potato production: Average production (kg) and planted area (ha) per gender of household head in 2012

	Gender of household head						
	2008		2012		difference		DID
Detail	Male	Female	Male	Female	Male	Female	
Production (kg)	512	172	1024	709	512	537	-25
Quantity of seed planted (kg)	101	28	141	99	40	70	-31
Estimated planted area (ha)	0.04	0.01	0.05	0.04	0.01	0.03	-0.01
Number of sample observations	85	44	85	44	85	44	

NOTES: One ha = 10,000 square meters; Planted area estimated using a seeding rate of 2,750kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

Table 18. Potato production: Average production (kg) and planted area (ha) per participation in farmer organizations

	Participation in FO							
	2008		2012		difference		DID	
Detail	Yes	No	Yes	No	Yes	No		
Production (kg)	564	372	1310	736	747	364	383	***
Quantity of seed planted (kg)	117	68	172	107	56	39	17	
Estimated planted area (ha)	0.04	0.02	0.06	0.04	0.02	0.01	0.01	
Number of sample observations	52	77	52	77	52	77		

NOTES: One ha = 10,000 square meters; FO = Farmer Organization. Planted area estimated using a seeding rate of 2,750kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

Table 19. Potato sellers: Average receipts, costs, and gross margins (in real Kwanzas) and percentage sold.

	Total		
	2008	2012	Diff
Detail			
Receipts (Kw)	15,296	49,590	34,295
Price per kg sold (Kw/kg)	52	87	36
Total Costs (Kw)	10,517	31,040	20,523
Production costs per kg produced (Kw/kg)	37.6	60.9	23.3
Marketing costs per kg sold (Kw/kg)	1.9	4.6	2.8
Gross margins (Kw)	4,779	18,551	13,772
Total quantity sold (% of total production)	87%	85%	-3%
Number of sample observations	108	108	108

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012. "Diff" = Difference between 2012 and 2008.
Source: ProRenda survey, Angola, 2009 and 2013

Table 20. Potato sellers: Average receipts, costs, gross margins and percentage sold, per participation in ProRenda.

	Participation in ProRenda							
	2008		2012		difference		DID	
Detail	Partic	Non Partic	Partic	Non Partic	Partic	Non Partic		
Receipts (Kw)	23,319	10,623	56,372	45,641	33,054	35,018	-1,964	
Price per kg sold (Kw/kg)	50	52	99	80	49	28	21	*
Total Costs (Kw)	16,269	7,167	33,313	29,716	17,043	22,550	-5,506	
Production costs per kg produced (Kw/kg)	35.6	38.8	74.3	53.1	38.7	14.3	24	*
Marketing costs per kg sold (Kw/kg)	2.9	1.2	8.5	2.4	5.6	1.1	4	
Gross margins (Kw)	7,049	3,456	23,059	15,925	16,010	12,468	3,542	
Total quantity sold (% of total production)	86%	88%	88%	83%	2%	-5%	7%	**
Number of sample observations	44	64	44	64	44	64		

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012. "DID" = Difference in Differences

Source: ProRenda survey, Angola, 2009 and 2013 ***1%, **5%, *10% significance levels

In addition to better prices for ProRenda participants, there was an increase in the total quantity sold as a percentage of total production of 2 percent with respect to a decrease by 5 percent for nonparticipants (Table 20). The difference of 7 percent between these changes is statistically significant by 5 percent level. Thus, ProRenda participants not only got a higher price for the potatoes they sold, but also they sold a higher percentage of their potato production.

During the period between 2008 and 2012, female headed households improved prices per kg sold of potatoes more than the male-headed households (Table 21). This difference is marginally statistically significant, with a p-value of 0.11. This increase in price contributed to much higher increase in receipts for female-headed households on average, although with the large variability in responses, the dif-in-dif estimate is not significant. Male headed households' total costs and production costs per kilogram produced increased less than the ones faced by female headed households. The DID indicator for total costs and production costs per kilogram produced were only marginally significant with p-values of 0.11 (Table 21). Production cost increases for female headed households indicated increased access to productivity enhancing inputs for these households, a good sign for the future.

Participation in FO in general did not seem to have a significant effect in receipts, costs or gross margins (Table 22).

Table 21. Potato sellers: Average receipts, costs, gross margins and percentage sold, per gender of household head

	Gender of household head							
	2008		2012		difference		DID	
Detail	Male	Female	Male	Female	Male	Female		
Receipts (Kw)	16,690	7,948	49,136	51,985	32,446	44,037	-11,591	
Price per kg sold (Kw/kg)	52	47	84	104	32	57	-25	~
Total Costs (Kw)	11,427	5,720	30,292	34,983	18,864	29,263	-10,399	~
Production costs per kg produced (Kw/kg)	38.6	32.3	55.7	88.2	17.1	55.9	-39	~
Marketing costs per kg sold (Kw/kg)	2.0	1.1	5.0	3.0	3.0	1.8	1	
Gross margins (Kw)	5,263	2,228	18,844	17,002	13,582	14,774	-1,193	
Total quantity sold (% of total production)	88%	86%	86%	80%	-2%	-5%	3%	
Number of sample observations	71	37	71	37	71	37		

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. Kwanzas: real Kwanzas, base Dec 2012.

"DID" = Difference in Differences

Source: ProRenda survey, Angola, 2009 and 2013

***1%, **5%, *10% significance levels; ~pvalue=0.11

In summary, farmers in the Planalto region are growing more potatoes, using productivity enhancing inputs and receiving higher prices for their commodities. Female headed households have benefited from the increases in prices and inputs bringing them closer to the same levels as the male-headed households in the region. Prices received by ProRenda farmers tended to increase significantly more in real terms than for non-participating farmers. The possibility of externalities (more traders, demonstrated methods of marketing, price information) is likely, with ProRenda interventions enabling more farmers to participate in markets, improve their quality and receive higher prices.

9. Bean production and bean farmers

As indicated in the community level surveys, bean production as severely affected by the drought conditions in the key growing season, and so the results on beans are less favorable than those on potatoes.

9.1. Bean production

Similar to potatoes, bean crop production was estimated at the household level and included the latest harvest. Planted area was estimated by using the quantity of seed farmers used, assuming 60 kg per hectare as a seeding rate. A total of 109 households grew and sold beans in 2008 and 2012. As indicated earlier, data were collected solely

Table 22. Potato sellers: Average receipts, costs, gross margins and percentage sold, per participation in FO

	Participation in FO						
	2008		2012		difference		DID
Detail	Yes	No	Yes	No	Yes	No	
Receipts (Kw)	18,103	13,484	54,793	46,233	36,690	32,749	3,940
Price per kg sold (Kw/kg)	49	53	90	85	40	32	8
Total Costs (Kw)	15,498	7,303	38,080	26,511	22,560	19,208	3,352
Production costs per kg produced (Kw/kg)	36.1	38.6	65.7	57.8	29.6	19.2	10
Marketing costs per kg sold (Kw/kg)	3.0	1.1	7.7	2.7	4.6	1.6	3
Gross margins (Kw)	2,606	6,181	16,735	19,722	14,129	13,541	588
Total quantity sold (% of total production)	85%	89%	86%	84%	1%	-5%	5%
Number of sample observations	45	63	45	63	45	63	

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. Kwanzas: real Kwanzas, base Dec 2012. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

for households selling beans, limiting the number of households, especially in a year of drought and reduced production, as can be seen in Table 2.

Total bean production among common bean sellers who produced in both years decreased between 2008 and 2012 (Table 23), such that an average total production of only 213 kgs was found in 2012. As indicated above, the sample includes only 21 ProRenda participant households that grew and sold beans in both 2008 and 2012 for extrapolation (Table 24). There are no statistically significant changes in production, quantity of seed planted and estimated planted area between participants and non-participants in ProRenda.

Gender of the household head does not seem to play a role in the differences in quantity produced by these marketing households between 2008 and 2012 (Table 25). For households headed by females, there was a significant increase in the quantity of seed planted (from 25 kgs in 2008 to 53 kgs in 2012) while households headed by males marginally decreased seed planted (from 64 to 57 kgs). Given the method of estimating area planted, this results in larger land areas for women headed households, approaching the average land area planted by selling households headed by men. Participation in FOs did not have an effect in production, seed planted or planted area for beans (Table 26).

Table 23. Bean production: Average production (kg) and planted area (ha)

	Total		
	2008	**2012**	**diff**
Detail			
Production (kg)	245	213	-32
Quantity of seed planted (kg)	53	56	3
Estimated planted area (ha)	0.89	0.94	0.05
Number of sample observations	109	109	109

NOTES: One ha = 10,000 square meters. Planted area estimated using a seeding rate of 60kg/ha. Variables are at the household level. Estimates weighted to reflect population. "Diff" = Difference between 2012 and 2008.
Source: ProRenda survey, Angola, 2009, 2013

Table 24. Bean production: Average production (kg) and planted area (ha) per participation in ProRenda

	Participation in ProRenda						
	2008		**2012**		**difference**		**DID**
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**	
Production (kg)	232	248	140	226	-91	-22	-69
Quantity of seed planted (kg)	38	56	41	59	2.6	3.0	-0.48
Estimated planted area (ha)	0.64	0.93	0.68	0.98	0.04	0.05	-0.01
Number of sample observations	21	88	21	88	21	88	

NOTES: One ha = 10,000 square meters. Planted area estimated using a seeding rate of 60kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

9.2. Sales receipts and margins

In spite of having a total of 109 observations for bean producers and sellers, we only had 84 valid observations to conduct the sales and receipt analysis (Table 27). The number of ProRenda participant observations for bean sellers that we could use for population estimates reduces to only 14. Therefore the comparison between participants in ProRenda with respect to nonparticipants in ProRenda, must be read considering the low sample numbers. Participants in ProRenda experience an increase in total receipts of 5,346 kw, with respect to an increase of 13,436 kw for nonparticipants in ProRenda (Table 28). The DID indicator of -8,090 kw indicates that participants increased in receipts is lower than for nonparticipants, and this difference is significant at 5 percent level (Table 28).

Table 25. Bean production: Average production (kg) and planted area (ha) per gender of household head

	Gender of household head							
	2008		2012		difference		DID	
Detail	Male	Female	Male	Female	Male	Female		
Production (kg)	236	270	228	173	-8	-97	89	
Quantity of seed planted (kg)	64	25	57	53	-6	28	-35	*
Estimated planted area (ha)	1.06	0.41	0.96	0.88	-0.11	0.47	-1	*
Number of sample observations	72	37	72	37	72	37		

NOTES: One ha = 10,000 square meters. Planted area estimated using a seeding rate of 60kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013 .
***1%, **5%, *10% significance levels

Table 26. Bean production: Average production (kg) and planted area (ha) per participation in farmer organizations

	Participation in FO							
	2008		2012		difference		DID	
Detail	Yes	No	Yes	No	Yes	No		
Production (kg)	275	237	235	207	-40	-30	-10	
Quantity of seed planted (kg)	49	55	41	61	-8	6	-14	
Estimated planted area (ha)	0.81	0.91	0.68	1.01	-0.13	0.10	0	
Number of sample observations	26	83	26	83	26	83		

NOTES: One ha = 10,000 square meters; FO = Farmer Organization. Planted area estimated using a seeding rate of 2,750kg/ha. Variables are at the household level. Estimates weighted to reflect population. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013
***1%, **5%, *10% significance levels

Production costs, and receipts increased more for non-participants than for participants in ProRenda, and prices were higher for both participants and nonparticipants. Gross margins for ProRenda participants actually decreased by 49 kw on average, with a significantly lower percentage of production sold. Non-participants, in contrast, increased gross margins by 5,750 kw (Table 27), a significant difference with the participants (Table 28). Given the low sample numbers among participants of ProRenda, it is difficult to interpret these results.

Table 27. Bean sellers: Average receipts, costs, gross margins and percentage sold

	Total		
	2008	2012	diff
Detail			
Receipts (Kw)	6,371	18,534	12,164
Price per kg sold (Kw/kg)	47	201	154
Total Costs (Kw)	1,025	8,348	7,324
Production costs per kg produced (Kw/kg)	5.0	71.7	66.8
Marketing costs per kg sold (Kw/kg)	1.0	2.5	1.5
Gross margins (Kw)	5,346	10,186	4,840
Total quantity sold (% of total production)	62%	51 %	-10 %
Number of sample observations	84	84	84

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. "Diff" = Difference between 2012 and 2008.
Source: ProRenda survey, Angola, 2009, 2013

Table 28. Bean sellers: Average receipts, costs, gross margins and percentage sold, participation in ProRenda.

	Participation in ProRenda							
	2008		2012		Difference		DID	
Detail	Partic	Non Partic	Partic	Non Partic	Partic	Non Partic		
Receipts (Kw)	6,501	6,346	11,847	19,782	5,346	13,436	-8,090	**
Price per kg sold (Kw/kg)	48	47	159	208	112	162	-50	
Total Costs (Kw)	2,103	824	7,498	8,507	5,395	7,683	-2,288	*
Production costs per kg produced (Kw/kg)	7.5	4.5	62.0	73.5	54.5	69.0	-14	
Marketing costs per kg sold (Kw/kg)	2.4	0.7	4.0	2.2	1.6	1.5	0	
Gross margins (Kw)	4,397	5,523	4,349	11,275	-49	5,753	-5,801	*
Total quantity sold (% of total production)	81%	59%	49%	52%	-31%	-6%	-25%	*
Number of sample observations	14	70	14	70	14	70		

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013. ***1%, **5%, *10% significance levels.

Regarding bean sales by gender of household head, male headed households received higher total receipts, 3,573 kw above the increase in receipts for female headed households (this DID is significant at 10 percent level) (Table 29). However male headed households also received lower prices per kg sold. The price per kg sold increased by 210 kw for female headed households, for male headed households this increase was of 131 kw, lower by 79 kw compare with the price per kg sold of beans for female headed households (Table 29). This DID indicator is significant at 5 percent level. This could be explaining the results from table 28. where production for female headed households decreased between 2008 and 2012 yet receipts increased.

Male headed households also experienced an increase in total costs of bean production and marketing. The increase in this cost was of 8,213 kw, 3,056 kw (Table 29) above the increase in costs for female headed households, and with a significant level for the DID indicator of 1 percent (Table 29). There were not significant differences between male and female headed households in terms of gross margins and on the total quantity sold as a percentage of total bean production.

As in the case of participation in ProRenda, only a small number of observations were available in the sample for participants in FO. For both participants and non-participants in FO, receipts practically doubled between 2008 and 2012 (Table 30). For participants in FO, this increase was lower by -7,217 kw and this DID is significant at 5 percent level (Table 30).

Table 29. Bean sellers: Average receipts, costs, gross margins and percentage sold, per gender of household head

	Gender of household head							
	2008		2012		difference		DID	
Detail	Male	Female	Male	Female	Male	Female		
Receipts (Kw)	8,063	2,249	21,268	11,880	13,204	9,631	3,573	*
Price per kg sold (Kw/kg)	47	45	178	255	131	210	-79	**
Total Costs (Kw)	1,181	644	9,394	5,801	8,213	5,157	3,056	***
Production costs per kg produced (Kw/kg)	4.8	5.3	94.1	17.2	89.3	11.9	77	
Marketing costs per kg sold (Kw/kg)	1.1	0.7	2.4	2.7	1.3	2.0	-1	
Gross margins (Kw)	6,882	1,605	11,873	6,079	4,991	4,474	517	
Total quantity sold (% of total production)	67%	51%	52%	51%	-15%	0%	-15%	
Number of sample observations	54	30	54	30	54	30		

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012. "DID" = Difference in Differences

Source: ProRenda survey, Angola, 2009 and 2013 ***1%, **5%, *10% significance levels

Table 30. Bean sellers: Average receipts, costs, per participation in FO

	Participation in FO							
	2008		2012		difference		DID	
Detail	Yes	No	Yes	No	Yes	No		
Receipts (Kw)	6,116	6,435	12,523	20,060	6,408	13,625	-7,217	**
Price per kg sold (Kw/kg)	45	47	234	192	189	145	44	
Total Costs (Kw)	2,284	705	13,815	6,961	11,531	6,256	5,275	*
Production costs per kg produced (Kw/kg)	8.9	4.0	152.7	51.2	143.8	47.2	97	**
Marketing costs per kg sold (Kw/kg)	1.9	0.7	4.4	2.0	2.5	1.3	1.2	
Gross margins (Kw)	3,831	5,730	-1,291	13,099	-5,123	7,369	-12,492	**
Total quantity sold (% of total production)	69%	61%	55%	51%	-14%	-9%	-5%	
Number of sample observations	17	67	17	67	17	67		

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012. "DID" = Difference in Differences
Source: ProRenda survey, Angola, 2009 and 2013 ***1%, **5%, *10% significance levels

Bean gross margins decreased for participants in FOs with respect to nonparticipants, with a DID of -12,492 kw, significant at 5 percent level (Table 30). At the same time the DID of total costs for beans was of 5,275 kw and the DID for production costs per kg produced is 97 kw, with significant levels of 10 percent and 5 percent correspondingly (Table 30). The decrease in the total receipts of FO participants and the also statistically significant increase in total costs and production costs per kg produced for participants in FO could be an explanation of the decrease in gross margins.

10. Onion production and onion farmers

10.1. Onion production

Similar to potatoes and beans, onion production was estimated at the household level and included the latest harvest. Additionally, planted area was estimated by using the quantity of seed farmers used. Since the quantity of seed required to plant one hectare is small (1 kg), small changes in this quantity will make planted area change by a large amount. Due to the difficulty with conversion factors for different units of measure for seeds we were unable to measure the quantity of seed used and a can of seed could have had different weight, so we do not report seed quantities for any estimated area planted.

Table 31. Onion production: Average production (kg)

	Total		
	2008	**2012**	**diff**
Detail			
Production (kg)	57	115	58
Number of sample observations	54	54	54

NOTES: FO = Farmer Organization. Quantity of seed used and planted area not reported because they appear to be inconsistent. Estimates weighted to reflect population. Only onion producers included. "Diff" = Difference between 2012 and 2008.
Source: ProRenda survey, Angola, 2009, 2013.

For the total number of households that produced onions in both 2008 and 2012 we had information to compare production for a total of 54. Average onion production almost doubled between 2008 and 2012 (Table 31). Sample numbers are small for conducting statistical comparison. We present tables with the estimates but we do not conduct statistical tests for equal means in the case of onion production.

Table 32 Onion production: Average production (kg) per participation in ProRenda

	Participation in ProRenda						
	2008		**2012**		**difference**		**DID**
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**	
Production (kg)	88	33	125	107	37	74	-37
Number of sample observations	23	31	23	31	23	31	

NOTES: FO = Farmer Organization. Quantity of seed used and planted area not reported because they appear to be inconsistent. Estimates weighted to reflect population. Only onion producers included.

Source: ProRenda survey, Angola, 2009, 2013.

10.2. Sales receipts and gross margins

Surprisingly, out of the 54 onion producers, only 33 households indicated selling part of their production. With these relatively small sample numbers, we present the extrapolated tables for information of the reader, but no analysis of significance of differences is provided (Tables 35-38).

Table 33. Onion production: Average production (kg) per gender of household head

	Gender of household head						
	2008		2012		difference		DID
Detail	Male	Female	Male	Female	Male	Female	
Production (kg)	59	33	119	71	60	38	22
Number of sample observations	38	16	38	16	38	16	

NOTES: FO = Farmer Organization. Quantity of seed used and planted area not reported because they appear to be inconsistent. Estimates weighted to reflect population. Only onion producers included.
Source: ProRenda survey, Angola, 2009, 2013.

Table 34. Onion production: Average production (kg) per participation in farmer organizations

	Participation in FO						
	2008		2012		difference		DID
Detail	Yes	No	Yes	No	Yes	No	
Production (kg)	83	42	141	101	57	59	-1
Number of sample observations	22	32	22	32	22	32	

NOTES: FO = Farmer Organization. Quantity of seed used and planted area not reported because they appear to be inconsistent. Estimates weighted to reflect population. Only onion producers included.
Source: ProRenda survey, Angola, 2009, 2013.

Table 35. Onion sellers: Average receipts, costs, gross margins and percentage sold

	Total		
	2008	2012	Diff
Detail			
Receipts (Kw)	4,902	15,432	10,530
Price per kg sold (Kw/kg)	69	176	107
Total Costs (Kw)	2,905	6,467	3,562
Production costs per kg produced (Kw/kg)	46.2	84.2	38.0
Marketing costs per kg sold (Kw/kg)	1.9	6.0	4.1
Gross margins (Kw)	1,997	8,966	6,969
Total quantity sold (% of total production)	79%	83%	5%
Number of sample observations	33	33	33

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population. "Diff" = Difference between 2012 and 2008. Information on Kwanzas is on real Kwanzas for Dec 2012.

Table 36. Onion sellers: Average receipts, costs, gross margins and percentage sold, per participation in ProRenda

	Participation in ProRenda						
	2008		2012		difference		DID
Detail	Partic	Non Partic	Partic	Non Partic	Partic	Non Partic	
Receipts (Kw)	8,471	2,339	26,320	7,616	17,849	5,277	12,572
Price per kg sold (Kw/kg)	92	52	252	121	160	69	91
Total Costs (Kw)	4,876	1,490	7,658	5,611	2,782	4,122	-1,340
Production costs per kg produced (Kw/kg)	58.2	37.6	98.5	73.9	40.4	36.3	4
Marketing costs per kg sold (Kw/kg)	1.8	2.0	2.1	8.9	0.3	6.9	-7
Gross margins (Kw)	3,595	850	18,662	2,005	15,067	1,155	13,911
Total quantity sold (% of total production)	81%	77%	72%	91%	-9%	14%	-23%
Number of sample observations	15	18	15	18	15	18	

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs.
Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009 and 2013

Table 37. Onion sellers: Average receipts, costs, gross margins and percentage sold, per gender of household head

	Gender of household head						
	2008		2012		difference		DID
Detail	Male	Female	Male	Female	Male	Female	
Receipts (Kw)	5,197	2,783	16,488	7,857	11,291	5,074	6,216
Price per kg sold (Kw/kg)	62	114	170	220	108	105	2
Total Costs (Kw)	3,021	2,075	6,346	7,329	3,326	5,254	-1,929
Production costs per kg produced (Kw/kg)	43.0	69.1	74.1	156.9	31.1	87.9	-57
Marketing costs per kg sold (Kw/kg)	2.0	1.5	6.2	5.3	4.2	3.7	0
Gross margins (Kw)	2,177	708	10,142	528	7,965	-180	8,145
Total quantity sold (% of total production)	80%	68%	82%	90%	2%	22%	-20%
Number of sample observations	20	13	20	13	20	13	

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs.
Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009 and 2013

Table 38. Onion sellers: Average receipts, costs, gross margins and percentage sold, per participation in FO

	Participation in FO						
	2008		2012		difference		DID
Detail	Yes	No	Yes	No	Yes	No	
Receipts (Kw)	8,513	2,415	24,766	9,005	16,253	6,590	9,663
Price per kg sold (Kw/kg)	103	45	259	119	156	74	82
Total Costs (Kw)	4,713	1,659	6,988	6,107	2,275	4,448	-2,173
Production costs per kg produced (Kw/kg)	59.7	36.9	96.9	75.5	37.2	38.6	-1
Marketing costs per kg sold (Kw/kg)	1.8	2.0	1.9	8.9	0.0	6.9	-7
Gross margins (Kw)	3,799	756	17,777	2,897	13,978	2,142	11,836
Total quantity sold (% of total production)	79%	78%	70%	93%	-10%	15%	-24%
Number of sample observations	13	20	13	20	13	20	

NOTES: Kw = Kwanzas. Costs include purchased inputs, hired labor and reported marketing costs. Variables are at the household level. Estimates weighted to reflect population.
Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009 and 2013

11. Use of fertilizers and pesticides

11.1. Potato producers' input use

Since potatoes are seen primarily as a cash crop for households and agronomists recommend fertilization in the Angolan highlands, it is expected that fertilizer use among the potato farmers would be relatively common. About 76 percent of the sample did use fertilizers in 2008 and 81 percent used fertilizer for potato production in 2012 (Table 39). The percentage of farmers using fertilizer among participants in ProRenda changed very little between 2008 and 2012, whereas a higher percentage of nonparticipants used it in 2012 compared to 2008. The DID indicator is -7 percent and is statistically significant at 1 percent level (Table 40). We do not have an accurate estimate of the dose used for fertilizers, as area is only estimated, not measured, but we did ask about quantity and cost. Although the quantity of NPK used increased between 2008 and 2012 for both participants and nonparticipants, nonparticipants increased the quantity used more than participants, with a DID of -102 NPK kg used, significant at 10 percent level (Table 39). Relatively slow growth in use of fertilizer by project participants could be part of the changes in their farming practices due to the drought, and may reflect training on cropping management and economic analysis. There are no significant changes in pesticide use between participants and nonparticipant in ProRenda. Also, while there is no statistically significant difference in the change of percentage of households using pesticides between ProRenda participants and

nonparticipants, the percentages of households them more than doubled for both types of households (Table 40).

Table 39. Potato production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers

	Total		
	2008	2012	Diff
Detail			
Use fertilizer (%)	76%	81%	4%
Use pesticide (%)	13%	41%	27%
Quantity of NPK used (kg)	62	268	206
Expenses on fertilizer (Kw)	5646	16173	10527
Number of sample observations	129	129	129

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. "Diff" = Difference between 2012 and 2008.
Source: ProRenda survey, Angola, 2009, 2013.

Table 40. Potato production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per participation in ProRenda

	Participation in ProRenda							
	2008		2012		difference		DID	
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**		
Use fertilizer (%)	81%	74%	80%	81%	-1%	7%	-8%	***
Use pesticide (%)	16%	11%	40%	41%	24%	30%	-6%	
Quantity of NPK used (kg)	101	41	241	283	140	242	-102	*
Expenses on fertilizer (Kw)	9,230	3,663	20,821	13,601	11,592	9,938	1,654	
Number of sample observations	50	79	50	79	50	79		

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.

Source: ProRenda survey, Angola, 2009013.
***1%, **5%, *10% significance levels

Comparing potato producing male and female headed households (Table 41), increased percentages of households were using both pesticides and fertilizers, without significant differences in the changes. Both types also increased the amount and expenditures on fertilizers, in spite of the drought. This result indicates that both male and female headed households were able to take advantage of the increased village availability of inputs.

In the case of participants in FO, the percentage of households using fertilizer and pesticide did not change in a statistically significant way. However, the increase in the amount of fertilizer NPK kg used per household in potato production was lower

participants in FO compared to nonparticipants in FO resulting in a DID of 215 kg NKP (10 percent significant level) (Table 42). Surprisingly, the change in total expenses in fertilizer for participants in FO was significantly greater such that the DID is 5,120 kw (Table 42). There may be a relationship with increased access and changing prices for fertilizers, but it is unclear.

Table 41. Potato production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per gender of head

	Gender of household head						
	2008		2012		difference		DID
Detail	Male	Female	Male	Female	Male	Female	
Use fertilizer (%)	78%	69%	81%	78%	3%	10%	-7%
Use pesticide (%)	13%	15%	41%	39%	28%	24%	4%
Quantity of NPK used (kg)	69	32	278	227	208	195	13
Expenses on fertilizer (Kw)	6,332	2,628	16,883	13,048	10,551	10,420	131
Number of sample observations	85	44	85	44	85	44	

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009013.
***1%, **5%, *10% significance levels

Table 42. Potato production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per participation in farmer organizations

	Participation in FO							
	2008		2012		difference		DID	
Detail	Yes	No	Yes	No	Yes	No		
Use fertilizer (%)	72%	79%	78%	83%	5%	3%	2%	
Use pesticide (%)	16%	11%	44%	38%	28%	27%	0%	
Quantity of NPK used (kg)	94	41	171	333	77	292	-215	*
Expenses on fertilizer (Kw)	8,303	3,877	21,904	12,358	13,601	8,481	5,120	*
Number of sample observations	52	77	52	77	52	77		

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009013.
***1%, **5%, *10% significance levels

11.2. Bean producers' input use

Since beans are primarily a food security crop, it fixes nitrogen, and has lower marketed percentage of production, it is not expected that many households apply external inputs (fertilizers or pesticides) to their bean crops. The percentage of households that used fertilizer among bean producers/sellers was 3 percent in 2008 and 16 percent in 2012, and there is no use of pesticide in any of the two years for bean production (Table 43)

Table 43. Bean production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers

	Total		
	2008	2012	diff
Detail			
Use fertilizer (%)	3%	16%	13%
Use pesticide (%)	0%	0%	0%
Expenses on fertilizer (Kw)	50	2060	2010
Number of sample observations			

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.

Table 44. Bean production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per participation in ProRenda

	Participation in ProRenda							
	2008		2012		difference		DID	
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**		
Use fertilizer (%)	0%	4%	42%	12%	42%	8%	34%	***
Use pesticide (%)	0%	0%	0%	0%	0%	0%	0%	
Expenses on fertilizer (Kw)	0	59	3,993	1,713	3,993	1,654	2,339	*
Number of sample observations	21	88	21	88	21	88		

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.
***1%, **5%, *10% significance levels

Table 45. Bean production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per gender of head

	Gender of household head							
	2008		2012		difference		DID	
Detail	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**		
Use fertilizer (%)	4%	0%	18%	13%	14%	13%	1%	
Use pesticide (%)	0%	0%	0%	0%	0%	0%	0%	
Expenses on fertilizer (Kw)	68	0	2,572	667	2,504	667	1,837	*
Number of sample observations	72	37	72	37	72	37		

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.
***1%, **5%, *10% significance levels

Table 46. Bean production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers, per participation in FO

	Participation in FO							
	2008		2012		difference		DID	
Detail	Yes	No	Yes	No	Yes	No		
Use fertilizer (%)	10%	1%	30%	13%	20%	11%	9%	
Use pesticide (%)	0%	0%	0%	0%	0%	0%	0%	
Expenses on fertilizer (Kw)	94	37	5,519	1,084	5,424	1,046	4,378	**
Number of sample observations	26	83	26	83	26	83		

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.
***1%, **5%, *10% significance levels

The percentage of participant households that use fertilizer increased over the increase for nonparticipants in ProRenda. The DID is of 34 percent and it is significant at 1 percent level (Table 44), expenses in fertilizer for participants in ProRenda with respect to nonparticipants also increased, with a DID of 2,339kw significant at 10 percent level. Male headed households also increased their expenses in fertilizer with respect to female headed households for the production of beans with a DID of 1,837 kw significant at 10 percent level (Table 45). This increase in expenses also was made by households participating in FO, which expenses that increase above the ones by nonparticipant in FO households by 4,378 kw with a significance level of 5 percent (Table 46).

11.3. Onion producers' input use

Onions, like potatoes, are seen as a cash crop and thus the use of fertilizers is once again expected to be more common than in bean production, but the area planted to onions is usually small and thus the quantities needed are small. As in the case for the production and receipts for onions, we have small sample numbers for producing meaningful statistical analysis and therefore, we provide Tables 47-50 with the data to inform the reader, but warn that the results must be read considering this caveat. The results indicate that there may be increased participation by women headed households in the use of purchased inputs of onions, both in terms of the percentage of households using as well as in the quantities of fertilizer used.

Table 47. Onion production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers.

	Total		
	2008	2012	diff
Detail			
Use fertilizer (%)	62%	71%	9%
Use pesticide (%)	14%	15%	1%
Quantity of NPK used (kg)	18	168	150
Expenses on fertilizer (Kw)	1834	4146	2311
Number of sample observations	54	54	54

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.

Table 48. Onion production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers per participation in ProRenda

	Participation in ProRenda						
	2008		2012		difference		DID
Detail	**Partic**	**Non Partic**	**Partic**	**Non Partic**	**Partic**	**Non Partic**	
Use fertilizer (%)	82%	47%	62%	77%	-19%	30%	-49%
Use pesticide (%)	28%	3%	21%	10%	-7%	7%	-14%
Quantity of NPK used (kg)	31	9	119	204	89	195	-106
Expenses on fertilizer (Kw)	3,556	574	2,945	5,024	-611	4,450	-5,061
Number of sample observations	23	31	23	31	23	31	

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.

Table 49. Onion production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers per gender of head

	Gender of household head						
	2008		2012		difference		DID
Detail	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	
Use fertilizer (%)	64%	38%	71%	70%	7%	32%	-25%
Use pesticide (%)	15%	1%	15%	18%	0%	17%	-17%
Quantity of NPK used (kg)	18	13	165	195	147	182	-35
Expenses on fertilizer (Kw)	1,923	933	4,128	4,321	2,205	3,388	-1,183
Number of sample observations	38	16	38	16	38	16	

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.

Table 50. Onion production: Farmers using fertilizers and pesticides, average quantity of NPK used and average expenses on fertilizers per participation in FO

	Participation in FO						
	2008		2012		difference		DID
Detail	Yes	No	Yes	No	Yes	No	
Use fertilizer (%)	70%	57%	71%	71%	1%	14%	-13%
Use pesticide (%)	34%	3%	21%	12%	-13%	9%	-22%
Quantity of NPK used (kg)	37	8	140	183	103	176	-73
Expenses on fertilizer (Kw)	3,674	839	3,478	4,507	-196	3,667	-3,864
Number of sample observations	22	32	22	32	22	32	

NOTES: Use of fertilizer and use of pesticide are binary (0=No, 1=YES). Kw = Kwanzas. Estimates weighted to reflect population. Information on Kwanzas is on real Kwanzas for Dec 2012.
Source: ProRenda survey, Angola, 2009, 2013.
***1%, **5%, *10% significance levels

12. Marketing strategies across the crops

ProRenda focused on development of farmer skills in marketing and there are noticeable changes in the strategies that farmers used in 2012 compared to the baseline period 2008. Both of these aspects (location and timing) demonstrate greater strategic behavior by farmers in their marketing.

There are substantial changes in where farmers market their commodities, reflecting a combination of market changes and farmer strategies (Table 51). For potatoes and onions, farmers were able to sell directly from their own homes or fields, indicating that they selected that sales location due to ease of sales, but13 percent indicated good relations with traders as key reasons for selling. Results presented earlier in this report pointed to higher prices for farmers in 2013, so farmers were able to achieve the higher prices while reducing their transport costs. Fewer farmers went to markets outside the local area to sell their potatoes, going from 28 percent of farmers down to just 12 percent for potatoes. In comparison, bean marketing shifted away from the field and home to local and more distant markets, primarily due to the ability to gain higher prices in those markets (47 percent of bean farmers indicated this reason for sales point in 2012 compared to 22 percent in 2008), although there were transport constraints indicated by 27 percent of farmers in 2012 compared to 16 percent in 2008.

The information on timing of sales shows a greater emphasis on sales at time of harvest for the three crops, especially for potatoes and onions (Table 52), but it should be noted that planting may have been more strategically planned such that the harvest period falls within key periods for high prices. Thus farmers indicate sales at harvest as the key reason for timing of sales, although other factors may be involved. This is reinforced by the seeking of sales points based on good prices, as well as a few of the shifts of harvest periods. For example, onion sales increasing in December with 19 percent of farmers selling in that month in 2012 compared to 15 percent in 2008, in time for the holidays.

Table 51 Farmers' location of sales and main reason for that choice of location, by crop, 2009 and 2013

	Reasons for selecting this place 2009						Reasons for selecting this place 2013					
Place of sales	**Ease of sales**	**Good price**	**Lack of transport**	**Good relations with traders**	**Other**	**Total**	**Ease of sales**	**Good price**	**Lack of transport**	**Good relations with traders**	**Other**	**Total**
Potatoes	(% farmers selling)						(% of farmers selling)					
Own field	4.1	0.0	0.8	0.3	0.0	5.2	6.8	0.9	3.9	2.2	0.9	14.7
Own home	11.6	1.0	2.9	0.5	0.6	16.7	11.3	2.5	4.2	10.4	0.1	28.5
Local market	37.8	1.8	9.1	1.2	0.3	50.2	34.4	7.2	1.7	0.1	0.5	44.0
Other market	3.7	16.9	0.0	2.4	2.8	25.8	4.2	6.6	0.1	0.0	0.0	10.9
Other place	0.1	2.0	0.0	0.0	0.0	2.1	1.1	0.5	0.3	0.0	0.0	1.9
Overall	57.4	21.7	12.8	4.4	3.7	100.0	57.7	17.7	10.3	12.7	1.6	100.0
Beans												
Own field	0.6	0.0	0.5	0.4	0.0	1.6	1.7	0.0	0.0	0.0	0.0	1.7
Own home	10.5	0.6	2.8	5.3	0.5	19.7	0.0	0.0	3.0	0.0	0.5	3.5
Local market	31.2	7.4	12.1	0.5	0.3	51.5	0.0	16.0	4.3	3.1	19.0	42.4
Other market	7.6	14.0	0.0	3.6	0.6	25.9	0.0	28.0	11.5	1.0	0.9	41.4
Other place	0.6	0.0	0.0	0.0	0.8	1.4	0.0	2.6	7.8	0.5	0.3	11.1
Overall	50.5	22.0	15.5	9.9	2.2	100.0	1.7	46.5	26.6	4.5	20.7	100.0
Onions												
Own field	5.5	0.0	0.7	0.4	0.0	6.6	9.3	4.7	0.7	7.8	0.0	22.5
Own home	14.6	0.7	4.7	1.3	0.0	21.3	7.0	2.2	2.3	10.7	0.0	22.1
Local market	28.3	5.4	9.5	3.2	0.4	46.8	20.7	9.3	1.1	0.0	0.0	31.1
Other market	3.1	15.9	1.2	0.7	2.7	23.6	3.3	19.0	0.0	0.7	1.3	24.3
Other place	0.1	1.6	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0
Overall	51.5	23.6	16.2	5.6	3.1	100.0	40.3	35.2	4.0	19.1	1.3	100.0

Note: Each farmer was asked for one main reason for choice per crop season of sales. Estimates weighted to reflect population.

Source: ProRenda Surveys, Angola 2009 and 2013

Table 52 Reasons for Month of Sales, by Crop, 2009 and 2013

	Reason for sales in that month, 2009						Reason for sales in that month, 2013					
Months	Harvest	Good price	Lack of storage	Other	Total	Months	Harvest	Good price	Lack of storage	Other	Total
	% of responses						% of responses					
Potatoes						**Potato**						
January	8.0	0.7	0.3	2.1	11.0	January	11.3	0.5	0.0	0.4	12.2
Febuary	1.4	1.3	0.0	1.7	4.4	February	6.5	0.3	1.1	0.3	8.3
March	0.1	0.1	0.0	0.0	0.3	March	0.6	0.0	0.0	0.0	0.6
April	1.4	0.0	0.0	0.0	1.4	April	1.5	0.5	0.0	0.1	2.0
May	0.1	0.0	0.0	0.4	0.5	May	3.4	0.1	0.0	0.0	3.5
June	2.7	2.5	0.0	2.5	7.7	June	6.6	0.4	0.0	0.0	7.0
July	4.7	1.2	0.0	1.0	6.9	July	4.4	1.9	0.0	0.0	6.3
August	1.2	0.4	0.0	0.6	2.2	August	3.4	0.8	0.0	0.1	4.2
Septembe	3.0	1.2	0.0	0.3	4.6	September	7.2	0.1	0.1	0.0	7.4
October	3.8	3.0	0.0	3.9	10.7	October	3.7	1.1	0.0	0.0	4.8
Novembe	6.2	4.0	0.0	0.4	10.6	November	3.8	3.4	0.0	0.4	7.6
Decembe	22.7	14.4	0.7	2.0	39.9	December	21.9	14.2	0.1	0.0	36.2
Overall	55.4	28.8	1.0	14.8	100.0	Overall	74.3	23.1	1.3	1.3	100.0
Beans						**Beans**						
January	14.8	2.1	0.0	7.0	23.9	January	16.4	4.4	1.1	0.3	22.2
Febuary	15.7	5.9	0.4	3.7	25.7	February	11.0	5.3	3.5	1.5	21.3
March	4.0	1.3	0.0	1.0	6.3	March	2.7	2.6	0.0	0.0	5.3
April	2.3	0.7	0.2	0.8	4.2	April	1.1	0.1	0.0	0.0	1.2
May	2.6	1.5	0.0	0.0	4.1	May	2.1	0.4	0.0	0.0	2.4
June	7.9	2.9	0.0	1.6	12.3	June	6.6	4.1	0.0	2.2	12.8
July	0.7	3.8	0.0	1.4	5.9	July	3.7	3.7	0.0	0.8	8.2
August	0.8	2.0	0.0	1.6	4.4	August	6.5	0.8	0.0	0.0	7.3
Septembe	2.1	5.3	0.0	0.1	7.5	September	3.1	4.9	0.2	0.1	8.2
October	0.0	1.3	0.0	0.3	1.5	October	0.1	0.6	0.0	0.0	0.7
Novembe	0.0	1.3	0.0	0.1	1.4	November	1.2	2.5	0.0	0.0	3.7
Decembe	2.2	0.2	0.0	0.4	2.8	December	3.3	3.2	0.0	0.3	6.7
Total	53.1	28.3	0.7	18.0	100.0	Total	57.7	32.5	4.8	5.0	100.0
Onions						**Onions**						
January	13.3	3.2	0.0	6.0	22.5	January	20.0	0.1	0.0	0.0	20.1
Febuary	10.7	5.3	0.3	0.4	16.7	February	5.1	0.0	0.0	0.0	5.1
March	0.3	0.0	0.0	0.2	0.5	March	2.9	0.0	0.0	0.0	2.9
April	5.3	0.0	0.0	0.1	5.4	April	0.0	0.0	0.0	0.0	0.0
May	5.5	0.0	0.0	0.0	5.5	May	5.2	0.5	0.0	0.0	5.7
June	3.4	0.0	0.0	0.6	4.0	June	12.8	0.4	0.0	0.4	13.6
July	4.7	1.2	0.0	0.0	6.0	July	1.7	0.0	0.0	3.0	4.7
August	11.4	0.6	0.0	0.9	12.9	August	6.8	2.1	0.4	0.2	9.5
Septembe	0.9	6.1	0.0	0.0	7.0	September	7.7	0.1	0.0	0.0	7.7
October	2.3	0.4	0.4	0.6	3.7	October	7.8	0.0	0.0	0.0	7.8
Novembe	3.2	0.5	0.0	0.5	4.2	November	1.6	2.6	0.0	0.0	4.2
Decembe	3.6	7.0	0.0	1.2	11.7	December	11.7	3.3	2.9	1.0	18.9
Total	64.6	24.3	0.7	10.4	100.0	Total	83.1	9.1	3.3	4.5	100.0

Notes: Each farmer may report for 2-3 harvests per year per crop. Estimates are weighted to reflect population.

Source: ProRenda Survey, Angola 2009 and 2013

Table 53 Main source of information on prices, by crop, 2009 and 2013

	Potatoes		Beans		Onions	
	2009	2013	2009	2013	2009	2013
	(% of selling households)					
Information sought	70	83	70	86	55	82
Of selling households that sought information:	(% of selling households who sought information)					
Wife	5	2	5	10	0	2
Friend	58	61	46	65	54	72
Radio	0	6	0	1	0	0
Trader	32	14	45	12	42	7
Association	0	4	0	2	0	4
Others	5	12	4	10	4	15

Source: ProRenda Surveys, Angola 2009 and 2013

In looking at the sources of information, a higher percentage of households for each crop sought price information for sales. While friends became more important sources indicated by those households selling beans and onions, for potato selling households, the person responsible for selling was more likely to seek out information from associations or the radio than before. Sellers of all the crops relied less on traders as a source of price information. One clarification is needed: many farmers use more than one source of information and the question was asked about primary source of information, so there may be under-reporting of the secondary sources. Since the radio and associations are new, they may still need ground-truthing by farmers and thus fit under secondary sources for now. Given ProRenda's investments in market information and market training we expected to see greater emphasis on associations and radio for information. Potatoes do show the initial steps in that direction.

The numbers are very small for analyzing ProRenda participants versus nonparticipants at a crop level to understand impact. In addition, the likelihood of externalities is high, since farmers in markets tend to benefit from the actions of a few. ProRenda's investments in marketing developments may have had strong impact in the communities and among farmers, as they sought more information, worked with traders to establish good relations, and sold in new markets.

It is also important to consider who in the household is participating in marketing of the different commodities (Table 54). For potatoes and beans, we have analyzed the response of the households when asked who was responsible for marketing the crop, first in 2008 and then in 2012. We find that women are more likely to have participated in the marketing of the crops in 2012 than in 2008, although for both commodities the responsibility is shared for some households in both periods.

Table 54 Gender of person selling potatoes and beans, 2008 and 2012

Commodity	2008				2012			
Potatoes	Primary	Secondary	Control	Overall	Primary	Secondary	Control	Overall
Male	56%	49%	69%	52%	39%	42%	59%	41%
Female	39%	40%	31%	39%	49%	47%	23%	47%
Both	5%	11%	0%	8%	10%	10%	19%	10%
Not specified	0%	0%	0%	1%	2%	2%	0%	2%
Beans								
Male	46%	51%	49%	50%	41%	40%	34%	40%
Female	49%	41%	46%	44%	58%	55%	41%	56%
Both	4%	8%	3%	6%	1%	5%	25%	4%
Not specified	1%	0%	2%	0%	0%	0%	0%	0%

Source: ProRenda 2009 and 2013 Survey.

For beans, women became the main sellers in 2012, especially in the ProRenda primary villages, with 58 percent of households stating that women were the main sellers. For potatoes, the primary villages demonstrated the same overall tendency, with woman in selling in 49 percent of the households, and participating with men in another 10 percent. In control villages, men were much more likely to control sales of potatoes.

13. Incidence of drought at the household level

Table 8 presented the assessment of effects of the 2012 drought at the community level. An event such as a drought affects both production and decisions at the farm level regarding farming practices, and it is a challenge to net out those effects in an impact assessment, although we do hypothesize that the drought effect was not systematically biased towards participants, nonparticipants, or other groupings. Using the household data, Table 50 shows the household assessments of the effect of the drought by crop. In this case we are using sample numbers and we aim to provide an overview of the effects of the drought and how these might have affected project impacts.

Between 43 percent and 53 percent of sample households that grew potatoes, beans and onions in both years responded that they consider that the harvest in 2012 was worse than the harvest in a good year (Table 55). When asked why that result, drought was the most common answer: 46 percent of the households that grew potatoes considered that their harvest was worse because of the drought, 71 percent for the households that grew beans and 47 percent for the ones that grew onions. Of those households indicating losses, between 56 percent and 70 percent of households considered their losses to be a large portion of the crop.

Table 55. Incidence of drought at the household level, by crop

Item		Potatoes		Beans		Onion	
		Freq	Percent	Freq.	Percent	Freq.	Percent
		Sample Numbers					
Was harvest in 2012 worse than harvest in a good year?	not collected	2	1%	1	1%	3	4%
	Yes	70	47%	82	56%	36	43%
	No	76	51%	63	43%	44	53%
	Total	148	100%	146	100%	83	100%
If harvest was worse, why	Seed	3	4%	3	4%	2	6%
	Pest/disease	6	9%	8	10%	1	3%
	Unfertilized	10	14%	7	9%	3	8%
	Little fertilizer	11	16%	3	4%	7	19%
	Drought	32	46%	58	71%	17	47%
	Other	8	11%	3	4%	6	17%
	Total	70	100%	82	100%	36	100%
To what extent was your crop production affected?	Small loss	15	21%	20	24%	14	39%
	Big loss	49	70%	53	65%	20	56%
	Total loss	6	9%	9	11%	2	6%
	Total	70	100%	82	100%	36	100%
If you experienced problems with drought, did you reduce the amount of labor?	Yes	12	38%	27	47%	11	65%
	No	20	63%	31	53%	6	35%
	Total	32	100%	58	100%	17	100%
If you experienced problems with drought, did you reduce the amount of fertilizer?	Yes	15	47%	19	33%	12	71%
	No	17	53%	39	67%	5	29%
	Total	32	100%	58	100%	17	100%
If you experienced problems with drought, did you reduce the amount of pesticide?	Yes	15	47%	20	34%	6	35%
	No	17	53%	38	66%	11	65%
	Total	32	100%	58	100%	17	100%
How did harvest in 2012 compare to harvest in 2011?	Not collected	13	9%	5	3%	6	7%
	Much better	16	11%	10	7%	2	2%
	Better	38	26%	35	24%	29	35%
	Same	7	5%	12	8%	5	6%
	Worse	37	25%	34	23%	19	23%
	Much worse	37	25%	50	34%	22	27%
	Total	148	100%	146	100%	83	100%

Source: ProRenda survey, Angola, 2013.

As expected, households did take action within their cropping practices to mitigate the negative economic effects of the drought. For the case of potatoes, 47 percent of the households reduced the amount of fertilizer and pesticide used, 71 percent reduced the amount of fertilizer used for onions, although the sample numbers for households who grew onions and used fertilizer are small. In general for the three crops, about 50 percent of households responded that the harvest in 2012 was worse or much worse compared to the harvest in 2011 (see Table 55).

14. Credit access by households

In 2008, we found that very few households had access to agricultural credit for the commodities of interest here. Less than 2 percent of farmers accessed credit for

production of common beans, Irish potatoes, and horticultural crops obtained credit for production, with only two farm households out of the sample accessing for more than one crop (Table 56). The majority of credit was used for potato production and ProRenda participants were more likely to have accessed credit in 2008. It was expected that by 2012, many more ProRenda farmers, in particular, would have accessed credit. The responses of farmers indicate that there was a slight increase to 3.1 percent of ProRenda farmers that had accessed credit, mostly for potatoes, but the overall credit access slightly reduced to just 1.4 percent of farm households. The drought may have decreased demand for credit, as the returns to inputs tend to be low or negative under such adverse conditions. While the differences were not significant, the very small numbers involved are insufficient for conclusive evidence.

Table 56 Percentage of households accessing credit, by year and participation in ProRenda

Number of credits accessed by household	Participation in ProRenda		
	Yes	No	Overall
	(percentage of households)		
2008			
0	97.1%	98.7%	98.4%
1	2.8%	0.9%	1.3%
2	0.1%	0.4%	0.3%
2012			
0	96.9%	99.0%	98.6%
1	2.7%	1.0%	1.3%
2	0.4%	0.0%	0.1%

Source: ProRenda Surveys 2009 and 2013

15. Investments by the households[14]

Given the observed positive change in gross margins for these crops for both participating and nonparticipating households for last twelve months in the 2013 survey, investment decisions become important in how the household deals with change. Differences are found between households participating or not in ProRenda, especially for investments in vehicles, electronics and food (higher quantity or better quality of diet) (Table 57).

[14] This section is based on analysis in Dulys-Nussbaum (2013).

Table 57 Investment behavior in 2012, percentage of households by participation in ProRenda

Investment category	PRORENDA Participants	Non-participants
	(% households that invested)	
Agriculture	0.174	0.115
	(0.029)	(0.025)
Livestock	0.572	0.518
	(0.035)	(0.031)
Vehicles	0.330	0.146
	(0.038)	(0.036)
Furniture	0.512	0.468
	(0.038)	(0.040)
Electronics	0.714	0.453
	(0.061)	(0.051)
Home Improvement	0.465	0.440
	(0.044)	(0.025)
Education	0.762	0.741
	(0.029)	(0.028)
Food/Diet	0.534	0.363
	(0.072)	(0.033)

Note: The outcome variables and whether or not a household participated in PRODRENDA are drawn from the 2013 survey. Numbers in parentheses are standard errors.

Using propensity score matching to compare households controlling for selected criteria, Dulys-Nussbaum estimated the effect of ProRenda participation on the decision to invest in agriculture, vehicles, electronics and more or better food. These were selected due to significant differences in the investment patterns between 208 and 2012 between participants and nonparticipants in simple comparisons. The estimates of the effect of ProRenda participation on 2013 investment decisions for households participating was significant and positive for agricultural investments, vehicle investments, and more/better food using all villages and a nearest neighbor approach to matching. For example, participating in Prorenda increased the likelihood of participants investing in agriculture by 19% when using all villages in analysis, as shown in Table 58. However, when looking at changes in investment behavior between 2008 and 2012, the effect of ProRenda participation on these decisions was not significant in the majority of models (see Dulys-Nusbaum 2013). Further analysis along these lines would be valuable to view ProRenda project impacts on decisions and other aspects.

Table 58 Investment decision: Treatment effect of ProRenda Participation

Investment	ATT	
Agriculture	0.19	***
	(0.04)	
Vehicles	0.26	***
	(0.04)	
Electronics	0.04	
	(0.25)	
More/better food	0.51	***
	(0.17)	
Treatment numbers	100	
Non treatment numbers	375	

Note: Based on nearest neighbor propensity score matching and full sample across village types. Matching based on access to schools, gender of head, and road condition. ATT is the average treatment effect on the treated, where the treatment is ProRenda participation.

***1%, **5%, *10% significance levels

Source: Dulys-Nusbaum, Elena. 2013.

16. Household wellbeing

Given the ProRenda objective to improve welfare of households, the heads of households and their spouses were separately asked about their perception of changes in food consumption compared to the previous year. Given the drought, we can anticipate that a large percentage may indicate reduced consumption, but the data show that half of household heads indicated that consumption was about the same and another 39 percent indicates that consumption was better (Table 59). While the differences in distribution were not significant between strata, male heads were more likely to have indicated improvements in food consumption, and female heads were more likely to have indicated staying the same. For both male and female headed households, only a small percentage (9 percent and 12 percent respectively) indicated that consumption was worse. Heads of households participating in ProRenda were more likely to indicate being better off than their nonparticipating comparison group.

Table 59 Food consumption this year (2012) compared to previous year (2011), as stated by the household head, by strata, gender, and ProRenda participation

	During the past year, was food consumption better, worse or the same as last year?		
Type of Household	**Better**	**Worse**	**Same**
	(% of households)		
Overall	39%	10%	51%
Strata			
Primary	45%	6%	50%
Secondary	37%	12%	51%
Control	23%	6%	71%
*Overall difference is not significant between strata.			
Gender of HH Head			
Male	44%	9%	47%
Female	28%	12%	60%
*Difference between male and female is significant at 5% level.			
Participating in ProRenda			
Participating households	52%	7%	41%
Nonparticipating households	35%	11%	54%
*Difference in distribution between participating and nonparticipating households is significant at 5% level.			

Source: ProRenda surveys, Angola, 2013.

Taking a special look at the results for ProRenda participants, (Table 59), we find that a higher percentage of ProRenda participants found their food consumption had improved compared to the nonparticipants. The distribution for the nonparticipants remained generally the same as in 2008, with 54 percent indicating no change in consumption from previous year whereas the majority of ProRenda participants found a positive change.

For those households indicating improved diets, an almost equal percentage indicated a change in the quantity of the basic staple (46 percent) as indicated a change in fish and meat consumption (48 percent) (Table 60). Those participating in ProRenda that saw an improvement, had an increased percentage with higher fruit and vegetable consumption, but the differences are not significant and sample numbers for disaggregates are small. We asked about fish consumption and found that in 2012, about 7 percent more households ate fish several times a week. In 2012, 40 percent of households ate fish several times per week versus 33 percent in 2008, but we could find no significant differences between populations.

Table 60 Declared direction of change in food consumption

	Declared direction of change in food consumption	
How did food consumption change?	**Better**	**Worse**
Change in quantity of basic food staples	46%	95%
Change in quantity of fish and meat	48%	2%
Change in quantity of fruits and vegetables	4%	0%
Others	2%	3%

Source: ProRenda surveys, Angola, 2009 and 2013.

When the women were asked about times whether or not there were times during the year 2012 when food for the family was insufficient, 78 percent of the households responded "yes". Of those households, 48 percent said that there were at least four weeks each year without sufficient food. In FY2008, 88 percent of households reported food insufficiency and of those, again 48 percent indicated four weeks or more of insufficient food per year.

For both heads of households and spouses, the main cause of the change in consumption was changes in production or sales of agricultural commodities, with the exception of improvements in consumption in 2012, attributed to increases in non-agricultural income. Declines in consumption were more aligned with changes in sales of agricultural commodities in 2008 and production of agricultural commodities in 2012, which is logical given the drought conditions.

17. Considerations on Post-Project Survey and further Impact Evaluation on ProRenda

There are several issues which will affect the validity of the Post-Project Survey and measurement of impacts of ProRenda. These are sampling realization and sampling challenges with additional attrition; simultaneity of ProRenda and public sector investments; issues with the control villages. The most important of these is the sampling aspects.

It is clearly shown in Table 2 and then discussed in the text that the realization of the sampling strategy was compromised in the baseline survey and then continued to face problems with EOP survey. A fundamental aspect is the relatively low number of farm households indicating participation in ProRenda or in farmer organizations in general, especially in EOP survey. When conducting the baseline the low participation numbers were attributed to the early period in program development; however, we expected that participation rate to go up by the time of the EOP survey, given project activities, especially in the primary villages. That the increase in participation was relatively small (for example, only 34 participating female headed households) causes concern with continued interviews and the ability to find significant impact. Analysis on onions was severely compromised for the EOP survey and it is doubtful that results from a Post-

Project survey would overcome the problem. With additional attrition of the sample, the analytical challenge will be even greater.

Concerning the control villages, ideally they would be exposed to the same economic and social conditions as the primary and control villages. The community questionnaires lead us to question that assumption. Since infrastructure investments in the Highlands were made during the ProRenda period and were focused mostly in the primary and secondary villages, the control villages were affected by a lack of infrastructure as well as no program intervention by ProRenda. Thus the impacts of ProRenda may be partially attributable to infrastructure as well as the program.

The control villages were needed to help control analytically for the externalities of program implementation in the primary and secondary villages among nonparticipants. ProRenda invested heavily in improving the market environment and many farmers, not just ProRenda participants, may have benefitted from this effort. For example, the training on quality of potatoes may have increased market prices, and observant nonparticipants in participating primary or secondary villages may have taken advantage of the processing knowledge to improve their quality and prices. Since the control villages did not have the infrastructural investments in addition to not having the quality training, analytical methods will not be able to sort out the relationships between ProRenda training and infrastructure.

As a result of these limitations, we are concerned that the Post Project Survey for Impact evaluation on ProRenda has been compromised and will be unable to fulfill the expectations of the donor on reliable empirical evidence. We were able to determine significant impacts on selected aspects in spite of attrition and other sampling issues, however further reduction in numbers would present additional challenges. Given population dynamics in Angola, it is highly likely that the attrition will again be substantial.

18. Conclusions

18.1. Changes in the environment and household structure

The analysis of the Baseline and EOP Survey results demonstrate various aspects of positive impact of the ProRenda project in the Highlands of Angola, although analysts faced difficulties in attribution of impact due to confounding factors and relatively low sample numbers. The EOP survey had attrition in the sample that diminishes the number of observations that we could use for comparison. Fortunately there was no sign of attrition bias and we did not require inverse probability weighting or other analytical methods to adapt the analysis to such bias, but the consequences of attrition on analytical power are strong, especially for aspects with high variability, such as incomes. A relatively rare drought event occurred during the 2011/2012 cropping year, adding yet another aspect to confound impacts and attribution of changes.

For the current report, the analysis was conducted comparing means for outcomes of interest before and after the project for different strata. The limited number of cases for participating ProRenda farmers and for farmers marketing production in both years of the survey constrains our ability to use more advanced econometric methods for estimating impacts.

Between 2008 and 2012 changes took place in the primary villages, which affect the conditions where the project was implemented. Access to services (electricity, markets, education, health) increased in general for all types of villages. Road rehabilitation might play a role in access to inputs and commercialization of agricultural products, and primary villages clearly benefits from investments, with 40% of primary villages along rehabilitated roads (gravel or paved) compared to 14% of control villages along rehabilitated gravel roads and none along paved roads at all. Secondary villages benefited from road rehabilitation, mostly gravel. Many villages benefitted from access to input and output markets, with primary villages generally showing higher rates of access to inputs for potatoes and potato output markets.

As mentioned above, a key factor in production is weather and in 2011/2012 production cycles, a rare major drought occurred in much of the highlands of Angola. As community leaders indicated, losses were felt for all the crops evaluated here, and losses in beans were often catastrophic. Since the drought affected all types of villages, the impact is expected to lower production and income across the region, and reduce the production potential for all farmers, regardless of ProRenda.

In general, demographic characteristics of households did not change significantly between 2009 and 2012. Female headed households increased attendance to school of children between 5-17 years old. However, since there was also an increase in access to middle school and high school for primary villages, we cannot attribute the whole change to ProRenda. There was a reduction in days missed at school due to sickness for children in primary villages in contrast to an increase for secondary villages.

18.2. Household impacts of ProRenda

Using the difference in difference approach to control for the general economic and environmental shifts between 2008 and 2012, we found evidence of ProRenda having impacts on production, marketing and incomes of households, especially in the primary villages, in spite of the 2011/2012 drought.

A review of the gross crop margins for potatoes, onions and beans combined shows that households throughout the region were able to increase their total gross margins dramatically from 3,047 Kw to 11,138 Kw in real 2012 kwanzas, thus accounting for inflation, based on the households remaining in the sample between 2009 and 2013 surveys. While increases for ProRenda participants were dramatic (from about 3,900 Kw to 20,700 Kw) nonparticipants also increased gross margins (from 2,700 KW to 11,800 Kw) such that the changes do not show a significant difference. Women-headed households significantly increased their total costs with investments in seeds and fertilizers across these crops, although the increases in receipts and in gross margins were not significantly different from the male headed households.

In general, ProRenda and other farmer organizations contributed to the increase in production of potatoes for participating farmers, in spite of the drought. By 2012, ProRenda participants averaged almost 1400 kgs of potatoes per households, with nonparticipating households at 628 kgs, however the increase did not show a significant DID as both groups had increased production from 2008. ProRenda participants had significantly larger increases in production costs than nonparticipants, as well as obtaining a significantly greater price increase per kg of potatoes. ProRenda farmers also saw a significant growth in percentage of the potato production that was marketed compared to nonparticipants. Female-headed households achieved higher prices

(increasing prices significantly more) and significantly larger positive change in costs of production per kg of potatoes compared to male-headed households, indicating increasing access to purchased production inputs. ProRenda literacy and numeracy programs may have played a role in those achievements.

The drought strongly affected beans and so the results show overall reductions in bean production per household across the region. Participation in ProRenda or in farmer organizations generally did not demonstrate significant differences in the changes between 2008 and 2012 production years. Female-headed households significantly increased their seeds planted compared to male households, however male-headed farmers saw greater increases in receipts than female-headed households in spite of female headed households receiving higher prices.

There were relatively few onion sellers that producers and sold onions in both 2008 and 2012 seasons (only 33 farm households in our sample), so the results are inconclusive. Overall, receipts almost tripled (314% higher) and gross margins quadrupled (450% higher) between the two seasons across the households, with ProRenda participants showing a higher percentage increase in gross margins than nonparticipants.

ProRenda sought to improve production technologies for the key crops and that included improved access to and knowledge of purchased inputs, including fertilizer, pesticides, and seeds. Since improving access to these inputs in the markets contributes to higher potential use by all farmers, it was difficult to attribute changes at the household level. The average quantity of fertilizer used by potato farming households increased across the types of farm households, as well as the percentage of farmers using, especially among the nonparticipants in ProRenda as a result of access changes. Given the drought and its effects on beans, it was surprising to see an overall increase in farmers using fertilizers for beans, especially among the ProRenda farmers. Use of fertilizers and pesticides on onions continued among participants and nonparticipants. In a related aspect, credit use remained very low between 2008 and 2012 and the drought could be an exacerbating factor, reducing demand for inputs and labor. ProRenda participants were more likely to obtain credit than other farm households, although credit constraints were high in the latter period.

Marketing strategies for potatoes, onions and beans changed between 2008 and 2012. Fewer households used traders as their primary source of market information. A few households indicated that radio and farmers associations were their primary source of information, but these sources are relatively new and likely to be considered secondary sources until their reliability is well known. In general, farmers established relationships with traders that enabled them to sell potatoes and onions directly from their fields and still get a good price, whereas for beans, farmers tended to shift from local selling to sales in more distance markets for a better price. While marketing tends to occur directly after harvest, it appears that farmers are using planting and other management practices to ensure harvest at the time of high prices. For example, onion sales in December increased, responding to seasonal demand, even though farmers indicate selling timing due to harvest, not prices. Another aspect of marketing relates to the gender of the person selling. In ProRenda primary villages, women were the primary sellers of potatoes by 2012. Women also gained more control over the sales of beans in the primary and secondary villages between 2008 and 2012.

When households were asked to assess the impact of the drought, it was clear that beans were the most heavily affected crop, followed by potatoes and then onions. Reductions

in labor, fertilizers and pesticides were reported as responses to the drought, with 50% or more of households reporting lower harvest in 2012 compared to 2011 for each of the three crops.

While the drought negatively affected overall agricultural production, the majority of households still reported that food consumption remained the same or improved. In ProRenda primary villages, when asked to compare 2012 to 2011, 45% of households said that food consumption was better in 2012, compared to 23% of control households indicating 2012 was better, although the difference was only significant when comparing ProRenda participants to nonparticipants. For households in which the food consumption was considered worse in 2012 than in 2011, the main shift was seen in consumption of staples (95% of responses) whereas for those with improved consumption almost equal percentages of households indicated increased consumption of food staples as of fish and meat.

The overall noted increases in gross margins led many households to invest. Assessing the percentage of households investing in different aspects, we find that ProRenda participants were more likely to invest in agriculture, vehicles, electronics and food/diet than nonparticipating households. The estimated impact on investment decisions of ProRenda participants was significant, with participation generating a 19% increase in the likelihood of investing in agriculture.

18.3. Future directions

Given the challenges to the sampling and survey implementation, as well as programmatic changes and drought, a large investment in a past-project impact survey may not be justified. Attrition rates especially among those households identified as participating farmers for ProRenda could threaten the ability to determine significant impacts of the project over the longer term.

Research methods on impact evaluation are evolving rapidly and additional analytical work may be merited, with care taken based on the sample numbers. DID approach taken in this report should be complemented by more multivariate analysis to determine impacts. That requires an investment in analytical time. Propensity score matching and multivariate analysis will be used in future research to assess impact, as was found in the preliminary research with these data by Dulys-Nussbaum (2013).

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Annex 1. Attrition analysis: Estimated probability of being reinterviewed in the EOP survey

Dependent variable: Household revisited for follow up survey=1

Explanatory Variables (pretreatment characteristics)	Coef.	Linearized Std. Err.	p-value
Female Head	-0.07	0.05	0.23
Participant revised	-0.09	0.14	0.57
Cellphone	-0.45	0.38	0.28
Plow	0.33	0.13	0.04
Radio	-0.10	0.09	0.27
Zinc roof	0.25	0.23	0.31
Bean gross margins	0.00	0.00	0.46
Bean sales as percentage of production	-0.11	0.10	0.29
Potatoes gross margins	0.00	0.00	0.87
Potatoes sales as percentage of production	0.01	0.15	0.92
Onion gross margins	0.00	0.00	0.52
Onion sales as percentage of production	0.12	0.13	0.38
Constant	0.90	0.09	0.00
n	604		
N	42399		

Note: results correspond to a probit model regression. N refers to estimated population and n corresponds to sample numbers.
Weights were used to estimate population values.

Annex 2. EOP Household survey 2013.

See attached file Quest2013_Final.pdf

Annex 3. EOP Community survey 2013.

See attached file EOP_ ComunitarioV9.pdf