LAND HUSBANDRY, WATER HARVESTING, AND HILLSIDE IRRIGATION (LWH) PROJECT

Baseline Household Survey Report

March 2013

LWH Project

Development Impact Evaluation Initiative (DIME)

& Global Agriculture & Food Security Program (GAFSP)

Table of Contents

Table of Figures

Acronyms and Abbreviations

CIDA	Canadian International Development Agency
DIME	Development Impact Evaluation Initiative
EDPRS	Economic Development and Poverty Reduction Strategy
FANTA	Food and Nutrition Technical Assistance Project (FANTA)
FAO	Food and Agriculture Organization
GAFSP	Global Agriculture and Food Security Program
GOR	Government of Rwanda
HHS	Household Hunger Scale
IDA	International Development Association
LWH	Land Husbandry, Water Harvesting & Hillside Irrigation
MAHFP	Months of Adequate Household Food Provisioning
MINAGRI	Rwanda Ministry of Agriculture and Animal Resources
SHG	Self-help Group
SWAp	Sector-Wide Approach
USAID	United States International Development Agency
WDDS	Women's Dietary Diversity Score

List of Appendices

1 Introduction

This report presents the main findings from a baseline survey for the impact evaluation of the Land Husbandry, Water Harvesting, and Hillside Irrigation (LWH) Project, conducted between May and August 2012. After a brief introduction to LWH, the LWH Impact Evaluation, and the baseline data collection exercise, the report provides descriptive statistics on the following topics: socioeconomic profile of the households, access to agricultural extension services, agricultural production and commercialization, household income and expenditures, access to and use of rural financial services, food security and women's dietary diversity, and irrigation.

2 Background

2.1 Land Husbandry, Water Harvesting & Hillside Irrigation Project

The Government of Rwanda considers agriculture an engine for the economy (cf. Rwanda Vision 2020; Rwanda's Economic Development and Poverty Reduction Strategy) and aims to reduce poverty and achieve food security through commercialized and professional agriculture, as well as increased export earnings and industrialization. This calls for improved and sustained productivity through investment in farmer-participatory land care, water-harvesting, and intensified irrigation in the hillsides. The Land and Water Husbandry (LWH) project is working to meet this objective.

Financed by IDA, USAID, CIDA, and GAFSP, the LWH project is a flagship program in the Government's overall poverty reduction and agricultural strategies, both for the agricultural sector and for the country as a whole. LWH uses a modified watershed approach to introduce sustainable land husbandry measures for hillside agriculture on selected sites and develops hillside irrigation for sub-sections of each site. The project has three components: (a) Capacity Development and Institutional Strengthening for Hillside Development, which aims to develop the capacity of individuals and institutions for improved hillside land husbandry, stronger agricultural value chains, and expanded access to finance; (b) Infrastructure for Hillside Intensification, which provides the essential hardware for hillside intensification to accompany the capacity development of the first component; and (c) Implementation through Ministry of Agriculture and Animal Resources (MINAGRI's) SWAP structure which aims to ensure that project activities are effectively managed within the government program. LWH is being rolled out in three phases: implementation in the four Phase 1A sites began in 2010, in the three Phase 1B sites in 2012, and will soon start in Phase 2 sites.

2.2 Impact Evaluation of LWH

The LWH Impact Evaluation (IE) is part of an ongoing program of IEs the Development Impact Evaluation (DIME) team is leading jointly with the Government of Rwanda and in collaboration with the Global Agriculture and Food Security Program (GAFSP). The IE program is being implemented following the Land and Water Husbandry project's (LWH) sector-wide approach, and involves a wide variety of actors, including the private sector and civil society organizations. This CN details the work program built so far under this IE program. By rigorously testing

alternative delivery mechanisms, partners working on the ground are learning to best respond to the farmers' needs. As these results feed back into Rwanda's agricultural strategy, the impact of development investments increases and more lives are changed. This work is aligned to the President's initiative on the Science of Delivery and constitutes one of the three proposed pilots (health in Nigeria, agriculture in Rwanda and financial capability in Brazil) to help demonstrate how the Bank can use experimental science to support countries find solutions to important development issues (maternal and child mortality, rural poverty, and shared growth, respectively) in 3 different contexts. These pilots take a sector-wide and iterative approach to resolve identified problems in close collaboration with governments and partners.

DIME is working closely with the LWH team to design a rigorous impact evaluation to measure the overall impact of the project on GAFSP core outcomes such as agricultural productivity, adoption of improved technologies, household income, and food security. This will be done through comparison of LWH Phase 1B and Phase 2 sites with control sites selected using pairwise matching. In addition, DIME has designed specific impact evaluation studies for the sub-components of LWH related to rural finance and provision of extension, identified by the Rwandan Ministry of Agriculture (MINAGRI) as priority areas for real-time learning. In rural finance, LWH will evaluate innovative savings products introduced to increase saving for agricultural inputs. For extension, LWH will test the effectiveness of different types of feedback mechanisms (phone calls, individual report cards, and group report cards) to monitor the quality of private extension services.[1] In addition, in the future DIME and LWH plan to collaborate on an impact evaluation of the irrigation component of the project.

3 Baseline Household Survey

3.1 Data Collection

The Baseline Household Survey used a multi-module questionnaire, with a specific focus on agricultural production, access to agricultural extension services, rural finance, and food security. In addition, the questionnaire contains modules on housing, labor, education, health, income and household assets. The full questionnaire is attached as Annex 1.

Fieldwork started on May 24, and continued through August 20. The field team included 20 enumerators, 4 supervisors, and 1 editor. All questionnaires were double-entered by a team of 12 data entry clerks and 1 data entry manager, with the first entry occurring in the field concurrent to data collection. First and second entries were compared and all discrepancies corrected through manual checks of the hard-copy questionnaires. In some cases, the field team was sent back to the field for verification.

3.2 Sample

The Baseline Household Survey was implemented in the three LWH Phase 1B sites (Rwamagana-34, Rwamagana-35 and Kayonza-4), and three control sites selected by pairwise-

[1] For more details on the impact evaluation design, refer to the "Land Husbandry, Water Harvesting, and Hillside Irrigation (LWH) Project: Impact Evaluation Concept Note", attached as Appendix 3.

matching.[2] The sample was designed to meet three criteria: geographic representation at the site-level, inclusion of multiple members of farmer groups within sites, and sufficient size to power tests of variations in treatment within the Phase 1B sites.

First, LWH could have different effects for different parts of the site, especially in regard to places that are irrigated (command area) relative to those that are not (catchment area). In order to achieve a geographically representative sample, within each site we stratified at the level of the village, with distribution of the household sample proportionate to the size of the village.

Second, LWH interventions are primarily group-level, implemented through Farmer Self-Help Groups (SHGs) formed by the project. To capture the impact of the project at this level of intervention, the sample was designed to include multiple members of farmer groups within sites. Sampling farmer groups presents a challenge, as SHG formation happens in the first stage of project implementation, and is therefore not completed at baseline. In addition, SHGs will not be formed in control sites. As SHGs are formed based on farmland-proximity, we created survey clusters by simulating SHGs.

Third, the sample within the Phase 1B sites should be sufficiently large to allow the project to test innovations within sites. In year 1, an evaluation of innovations to the agricultural extension component will be tested in Phase 1B sites. The within-site impact evaluations rely on variations across farmers groups. For this reason, we sampled a larger numbers of groups in treatment sites than in the control sites.

To meet these criteria, sampling was done through a two-stage process. In the first stage, we randomly sampled “seed” households, stratified by village. The total number of “seed” households varied by treatment status. For treatment sites, the number of “seeds” depended on the estimated number of SHG (calculated based on the site population and the typical size of SHGs, 20 households). For control sites, the number of “seeds” was set at 25, which will provide sufficient power for the measurement of overall project impact.

In the second stage, we asked each ”seed” farmer to list four “plot neighbors”, i.e. people who have contiguous or near-contiguous plots to his own. These four people were added to the survey sample, and the five respondents together constitute a synthetic SHG. Since the SHGs are formed based on proximity of agricultural land, households in synthetic SHGs are likely to be assigned into a single farmer group.

Table 1 shows the distribution of the clustered sample across treatment and control cells, and the actual number of interviews completed per site.

Site	Type	Population	Sample	Interviews Completed
Rwamagana 34	Treatment	1799	475 HH (95 groups)	470 (95 groups)
Rwamagana 35	Treatment	2834	635 HH (127 groups)	615 (123 groups)
Kayonza 4	Treatment	1957	525 HH (105 groups)	524 (102 groups)

[2] For details on the control site selection, refer to the “Land Husbandry, Water Harvesting, and Hillside Irrigation (LWH) Project: Impact Evaluation Concept Note,” attached as Appendix 3.

Sub-total Treatment		*6590*	*1635 (327 groups)*	*1610 (320 groups)*
Rwamagana 2	Control	1927	125 HH (25 groups)	109 (23 groups)
Rwamagana 33	Control	2778	125 HH (25 groups)	120 (23 groups)
Kayonza 15	Control	331	125 HH (25 groups)	125 (25 groups)
Sub-total Control		*5036*	*375 HH (75 groups)*	*354 HH (71 groups)*
TOTAL		11626	1875 HH (402 groups)	1964 (391 groups)

Table 1: Baseline Sample

3.3 Control Sites

The impact evaluation will formally document the overall impact of the LWH in the project sites, using as a comparison group similar pre-identified sites that will not receive LWH project activities. The main identifying assumption is that the only difference between pre-identified sites that receive LWH and those that do not is the project.

Comparison sites were selected using pair-wise matching, from a list of sites considered eligible to receive LWH but that will not receive the project. LWH will only be implemented in a small subset of suitable valleys, and the pre-identification of the sites was well documented. Many sites were considered for inclusion in the LWH, and data was collected on their geography, weather, and land use patterns. These data can be used to identify similar sites to those receiving LWH.

Data from the baseline survey shows that control and treatment sites are similar with respect to a large number of observable characteristics (Table 2).[3]

	Treatment N	Control N	Treatment Mean	Treatment SD	Control Mean	Control SD	Difference in Means	P Value[4]
Female Headed Household	1609	353	0.25	0.76	0.26	0.52	-0.01	0.81
Number of Children Age 0-17	1609	353	2.42	4.46	2.48	2.53	-0.06	0.75
HH Head Completed Primary	1609	353	0.26	0.96	0.23	0.59	0.03	0.48
Household Owns a Cow	1608	353	0.32	2.98	0.40	1.45	-0.08	0.48
Income (Rwf)								
On-Farm Income (Rwf)	1609	353	49,206	423,816	54,657	218,118	-5,451	0.75
Off-Farm Income (Rwf)	1609	353	69,350	310,310	89,396	201,321	-20,045	0.20
Total Household Income (Rwf)	1609	353	121,501	615,555	150,226	338,040	-28,725	0.29
Expenditure								
Weekly Expenditure[5]	1609	353	4,970	12,015	4,510	9,474	459	0.48
Yearly Expenditure[6]	1609	353	148,422	1,014,792	137,879	534,210	10,543	0.79

[3] All variables winsorized at 1% upper tail except yields. Yields trimmed at top and bottom 2% tails
[4] P value reports the results from a clustered T test of equality of means between treatment and control
[5] Weekly Expenditure covers frequent expenses such as transportation and communication, excluding food.
[6] Yearly Expenditure covers infrequent expenses such as housing, school fees, and purchase of livestock.

Food Expenditure	1609	353	4,638	9,202	4,208	5,461	430	0.31
Agricultural Output								
Gross Yield (Rwf/Ha)	1283	294	850,957	3,740,181	811,600	2,010,307	39,357	0.81

Table 2: Balance tests of data from treatment and control sites

Note: The remainder of the report refers to data from the three treatment sites only.

4 HH profile

This section describes the households and their socioeconomic status, including characteristics of the household head, the dwelling, access to water and sanitation, energy sources, and health. The baseline survey covered a rural population, in two districts in Rwanda's eastern province. The average household has 5 members, and half of the households have at least one child under 5.

4.1 Characteristics of the Household Head

1 in 4 of the households in the sample is headed by a female. Female household heads tend to be older, less educated, and less healthy than their male counterparts, as shown in Table 3. The gaps in literacy is particularly striking: 72% of male-headed households report being able to read and write a simple letter, compared to only 31% of female household heads.

	Male-headed	Female-headed	Total
Gender	75.08%	24.92%	100.00%
Mean age	43.30	54.80	46.30
No formal education	64.16%	86.78%	69.79%
Completed primary	30.71%	11.72%	25.98%
Completed secondary	1.08%	0.00%	0.81%
Can read and write a letter or simple note	71.69%	31.17%	61.59%
Suffered health problem that disrupted normal activities in last 12 months	39.40%	65.34%	45.87%

Table 3: Characteristics of HH Head

A more in-depth look at educational attainment of the household head is shown in Table 4, which divides the sample into quartiles based on total agricultural production.[7] The analysis shows distinct patterns across ranges of the distribution of agricultural production: farmers in the bottom quartile are more likely to have no formal education, less likely to have completed primary education, and have lower-than-average literacy rates. The opposite is true for farmers in the top quartile. For example, while the overall literacy rate for household heads is 62%, only 54% of household heads in the bottom quartile are literate, compared to 67% of household heads in the top quartile. The patterns are most pronounced for male-headed households.

[7] We also conducted the distributional analysis using income quartiles; results were very similar so only production quartiles are presented in the report.

		Male-Headed	Female-Headed	Total
No formal education	*1st Quartile*	66.90%	86.07%	72.70%
	2nd Quartile	64.98%	89.52%	71.39%
	3rd Quartile	65.38%	84.44%	69.65%
	4th Quartile	59.75%	86.90%	65.42%
Completed primary	*1st Quartile*	28.83%	11.48%	23.57%
	2nd Quartile	29.63%	10.48%	24.63%
	3rd Quartile	30.13%	13.33%	26.37%
	4th Quartile	33.96%	11.90%	29.35%
Completed secondary	*1st Quartile*	1.42%	0.00%	0.99%
	2nd Quartile	0.67%	0.00%	0.50%
	3rd Quartile	0.96%	0.00%	0.75%
	4th Quartile	1.26%	0.00%	1.00%
Can read and write a letter or simple note	*1st Quartile*	65.48%	28.69%	54.34%
	2nd Quartile	71.38%	34.29%	61.69%
	3rd Quartile	72.44%	33.33%	63.68%
	4th Quartile	76.73%	28.57%	66.67%

Table 4: Educational attainment of HH head, by agricultural production quartile

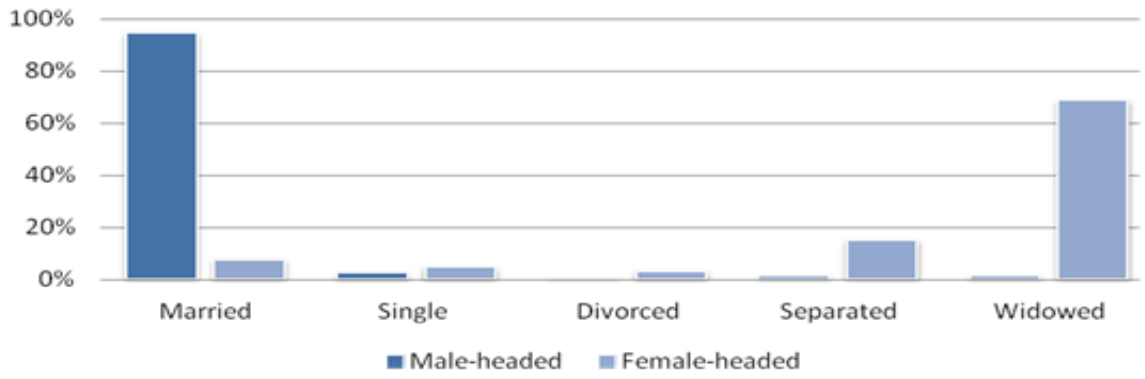

Table 5 shows the marital status of the household heads. Nearly all (94%) male household heads are married. In contrast, nearly all female household heads are widowed, separated or divorced. This further illustrates the economic vulnerability of female-headed households.

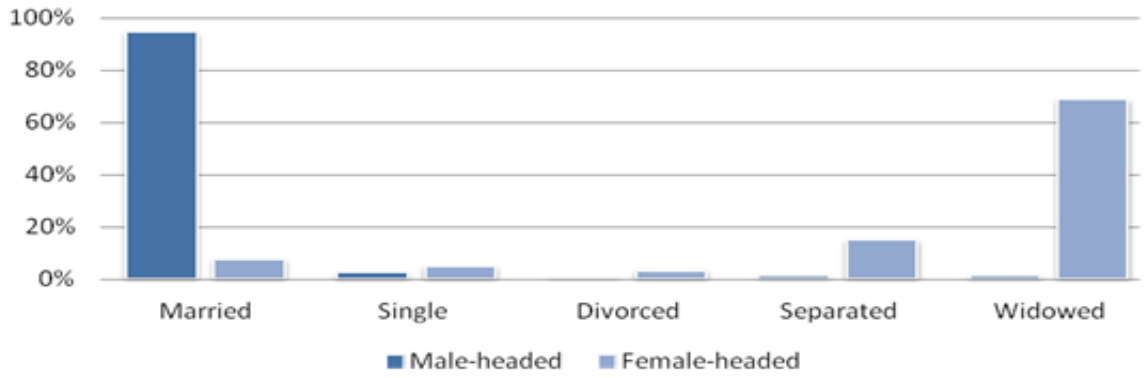

Table 5: Marital Status of HH Head

4.2 Physical characteristics of the dwelling

98% of the households interviewed own the houses that they live in, as shown in Table 6. More than half of the dwellings are improved structures made from adobe or bricks. A third is made from wattle and mud or reeds. Nearly all of the houses have metal roofs. Four out of five have simple earthen floors. Female-headed households tend to have slightly lower-quality dwellings, but gender differences are minor.

	Male-Headed	Female-Headed	Total
Occupancy status			
Owner occupied	98.18%	96.76%	97.82%
Tenancy	1.16%	1.50%	1.24%
Wall material			
Adobe or un-burnt bricks	55.22%	49.38%	53.76%
Fired bricks	3.48%	3.74%	3.54%
Cemented mud and wattle	8.94%	7.98%	8.70%
Un-cemented mud and wattle	20.53%	24.19%	21.44%
Wattle and reeds	9.85%	12.72%	10.57%
Roofing material			
Thatch, leaves or grass	1.66%	1.25%	1.55%
Metal sheets or corrugated iron	96.11%	96.01%	96.08%
Earth tile	1.82%	2.49%	1.99%
Flooring material			
Mud, earth or sand	80.36%	83.29%	81.09%
Clay	4.23%	3.49%	4.04%
Cement or concrete	14.33%	12.47%	13.87%
N	1,208	401	1,609

Table 6: Housing characteristics

Most households rely on public taps for the water they use domestically, though approximately 20% rely on unprotected sources (Table 7). 1 in 10 male-headed households and 1 in 5 female-headed households have a water tap on their property.

	Male-Headed	Female-Headed	Total
Public tap	52.73%	54.75%	53.23%
Surface water	12.33%	12.50%	12.38%
Tap on property	10.10%	5.00%	8.83%
Protected spring	7.86%	7.50%	7.77%
Unprotected spring	5.71%	8.00%	6.28%
Protected well	3.15%	4.50%	3.48%
Unprotected well	3.64%	4.00%	3.73%
Tap inside house	2.40%	1.50%	2.18%
N	1,208	401	1,609

Table 7: Source of drinking water

Table 8 shows access to sanitation facilities. 87% of households use an ordinary pit latrine. 10% rely on an open pit.

	Male-Headed	Female-Headed	Total
Ordinary pit latrine	87.74%	85.04%	87.06%
Open pit with no walls	9.36%	11.97%	10.01%
Flush latrine	1.57%	0.75%	1.37%
N	1,208	401	1,609

Table 8: Toilet facilities

4.3 Energy Sources

Paraffin is the most common source of energy for lighting. 11% of households are connected to the electric grid. However, new technologies are clearly being adopted: 18% of households have a solar panel. For cooking, all households rely on firewood.

	Male-Headed	Female-Headed	Total
Source of energy for lighting			
Paraffin	44.82%	49.63%	46.02%
Lamp or lantern	18.81%	18.20%	18.66%
Solar panel	17.81%	19.95%	18.35%
Electricity	13.01%	5.99%	11.26%
Torch	4.64%	5.49%	4.85%
Source of energy for cooking			
Firewood	98.01%	99.75%	98.45%
Charcoal	1.66%	0.25%	1.31%
N	1,208	401	1,609

Table 9: Source of cooking fuel

4.4 Health

46% of households reported that the household head was unable to perform normal activities due to illness during the previous 12 months, as shown in **Error! Reference source not found.**. The average duration of illness was 3 months. Female household heads were much more likely to have health problems than their male counterparts; nearly two-thirds of female household heads were ill, and the average duration of illness was 3.4 months. As the household head is typically the primary earner in the household, this is a significant productivity loss for the household, and female-headed households are disproportionately affected.

	Male-headed	Female-headed	Total
Household head ill in last 12 months	39.40%	65.34%	45.87%
Duration of household head illness	2.74	3.35	2.96
	(3.49)	(3.72)	(3.59)
N	1,208	401	1,609

Table 10: Health of Household Head

56% of households reported that at least one household member was unable to perform normal activities due to illness during the previous 12 months, as shown in Table 12. In contrast to the above, female-headed households had a lower incidence of health problems for household members than the male-headed households. On average, 1 of 5 household members reported illness over the past twelve months.

	Male-headed	Female-headed	Total
Household had at least one member that suffered health problems in last 12 months	59.85%	45.14%	56.18%
Share of HH members with health problem	22.18%	16.97%	20.88%
Duration of household member illness	1.62	1.42	1.57
	(2.73)	(2.77)	(2.74)
N	1,208	401	1,609

Table 11: Health of Household Members

Table 12 shows that the most commonly reported health problems were malaria, diarrhea, and respiratory infections.

Most common health problems			
Malaria	27.77%	28.89%	28.00%
Diarrhea	18.74%	14.53%	17.90%
Respiratory infection	10.61%	6.71%	9.83%
Gynecological problems	5.31%	0.83%	4.41%
Skin disease	4.26%	3.20%	4.04%
N	723	181	904

Table 12: Health problems in last 12 months (HH members)

5 Access to Agricultural Extension and Farmer Organizations

5.1 Access to Agricultural Extension

Households have little access to agricultural extension services at baseline. 5.4% of households were visited by a public extension worker in the last 12 months. As Table 13 indicates, access is even more limited for female-headed households: 6.1% of male-headed households had access to public extension workers, compared to only 3.2% of female-headed households. Even for the small proportion of households visited by a public extension worker, frequency of interaction is quite low: the visited households reported an average of 4 visits over the past 12 months.

	Male-Headed	Female-Headed	Total
Public extension worker visited HH farm	6.13%	3.24%	5.41%
Field Officer from TUBURA visited HH farm	0.99%	1.25%	1.06%
Extension worker from NGO or private company visited farm	0.08%	0.00%	0.06%
Respondent accessed price/market information using mobile phone or ESOKO	0.58%	0.25%	0.50%
N	1,208	401	1,609

Table 13: Access to Agricultural Extension

Table 14 shows access to agricultural extension across quartiles of agricultural production. All indicators show clear patterns across the distribution: households that produce the most are more likely to have access to agricultural extension services. Only 2.2% of households in the bottom production quartile were visited by a public extension worker; compared to 9.7% of households in the top production quartile. This pattern is particularly distinct for male-headed households.

		Male-headed	Female-headed	Overall
Extension worker from MINAGRI or sector agronomist visited farm in the last 12 months	*1st Quartile*	2.85%	0.82%	2.23%
	2nd Quartile	3.70%	4.76%	3.98%
	3rd Quartile	6.09%	4.44%	5.72%
	4th Quartile	11.32%	3.57%	9.70%
Extension worker from TUBURA visited farm in the last 12 months	*1st Quartile*	0.36%	0.00%	0.25%
	2nd Quartile	0.34%	0.00%	0.25%
	3rd Quartile	0.96%	2.22%	1.24%
	4th Quartile	2.20%	3.57%	2.49%
Extension worker from other NGO or private company visited farm in the last 12 months	*1st Quartile*	0.00%	0.00%	0.00%
	2nd Quartile	0.00%	0.00%	0.00%
	3rd Quartile	0.00%	0.00%	0.00%
	4th Quartile	0.31%	0.00%	0.25%
Respondent accessed information about markets or prices using mobile phone or ESOKO	*1st Quartile*	0.00%	0.00%	0.00%
	2nd Quartile	0.34%	0.00%	0.25%
	3rd Quartile	0.64%	0.00%	0.50%
	4th Quartile	1.26%	1.19%	1.24%

Table 14: Access to Agricultural Extension (distributional analysis)

5.2 Farmer Organizations

LWH aims to build farmer organizations' capacity: project interventions are implemented primarily at the level of the self-help group, and all crop marketing is done through newly-established cooperatives. To document progress on this aspect of the project, the baseline collected detailed information on existing farmer groups and cooperatives. There is a minimal degree of organization: 12% of respondents are members of a farmer group, and 16% are members of a cooperative. As Table 15 shows, rates of organization are similar between genders.

	Male-Headed	Female-Headed	Total
Farmer organization membership			
Respondent is a member of a farmer group	11.67%	12.97%	12.00%
Respondent is a member of a cooperative	16.80%	14.21%	16.16%
Respondent is chairman of farmer organization	0.83%	0.50%	0.75%
Respondent is secretary of farmer organization	0.66%	0.25%	0.56%
Respondent is treasurer of farmer organization	0.58%	0.75%	0.62%
Respondent is advisor of farmer organization	1.32%	0.00%	0.99%
Respondent is member of farmer organization	23.51%	24.69%	23.80%
Respondent holds other position in farmer organization	1.49%	0.75%	1.31%
N	1,208	401	1,609

Table 15: Membership in farmer organizations

Most farmers who are members of a farmer organization pay membership fees, and nearly half pay contribution fees, as shown in Table 16.

	Male-headed	*Female-Headed*	*Total*
Farmer organization fee			
Respondent paid a membership fee	81.92%	79.82%	81.42%
Respondent paid a contribution fee	41.69%	44.04%	42.26%

Table 16: Proportion of HHs paying fees to farmer organization

As Table 17 shows, the median membership fee paid is RWF4,800 per year and the median contribution fee is RWF3,000 per year.

Amount of fees in Past 12 months (RWF)	*Mean (all HH)*	*SD (all HH)*	*Median (all HH)*
Membership fee paid to farmer organization	20,530.72	187,608.20	4,800
Contribution fee paid to farmer organization	7,577.94	11,795.49	3,000

Table 17: Fees paid to farmer organizations

6 Agriculture

As the main objective of LWH is hillside transformation and agricultural intensification, very detailed data on agricultural productivity and practices was collected in the baseline survey. This section reports details of crop production during Season A 2012 (September 2011 – February 2012) and Season B 2012 (March 2012 – July 2012). Data was collected for seasonal crops cultivated on the household's three most important plots, and also for all annual ("permanent") crops, such as coffee, bananas and mangos. For the 80% of households that cultivated 3 or fewer plots, the data adequately measures the household's entire production. However, for households that cultivated more than three plots, production of seasonal crops was only surveyed for their main 3 plots.

6.1 Agricultural landholdings

Over 99% of households cultivated at least one plot during both Season A and Season B. More than half (56.84%) of households cultivated at least one plot during Season C. On average, households farmed 2 to 3 small plots during the year. Male-headed households tend to have more plots than female-headed households (2.9 compared to 2.44). The average plot is 0.5 hectares, slightly larger for female-headed households (0.54ha) compared to male-headed households (0.47ha). Less than 10% of the households farmed more than 4 plots during any season.

	Male-headed				Female-headed				Total			
	N	mean	sd	p50	N	mean	sd	p50	N	mean	sd	p50
Total number of plots cultivated by HH	1208	2.93	2.00	3.00	401	2.44	1.63	2.00	1609	2.81	1.92	2.00
Average plot size (ha)	1014	0.47	0.61	0.26	332	0.54	0.73	0.26	1346	0.49	0.65	0.26

Table 18: Agricultural landholdings

6.2 Knowledge and Adoption of Agricultural Technologies

Farmers' knowledge of agricultural technologies is uneven: awareness of some common technologies is very high, but for newer technologies it is low. For example, Table 19 shows that more than 90% of farmers have heard of chemical fertilizer (95.2%), mulching (93.1%), improved seeds (92.2%), and organic fertilizer (90.3%).

	Heard of Technology				Adopted New Technology (conditional on having heard of it)		
	Male-Headed	Female-Headed	Total	N	Male-Headed	Female-Headed	Total
Chemical fertilizer (UREA, NPK, DPK)	95.61%	91.02%	94.47%	1,155	59.31%	49.59%	56.97%
Mulching	94.29%	89.53%	93.10%	1,139	77.70%	74.65%	76.97%
Improved seeds	92.88%	90.27%	92.23%	1,122	53.03%	45.03%	51.08%
Organic fertilizer (animal manure or manure from toilets)	90.23%	90.52%	90.30%	1,090	87.71%	84.85%	86.99%
Conservation tillage	79.64%	78.55%	79.37%	962	98.86%	98.10%	98.67%
Radical terraces	73.26%	71.07%	72.72%	885	2.49%	2.46%	2.48%
Intercropping with plant cover	57.62%	58.35%	57.80%	696	92.24%	92.74%	92.37%

Table 19: Knowledge and use of improved technologies with higher level of farmer awareness

In contrast, less than 10% of farmers have heard of compost making, green manure, improved bench terraces, connecting drainage canals to cut-off drains, connecting cut-off drains to waterways, improved narrow-cut benches, or construction of micro-basins and tree planting, as seen in Table 20. Overall, male-headed households are slightly more likely to have heard of these technologies than female-headed households.

	Heard of Technology				Adopted New Technology (conditional on having heard of it)		
Improved farming method	Male-Headed	Female-Headed	Total	N	Male-Headed	Female-Headed	Total
Pesticides	56.37%	48.63%	54.44%	681	58.00%	42.05%	54.45%
Grass strip	45.36%	45.64%	45.43%	548	92.70%	91.80%	92.48%
Soil band	26.66%	24.19%	26.04%	322	66.15%	60.82%	64.92%
Reforestation	26.66%	21.20%	25.30%	322	58.70%	40.00%	54.79%
Agro-forestry interventions	25.66%	21.70%	24.67%	310	54.52%	58.62%	55.42%
IPM	23.76%	19.20%	22.62%	287	60.98%	62.34%	61.26%
Progressive terraces	22.43%	16.46%	20.94%	271	61.62%	54.55%	60.24%
Strengthening terraces with legume and grass	19.37%	17.46%	18.89%	234	61.97%	67.14%	63.16%
Waterways	12.83%	10.47%	12.24%	155	47.74%	54.76%	49.24%
Liming	12.25%	5.99%	10.69%	148	11.49%	8.33%	11.05%
Compost making	8.28%	4.99%	7.46%	100	16.00%	10.00%	15.00%
Green manure	6.37%	7.48%	6.65%	77	57.14%	70.00%	60.75%
Improved bench	6.29%	5.24%	6.03%	76	3.95%	0.00%	3.09%
Connecting drainage canals to cut-off drains	4.97%	2.74%	4.41%	60	53.33%	54.55%	53.52%
Connecting cutoff-off drains to waterways	2.98%	2.00%	2.73%	36	50.00%	37.50%	47.73%
Improved narrow cut bench	1.32%	0.75%	1.18%	16	0.00%	0.00%	0.00%
Construction of micro-basins with tree planting	0.83%	1.00%	0.87%	10	10.00%	25.00%	14.29%

Table 20: Knowledge and use of improved technologies with lower level of farmer awareness

Table 19 and Table 20 make it clear that knowledge does not necessarily translate into adoption. For example, 95% of farmers have heard of chemical fertilizers, but only 57% actually used them. Importantly for LWH project, whereas 73% of farmers have heard of radical terraces, only 2.5% have adopted them.

The most widely adopted technologies, conditional on prior knowledge, include: conservation tillage, organic fertilizer, mulching, intercropping with plant cover, and grass strips. The least adopted are: radical terraces, liming, compost making, improved bench, improved narrow-cut bench, and construction of micro basins with tree planting.

Details on technology use and adoption at the site level are available in Appendix 4.

Table 21 presents patterns of knowledge and adoption of improved technologies across ranges of the distribution of total agricultural production. Although there is some variation by technology, overall, households at the top of the agricultural production distribution are more likely to know and use improved technologies. The pattern is most consistent for male-headed households.

		Heard of Technology			Adopted New Technology (conditional on having heard of it)		
		Male-headed	Female-headed	Total	Male-headed	Female-headed	Total
Improved seeds	*1st Quartile*	5.69%	1.64%	4.47%	6.25%	0.00%	5.56%
	2nd Quartile	6.06%	4.76%	5.72%	11.11%	20.00%	13.04%
	3rd Quartile	9.6%	8.89%	9.45%	26.67%	12.50%	23.68%
	4th Quartile	11.32%	5.95%	10.20%	13.89%	0.00%	12.20%
Conservation tillage	*1st Quartile*	9.96%	6.56%	8.93%	10.71%	0.00%	8.33%
	2nd Quartile	11.11%	3.81%	9.20%	12.12%	0.00%	10.81%
	3rd Quartile	13.8%	7.78%	12.44%	9.30%	0.00%	8.00%
	4th Quartile	13.84%	5.95%	12.19%	13.64%	40.00%	16.33%
Radical terraces	*1st Quartile*	93.24%	80.33%	89.33%	56.87%	63.27%	58.61%
	2nd Quartile	93.94%	91.43%	93.28%	74.19%	75.00%	74.40%
	3rd Quartile	95.5%	94.44%	95.27%	85.23%	75.29%	83.03%
	4th Quartile	94.34%	95.24%	94.53%	91.67%	87.50%	90.79%
Soil band	*1st Quartile*	55.87%	56.56%	56.08%	85.99%	86.96%	86.28%
	2nd Quartile	58.92%	57.14%	58.46%	94.29%	95.00%	94.47%
	3rd Quartile	55.8%	60.00%	56.72%	93.68%	96.30%	94.30%
	4th Quartile	59.75%	60.71%	59.95%	94.21%	94.12%	94.19%
Progressive terraces	*1st Quartile*	1.42%	1.64%	1.49%	0.00%	0.00%	0.00%
	2nd Quartile	0.67%	0.00%	0.50%	0.00%	.	0.00%
	3rd Quartile	1.3%	1.11%	1.24%	0.00%	0.00%	0.00%
	4th Quartile	1.89%	0.00%	1.49%	0.00%	.	0.00%
Strengthening terraces with legume and grass	*1st Quartile*	69.04%	68.85%	68.98%	1.55%	2.38%	1.80%
	2nd Quartile	72.73%	72.38%	72.64%	2.78%	2.63%	2.74%
	3rd Quartile	75.0%	73.33%	74.63%	2.14%	3.03%	2.33%
	4th Quartile	75.79%	70.24%	74.63%	3.32%	1.69%	3.00%
Compost making	*1st Quartile*	3.56%	1.64%	2.98%	50.00%	50.00%	50.00%
	2nd Quartile	4.04%	7.62%	4.98%	33.33%	62.50%	45.00%
	3rd Quartile	5.5%	1.11%	4.48%	52.94%	0.00%	50.00%
	4th Quartile	6.60%	0.00%	5.22%	66.67%	.	66.67%
Improved bench	*1st Quartile*	2.14%	1.64%	1.99%	50.00%	50.00%	50.00%
	2nd Quartile	2.02%	2.86%	2.24%	50.00%	33.33%	44.44%
	3rd Quartile	3.2%	3.33%	3.23%	40.00%	33.33%	38.46%
	4th Quartile	4.40%	0.00%	3.48%	57.14%		57.14%
Connecting drainage canals to cut-off drains	*1st Quartile*	0.36%	1.64%	0.74%	0.00%	0.00%	0.00%
	2nd Quartile	1.01%	0.95%	1.00%	0.00%	100.00%	25.00%
	3rd Quartile	1.3%	1.11%	1.24%	25.00%	0.00%	20.00%
	4th Quartile	0.63%	0.00%	0.50%	0.00%	.	0.00%
Connecting cutoff-off drains to waterways	*1st Quartile*	28.83%	22.95%	27.05%	50.62%	28.57%	44.95%
	2nd Quartile	26.60%	24.76%	26.12%	51.90%	50.00%	51.43%
	3rd Quartile	28.2%	16.67%	25.62%	69.32%	40.00%	65.05%
	4th Quartile	23.27%	19.05%	22.39%	62.16%	43.75%	58.89%
Improved narrow cut bench	*1st Quartile*	6.41%	4.92%	5.96%	44.44%	50.00%	45.83%
	2nd Quartile	5.72%	11.43%	7.21%	47.06%	91.67%	65.52%
	3rd Quartile	5.8%	7.78%	6.22%	61.11%	57.14%	60.00%
	4th Quartile	7.55%	5.95%	7.21%	70.83%	60.00%	68.97%

Table 21: Knowledge and Use of Improved Technologies (by agricultural production quartile)

6.3 Sources of Information for Agricultural Technologies

Knowledge about farming techniques is transferred through different sources, depending on the technology.

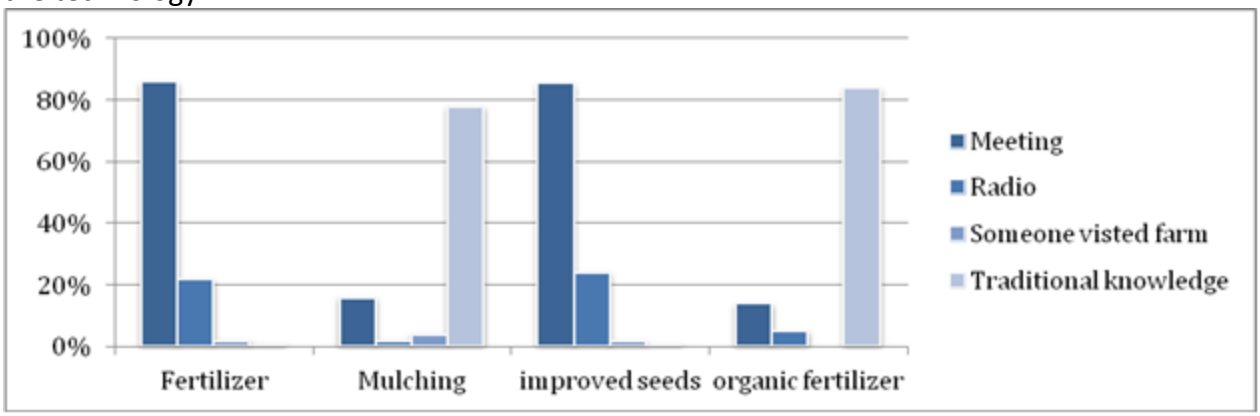

Table 22 shows the sources of information for four improved technologies: chemical fertilizer, improved seeds, mulching, and organic fertilizer. Meetings are the most important source of information for fertilizer and improved seeds. In contrast, most farmers learned of mulching and organic fertilizer through traditional knowledge[8].

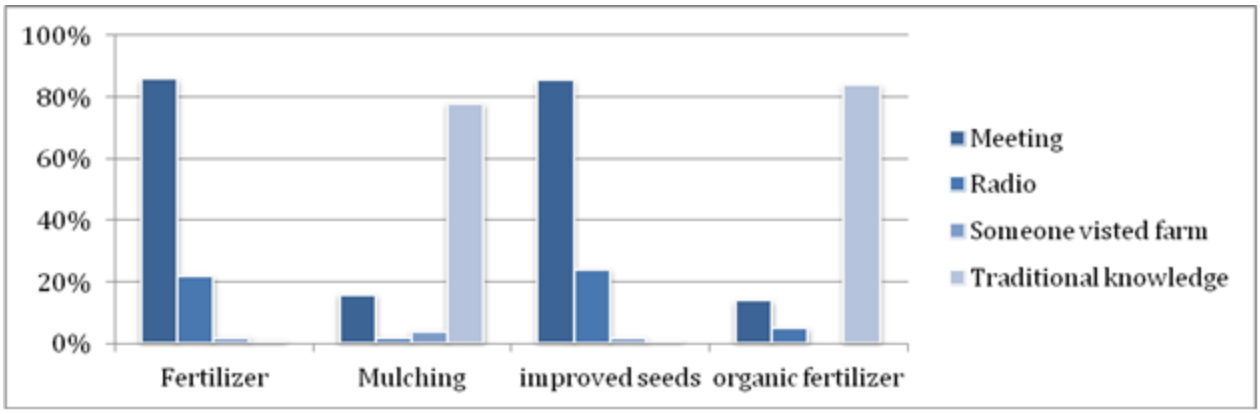

Table 22: Primary sources of information for 4 most commonly adopted technologies

6.4 Input usage

Organic manure is the most common type of input, applied by 62% of farmers in Season A and 40% of farmers in Season B. As this is almost always sourced from a household's own production, this is not surprising. Chemical fertilizer was used by 39% and 17% of farmers, respectively, and most was sourced from local government. Pesticides are not as widespread as manure and fertilizer; they were used by less than 10% of farmers in either season. Most farmers who applied pesticide procured it from an agro-dealer. Lime is extremely uncommon, used by less than 1% of farmers.

	Use of input						Source of input (conditional on use)			
	Male-Headed		Female-Headed		Total		HH Production	Agro-dealer	Local Govt	MINAGRI
Season A	*N*	*%*	*N*	*%*	*N*	*%*	*%*	*%*	*%*	*%*

[8] Traditional knowledge is defined as knowledge passed to the farmer by his/her forefathers.

Organic manure	1,187	64.28%	396	54.55%	1,583	61.84%	93.05%	2.76%	0.82%	--
Chemical fertilizer	1,187	42.12%	396	29.29%	1,583	38.91%	0.49%	15.91%	77.27%	3.90%
Pesticides	1,187	8.68%	396	4.80%	1,583	7.71%	1.64%	45.08%	38.52%	7.38%
Lime	1,187	0.34%	396	0.00%	1,583	0.25%	--	25.00%	75.00%	--
Season B										
Organic manure	1189	41.63%	400	36.25%	1,589	40.28%	93.44%	1.41%	1.72%	--
Chemical fertilizer	1189	19.01%	400	10.75%	1,589	16.93%	0.74%	31.60%	62.83%	2.60%
Pesticides	1189	5.05%	400	2.00%	1,589	4.28%	--	58.82%	25.00%	4.41%
Lime	1189	0.08%	400	0.00%	1,589	0.06%	--	--	100.00%	--

Table 23: Proportion of households using common agricultural inputs, by season

6.5 Agricultural Production Value

Total agricultural production is measured in RwF, and represents the total market value of crops harvested, regardless of whether or not they were sold.

The value for crops is generated by assigning a price to each crop based on the best available estimate of farm gate prices. For crops that are frequently sold among survey respondents, the prices are calculated based on self-reported sales data at the site-level. For crops where insufficient sales data is available in the baseline data, prices are estimated from the eSoko database, using site-level averages.[9] The prices used for each crop can be found in Appendix 2.

Table 24 reports statistics for agricultural production.[10] On average, farmers in the sample produced crops worth 413,984 Rwf ($776 USD) during the two primary agricultural seasons. Production value in Season A was roughly double that of Season B, reflecting higher area cultivated and higher productivity. Production value was higher for male-headed household than for female-headed ones, reflecting primarily differences in cultivated area.

	Male-Headed			Female-Headed			Total		
	mean	sd	p50	mean	sd	p50	mean	sd	p50
All sites									
Season A	136,851	177,121	79,575	122,268	159,573	65,700	133,217	172,981	75,000
Season B	78,302	116,538	30,000	62,480	99,262	22,000	74,359	112,659	27,000
Permanent	217,479	335,178	107,728	162,752	223,189	91,488	203,840	311,898	102,523
Total	455,564	552,396	294,992	360,953	419,608	233,160	431,984	523,947	277,134
N		1,208			401			1,609	
Rwamangana 34									
Season A	129007	142104	79525	109898	122421	70000	124210	137551	75533
Season B	15565	29900	0	16567	32384	0	15816	30510	0
Permanent	188968	303295	76240	136894	196584	79034	175894	281061	77434
Total	337919	375736	193876	266321	271093	183184	319944	353493	193773
N		352			118			470	
Rwamangana 35									
Season A	190392	265461	105600	156926	241171	79000	181686	259584	98100
Season B	72716	114676	30240	41138	59437	19875	64501	104071	25000
Permanent	309410	599696	141789	213973	385411	125420	284581	553300	138121

[9] eSoko reports market prices instead of farm gate prices, which are likely to be overestimates. For crops where our survey contained sales data, farm gate prices were on average 81% of the prices reported by eSoko. To correct for this discrepancy, we estimate farm gate prices at 81% of the market prices reported by eSoko.

[10] All production variables are winsorized at the 1% level at the upper and lower tails to decrease the influence of outliers.

Total	597734	838856	351904	444170	702023	253963	557782	807763	330908
N		455			160			615	
Kayonza 4									
Season A	89710	110770	55400	98452	124513	46400	91762	114081	50750
Season B	141562	142308	104000	136900	148663	97067	140468	143694	104000
Permanent	170628	199924	99830	138070	170257	63450	162985	193707	99830
Total	409358	359896	308864	374325	322673	273400	401134	351527	304135
N		401			123			524	

Table 24: Total agricultural production (RWF)

6.6 Labor for agricultural activities

As shown in Tables Table 25 and Table 26, adult household members contributed 160 person-days of labor on all tasks related to agriculture over the course of the year.

	Season A						**Season B**					
	Male-headed		Female-headed		Total		Male-headed		Female-headed		Total	
	mean	*sd*	*mean*	*sd*	*mean*	*sd*	*mean*	*sd*	*mean*	*sd*	*mean*	*sd*
Adult HH members	90	81	70	75	85	80	66	59	52	56	62	59
Unpaid labor	1	6	3	11	2	8	1	5	2	8	1	6
Paid labor	22	60	12	28	19	54	15	37	10	41	14	38
N	1208		401		1609		1208		401		1609	

Table 25: Mean labor days for all agricultural activities related to seasonal crops, by season

More than half of household members' labor time was spent on activities related to Season A, and only 13 days for cultivation of permanent crops. Households also hired in supplemental paid labor. Unpaid assistance[11] provided a significant contribution only in activities relating to permanent crops.

	Male-headed			Female-headed			Total		
	N	mean	sd	N	mean	sd	N	mean	sd
Adult HH members	72	15	22	28	9	15	100	13	20
Unpaid labor	15	9	15	10	3	3	25	7	12
Paid labor	1186	14	41	396	13	30	1,582	14	39

Table 26: Mean labor days for all agricultural activities related to permanent crops

Table 27 shows a breakdown of (conditional) labor allocation by specific tasks during each of the two agricultural seasons. Household members spent the largest amount of time on irrigation, followed by land preparation, weeding, and harvesting. Paid labor was used most for land preparation and weeding. Households most rely on the support of relatives, friends, or other unpaid assistance for land preparation and irrigation.

Male-headed households invested more labor in all tasks than female-headed households, from both household members and paid workers. Male-headed households had more access to irrigation; among the small number of households who irrigated, male-headed households invested nearly triple the amount of labor compared to female-headed households.

[11] Unpaid assistance included any relatives (outside of the household), friends or neighbors who worked in the household's gardens, through labor-sharing agreements or other informal mechanisms

	Season A									Season B								
	Male-headed			Female-headed			Total			Male-headed			Female-headed			Total		
	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd
Land preparation																		
Adult household members	1,198	27	31	398	20	24	1596	26	30	1,203	20	22	399	16	20	1,602	19	21
Unpaid labor	55	9	10	43	11	14	98	10	12	53	6	5	47	7	7	100	6	6
Paid labor	510	19	26	165	13	21	675	18	25	462	14	17	128	10	13	590	13	16
Planting																		
Adult household members	1,198	11	14	398	9	11	1596	10	14	1,203	9	12	399	7	8	1,602	9	11
Unpaid labor	60	5	4	43	6	7	103	5	6	49	4	8	43	3	3	92	4	6
Paid labor	384	10	31	108	6	6	492	9	27	349	8	12	93	6	6	442	7	11
Weeding																		
Adult household members	1,187	19	20	397	16	18	1584	18	20	1,188	16	18	390	14	17	1,578	16	18
Unpaid labor	60	7	9	35	6	7	95	6	9	53	5	9	42	5	5	95	5	7
Paid labor	433	17	45	115	10	13	548	16	41	416	13	33	101	17	70	517	14	43
Applying inputs																		
Adult household members	823	8	12	245	6	7	1068	8	11	523	6	9	139	5	7	662	6	9
Unpaid labor	17	4	6	14	3	2	31	4	4	7	3	3	5	4	2	12	3	2
Paid labor	162	9	17	40	5	4	202	8	15	75	7	10	18	4	4	93	6	9
Harvesting																		
Adult household members	1,177	18	22	393	14	19	1570	17	21	1,056	16	21	354	13	22	1,410	15	21
Unpaid labor	59	4	7	44	3	3	103	4	5	46	3	3	31	4	4	77	3	4
Paid labor	277	10	23	67	6	7	344	9	21	207	10	16	53	6	6	260	9	15
Irrigation																		
Adult household members	51	46	40	14	17	22	65	40	38	62	27	30	13	11	11	75	24	28
Unpaid labor	2	12	6	0	0	0	2	12	6	2	7	1	0	0	0	2	7	1
Paid labor	15	8	9	3	2	1	18	7	8	15	8	9	3	2	1	18	7	8
Crop processing																		
Adult household members	1,108	9	13	378	8	15	1,486	9	14	1,095	3	4	362	2.41	3.28	1,457	3	4
Unpaid labor	44	3	3	25	4	3	69	3	3	1,095	0	0	362	0.17	1.05	1,457	0	1
Paid labor	132	6	15	40	4	8	172	6	14	127	4	6	34	3.15	3.13	161	4	6

Table 27: Mean labor days by agricultural activity and season, conditional on devoting labor to the activity

6.7 Agricultural Storage & Commercialization

Tables 26-29 show the primary crops grown and commercialized in the project area. In season A, the most commonly grown crops were beans and maize, while the most commonly commercialized crops were maize and groundnuts (Table 28). In Season B, the most commonly grown crops were beans and sorghum, and the most commercialized crops were beans and soya (Table 30). Table 31 shows that the most common annual crops were coking bananas, poyo bananas, and cassava. Of the annual crops, coffee, *poyo* bananas and mango are most often commercialized.

Season A	Male-Headed		Female-Headed		Total	
Crop	*# growing*	*% commercialized*	*# growing*	*% commercialized*	*# growing*	*% commercialized*
All sites						
Dry bean	925	69.64%	334	68.81%	1,259	69.42%
Dry maize	617	72.35%	208	76.49%	825	73.39%
Sweet potato	234	65.02%	89	69.11%	323	66.14%
Irish potato	238	67.17%	72	65.84%	310	66.86%
Groundnut	107	73.04%	30	68.24%	137	71.99%
Rwamangana 34						
Dry bean	292	77.36%	103	67.67%	395	74.84%
Dry maize	214	77.04%	70	81.44%	284	78.13%
Sweet potato	63	68.24%	24	63.56%	87	66.95%
Irish potato	57	70.69%	15	50.70%	72	66.53%
Groundnut	22	66.47%	6	50.00%	28	62.94%
Rwamangana 35						
Dry bean	320	72.04%	131	73.60%	451	72.50%
Dry maize	276	75.26%	96	77.21%	372	75.76%
Sweet potato	137	63.21%	50	68.64%	187	64.66%
Irish potato	142	65.94%	40	69.25%	182	66.66%
Groundnut	72	76.90%	20	81.87%	92	77.98%
Kayonza 4						
Dry bean	313	59.97%	100	63.72%	413	60.88%
Dry maize	127	58.12%	42	66.62%	169	60.23%
Sweet potato	34	66.32%	15	79.54%	49	70.37%
Irish potato	39	66.50%	17	71.16%	56	67.91%
Groundnut	16	80.21%	3	72.22%	19	78.95%

Table 28: Agricultural commercialization, by crop (Season A)

Season B	Male-Headed		Female-Headed		Total	
Crop	*# growing*	*% commercialized*	*# growing*	*% commercialized*	*# growing*	*% commercialized*
All sites						
Dry bean	489	72.32%	173	81.93%	662	74.83%
Sorghum	320	64.84%	114	63.16%	434	64.40%
Irish potato	152	68.68%	48	64.42%	200	67.66%
Groundnut	50	70.67%	16	62.50%	66	68.69%
Dry maize	46	57.92%	19	68.42%	65	60.99%
Soybean	29	79.20%	17	70.59%	46	76.02%
Rwamangana 34						
Dry bean	117	83.97%	45	88.93%	162	85.35%
Sorghum	0	0.00%	1	100.00%	1	100.00%
Irish potato	13	89.63%	4	57.50%	17	82.07%
Groundnut	3	33.33%	0	0.00%	3	33.33%
Dry maize	0	0.00%	0	0.00%	0	0.00%
Soybean	2	100.00%	1	100.00%	3	100.00%

Table 29: Agricultural commercialization, by crop (Season B)

Rwamangana 35						
Dry bean	220	73.34%	75	86.78%	295	76.75%
Sorghum	38	68.31%	13	56.04%	51	65.19%
Irish potato	111	67.87%	32	73.13%	143	69.05%
Groundnut	44	73.48%	12	66.67%	56	72.02%
Dry maize	8	80.21%	7	85.71%	15	82.78%
Soybean	22	86.36%	14	71.43%	36	80.56%
Kayonza 4						
Dry bean	152	61.87%	53	69.13%	205	63.75%
Sorghum	282	64.37%	100	63.71%	382	64.20%
Irish potato	28	62.18%	12	43.52%	40	56.58%
Groundnut	3	66.67%	4	50.00%	7	57.14%
Dry maize	38	53.23%	12	58.33%	50	54.45%
Soybean	5	39.35%	2	50.00%	7	42.40%

Table 30: Agricultural commercialization, by crop (Season B – continued)

Permanent Crops	Male-Headed		Female-Headed		Total	
Crop	*# growing*	*% commercialized*	*# growing*	*% commercialized*	*# growing*	*% commercialized*
All sites						
Banana (cooking)	1032	68.64%	345	69.86%	1377	68.94%
Banana (poyo)	457	89.06%	127	87.63%	584	88.75%
Cassava	329	77.33%	113	79.29%	442	77.83%
Coffee	295	99.88%	94	100.00%	389	99.91%
Avocado	157	80.49%	47	75.94%	204	79.44%
Mango	80	85.90%	20	95.71%	100	87.86%
Rwamangana 34						
Banana (cooking)	318	70.24%	112	70.90%	430	70.41%
Banana (poyo)	111	87.71%	29	88.14%	140	87.80%
Cassava	71	82.63%	23	76.98%	94	81.25%
Coffee	12	98.21%	4	100.00%	16	98.66%
Avocado	41	79.17%	9	71.80%	50	77.84%
Mango	22	85.70%	8	98.44%	30	89.10%
Rwamangana 35						
Banana (cooking)	401	69.79%	142	68.07%	543	69.34%
Banana (poyo)	258	89.17%	73	87.69%	331	88.84%
Cassava	229	99.93%	76	100.00%	305	99.95%
Coffee	115	74.77%	49	80.42%	164	76.46%
Avocado	83	78.44%	21	74.06%	104	77.56%
Mango	48	88.27%	8	95.00%	56	89.23%
Kayonza 4						
Banana (cooking)	313	65.54%	91	71.37%	404	66.9%
Banana (poyo)	88	90.44%	25	86.86%	113	89.7%
Cassava	143	76.76%	41	79.24%	184	77.3%
Coffee	54	100.00%	14	100.00%	68	100.0%
Avocado	33	87.30%	17	80.44%	50	85.0%
Mango	10	75.00%	4	91.67%	14	79.8%

Table 31: Agricultural commercialization, by crop (Annual Crops)

Most farmers utilized post-harvest infrastructure for crop storage, as seen in Table 32.

	Season A			Season B		
	Male-Headed	Female-Headed	Total	Male-Headed	Female-Headed	Total
%	68.86%	68.78%	68.84%	64.47%	63.81%	64.31%
N	1,108	378	1,486	1,095	362	1,457

Table 32: Use of post-harvest infrastructure (any crop)

6.8 Yields for major crops

Agricultural yield is measured in RwF/Ha, and represents the monetary value of cultivated land. Value of production was calculated as described in the previous section, and plot area was measured for a subset of plots, using both GIS mapping and self-reporting[12]. Yield statistics are calculated based plots where the area was reliably measured.

Gross yield is calculated using the total value of harvested crops, while net yield uses the total value of harvested crops minus money spent on inputs. This includes money spent on seeds, fertilizer, pesticides, labor, and irrigation. However, it does not impute a cost for household and other unpaid labor.

Gross yields are reported in Table 33.[13] Average gross yield over the previous year was 850,958 Rwf/Ha ($1364 USD/Ha). Productivity was marginally higher for Season A seasonal crops (351,232 Rwf) compared to Season B seasonal crops (302,678 Rwf). Productivity was roughly the same for male-headed and female-headed households.

	Male-Headed				Female-Headed				Total			
	N	mean	sd	p50	N	mean	sd	p50	N	mean	sd	p50
Season A	833	351,583	412,487	204,762	279	350,185	501,501	166,667	1,112	351,232	436,292	199,650
Season B	611	313,749	351,775	197,756	203	269,362	348,063	141,850	814	302,680	351,166	181,789
Total (includes permanent)	967	851,482	1,019,900	515,109	316	849,352	1,103,511	434,149	1,283	850,958	1,040,677	496,743

Table 33: Gross agricultural yield per hectare (RWF)

Results framework note: These yields are notably higher than those originally reported during the Phase 1A LWH baseline: yields in Phase 1A sites were calculated as $492 USD/ha for the command area, and $469 USD/ha for the non-command area. However, this difference primarily reflects differences in both survey instrument and calculation strategy. In the Phase 1A baseline data, yield was calculated by dividing the total crop value for each household by the average landholding of .54 ha. For this Phase 1B baseline, each household's production is

[12] Areas were calculated using GPS for a subset of plots (approximately 20%). For the remainder, areas are based on self-reported data.

[13] The raw data contains a large number of outliers, likely due to mis-reporting of plot area. Therefore, the reported yield data (gross and net) is trimmed at the upper and lower 2% tails.

divided by their individual landholdings. For comparison, we re-calculated the Phase 1A yield data using household production divided by individual landholdings, and found an average of $1,140 USD/ha which is approximately 20% lower than the Phase 1B baseline calculation of $1,278 USD/ha.

Net yields are reported in Table 34. Average net yields are 797,307 Rwf/Ha ($1,278 USD/ha). Net yields are only slightly lower than gross yields, reflecting the low amount of input usage in the sample. As with gross yields, net yields are higher in Season A than in Season B, but roughly similar among male and female-headed households.

	Male-Headed				Female-Headed				Total			
	N	mean	sd	p50	N	mean	sd	p50	N	mean	sd	p50
Season A	828	309,186	385,115	176,010	283	296,322	434,149	146,530	1,111	305,909	398,017	166,377
Season B	609	289,030	329,760	168,516	202	251,771	337,364	125,454	811	279,750	331,852	160,742
Total (includes permanent)	968	794,848	984,335	473,366	319	804,770	1,074,554	414,259	1,287	797,307	1,007,031	459,068

Table 34: Net agricultural yield per hectare (RWF)[14]

6.9 Agricultural Income

Agricultural income, presented in Table 35, is defined as the total value of crops that are sold. The average agricultural income for the year is 165,877 Rwf ($266 USD). However, many people in the sample have extremely low amount of income and the median value of agricultural income is well below the mean, at 78,000 Rwf ($125 USD). Income is higher in Season A then in Season B; in fact, the majority of households sell no seasonal crops in Season B. Male-headed households' agricultural income is consistently higher than that of female-headed households.

	Male-Headed				Female-Headed				Total			
	N	mean	sd	p50	N	mean	sd	p50	N	mean	sd	p50
Season A	1,208	31,437	67,469	4,775	401	24,519	55,527	3,600	1,609	29,713	64,752	4,500
Season B	1,208	8,797	24,427	0	401	6,792	20,421	0	1,609	8,297	23,503	0
Permanent crops	1,208	129,828	212,720	50,000	401	108,069	184,319	40,000	1,609	124,405	206,168	46,500
Total	1,208	174,068	249,915	82,000	401	141,203	215,738	63,000	1,609	165,877	242,202	78,000

Table 35: Agricultural income (RWF)

[14] The number of observations differs slightly between Tables 32 and 33 because the data was windsored before separating into male/female headship.

7 Assets, Income & Expenditures

7.1 Household Assets

The most commonly owned household assets are mosquito nets, beds, and tables, as shown in Table 36. 79% of households have a radio, and mobile coverage is 63%. Nearly half of the households have a bicycle. 4% have a television. Overall, male-headed households have more assets than female-headed households, with especially significant gaps in terms of bicycles, radios, and mobile phones, all of which have important implications for access to information and markets.

Asset	Male-Headed	Female-Headed	Total
Mosquito net	94.62%	91.02%	93.72%
Bed	89.74%	82.54%	87.94%
Table	82.95%	73.57%	80.61%
Radio	82.95%	66.83%	78.93%
Cell phone	68.77%	46.88%	63.31%
Chair	56.04%	50.12%	54.57%
Bicycle	53.31%	20.45%	45.12%
Living room suite	42.38%	32.17%	39.84%
Cupboard	7.28%	4.24%	6.53%
Television	4.97%	0.75%	3.92%
N	1208	401	1609

Table 36: Ownership of common assets

In terms of agricultural assets, most households have hoes or shovels and mortar and pestle, as shown in Table 37. Less than 10% have a wheelbarrow. Mechanized tools are not included in the table as ownership was less than 1% in all categories.

	Male-Headed	Female-Headed	Total
Hoe or shovel	98.43%	96.76%	98.01%
Rake or spade	16.23%	9.48%	14.54%
Pick	16.06%	8.48%	14.17%
Wheel barrow	11.34%	5.49%	9.88%
Mill	14.24%	23.69%	16.59%
Mortar and pestle	81.21%	81.55%	81.29%
N	1208	401	1609

Table 37: Ownership of agricultural assets

Table 38 shows livestock ownership. Goats are the most common type of livestock, owned by 58% of the households. Approximately one-third of the households have chickens and cows, and one-quarter have pigs. 1 in 10 households keeps a bull.

	Male-Headed	Female-Headed	Total
Goat	59.11%	55.00%	58.08%
Chicken or other poultry	36.18%	28.50%	34.27%
Cow	33.11%	27.25%	31.65%
Pig	26.74%	25.00%	26.31%
Sheep	15.40%	12.00%	14.55%
Bull	11.59%	7.75%	10.63%
Rabbit	9.35%	5.25%	8.33%
Guinea pig	4.14%	3.50%	3.98%
N	1,208	401	1,609

Table 38: Livestock ownership

7.2 Income & Expenditures

Income varied widely across sampled households. Farm income includes all earnings from seasonal and annual crops. The most important sources of non-farm income are: sale of livestock, casual labor (by male HH members), own-farm enterprise, sale of land, and salaried or wage labor (by male HH members). As Table 39 shows, average annual income was RWF119,807 (equivalent to approximately $185). However, half of the sampled households earned less than RWF42,000 ($65). Households headed by males have significantly higher incomes than households headed by females, RWF130,574 ($200) vs. RWF87,371 ($135). Half of female-headed households earn less than RWF28,000 ($45) per year.

	Male-Headed			Female-Headed			Total		
	mean	sd	p50	mean	sd	p50	mean	sd	p50
Income									
Annual Farm income	53,622	101,927	10,000	31,268	67,198	0	48,051	94,948	4,000
Annual Non-farm income[15]	73,044	152,660	0	55,225	143,238	0	68,603	150,521	0
Total	130,574	193,461	50,000	87,371	165,109	28,000	119,807	187,682	42,000
Expenditures									
Infrequent expenditures (annual)	166,581	305,454	49,000	96,513	239,035	22,000	149,119	291,834	37,000
Frequent expenditures (weekly)	5,608	9,183	1,900	3,047	6,563	570	4,970	8,674	1,500
Food expenditures (weekly)	4,959	3,910	4,145	3,672	3,404	2,780	4,638	3,830	3,800
N	1,208			401			1,609		

Table 39: Summary of income and expenditures

Expenditures were measured annually for infrequent events such as purchase of land, assets, and housing, or payment of school fees or health insurance. These averaged RWF149,119 ($230) per year, but with a widespread distribution similar to income. Half of the households had less than RWF37,000 ($60) in expenditures. The gender disparity is similar to that observed for income: average expenditures for female-headed households are close to half the level for male-headed households. The most important sources of infrequent expenditures are: housing, purchase of land, school fees, and health insurance.

[15] This category includes any income from sources unrelated to the household farm, such as small businesses, petty trade, retail, etc.

Expenditures were measured over the last one week for frequent purchases such as food, transportation, phone credit, and leisure activities. Weekly expenditures on non-food items average RWF4,970 ($8). Weekly expenditures for male-headed households were RWF5,608 ($9) compared to RWF3,047 ($5) for female-headed households. Half of the female-headed households spent less than $1 per week on non-food expenditures.

Food expenditures average RWF4,638 ($7) per week; RWF4,959 ($8) for male-headed households and RWF3,672 ($6) for female-headed households. Half of the female-headed households spent less than $4.50 per week on food.

8 Rural finance

In terms of access to finance and savings behaviors in the project area, half the sampled households include at least one household member with a bank account, with 39% of female-headed households and 56% of male-headed, specifically (Table 40). Access to credit is low compared to formal savings; only 6.5% of households report requesting any loan in the past 12 months.

	Male-headed	Female-headed	Total
All sites			
HH member has one or more bank accounts[16]	55.76%	38.50%	51.46%
Household member has informal savings	45.53%	40.15%	44.19%
Household member has requested loan in the last 12 months	7.28%	3.99%	6.46%
N	1,208	401	1,609
Rwamangana 34			
HH member has one or more bank accounts	47.16%	37.29%	44.68%
Household member has informal savings	46.02%	44.07%	45.53%
Household member has requested loan in the last 12 months	9.38%	5.93%	8.51%
N	352	118	470
Rwamangana 35			
HH member has one or more bank accounts	70.11%	43.13%	63.09%
Household member has informal savings	48.79%	38.12%	46.02%
Household member has requested loan in the last 12 months	7.91%	1.87%	6.34%
N	455	160	615
Kayonza 4			
HH member has one or more bank accounts	46.88%	33.33%	43.70%
Household member has informal savings	41.40%	39.02%	40.84%
Household member has requested loan in the last 12 months	4.74%	4.88%	4.77%
N	401	123	524

Table 40: Access to Finance

16

45% of households report keeping savings in their homes or informal savings groups. The primary uses of informal savings are for investments in housing and livestock, as shown in

Table 41.

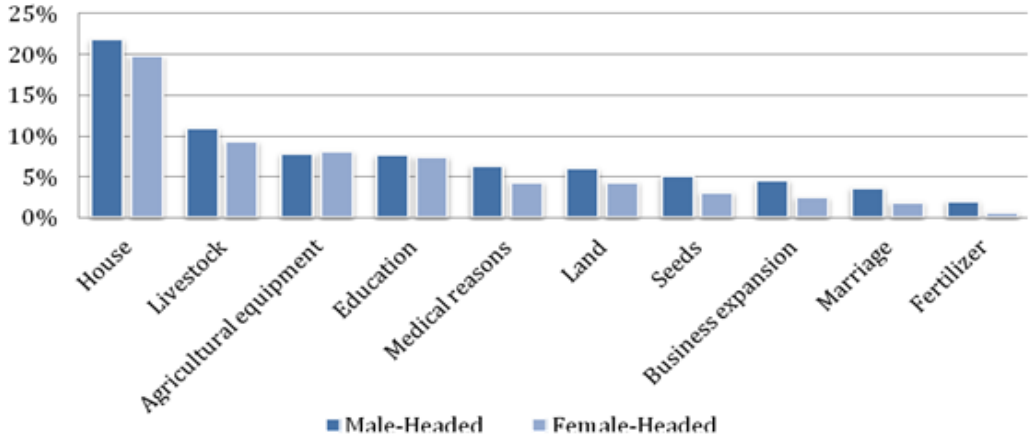

Table 41: Most common uses for informal savings

Table 42 shows that the most commonly reported reasons for having a formal bank account are to save and to keep money safely. 10% reported that a primary purpose of the bank account was to access loans.

	Male-Headed	Female-Headed	Total
To save	77.61%	70.78%	76.33%
To keep money safely	48.58%	46.75%	48.24%
To access loans	11.19%	6.49%	10.32%
To receive wages	4.33%	3.90%	4.25%
To deposit money from business	2.39%	0.65%	2.07%
Other reason	1.64%	3.25%	1.94%
N	670	154	824

Table 42: Reasons for having a bank account

Households that do have access to loans primarily take them to invest in their homes (male-headed households) or agricultural equipment and education (female-headed households). This suggests interesting differences in consumption and financial choices across gender lines.

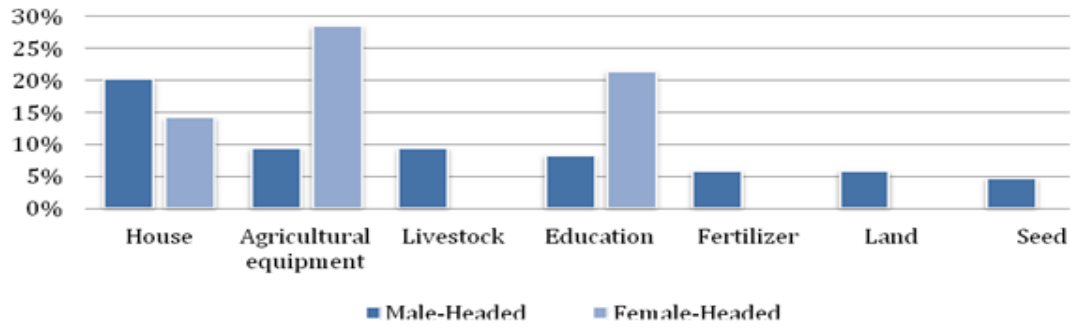

Table 43: Most common reasons for requesting loans

9 Food Security

The baseline questionnaire included three measures of food security designed and tested cross-culturally by the Food and Nutrition Technical Assistance (FANTA) Project, USAID and the FAO.. The three food security measures are: Household Hunger Scale[17], Women's Dietary Diversity Score, and Months of Adequate Household Food Provisioning. Together the indicators provide a comprehensive profile of food security. Multiple measures are necessary, since food security depends at once on adequate availability of food, adequate access to food, and appropriate food utilization and consumption.

The Household Hunger Scale is a simple, cross-culturally applicable indicator developed by FANTA to measure the prevalence of household hunger. The HHS is the most basic measure of the GAFSP food security indicators. It consists of six questions that measure occurrence and frequency of food insecurity events (such as a household member going to sleep hungry because there was not enough food). It estimates the proportion of households affected by three different severities of household hunger: little to no hunger, moderate hunger, and severe hunger, using a reference period of the previous 12 months. The HHS focuses on the food quantity dimension of food access. It measures food availability and access, but does not measure dietary quality.

The women's dietary diversity score (WDDS) is an indicator developed by the Food and Agriculture Office (FAO). It is meant to reflect, in a snapshot form, the economic ability of a household to access a variety of foods. Individual dietary diversity scores aim to reflect nutrient adequacy, as the evidence shows that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. The WDDS is an aggregate of nine food groups with important micronutrients. Although there is no internationally-recognized benchmark, a low WDDS is proven internationally to be correlated with micronutrient deficiencies such as anemia

[17] The Household Hunger Scale is a required indicator for Feed the Future, the US government's global hunger and food security initiative (http://www.feedthefuture.gov/), and the US Agency for International Development's Food for Peace program,

or low vitamin A. The dietary diversity module was administered to an adult female household member, using a reference period of the previous 24 hours. The respondent was asked about her own food consumption.

The Months of Adequate Household Food Provisioning is a simple indicator of household food access. Respondents are asked if in any months of the past 12, there was not enough food to meet the needs of all household members, and in which months the shortages occurred. The MAHFP is measured on a scale of 0-12, in which 12 means the household met its food needs in all 12 months, and 0 means the household was not able to meet its food needs in any of the 12 months.

9.1 Household Hunger Scale

The HHS shows that severe hunger is not prevalent in the sampled areas, as shown in Table 44: 95% of households report little to no hunger, and only 1.43% report severe hunger.

Household Hunger Score	Household Hunger Categories	Overall	R-34	R-35	K-4
0–1	Little to no hunger in HH	94.66%	92.98%	96.1%	94.47%
2–3	Moderate hunger in HH	3.91%	5.96%	2.6%	3.63%
4–6	Severe hunger in HH	1.43%	1.06%	1.3%	1.91%

Table 44: Household Hunger Scale

Table 45 shows a more detailed analysis of the household hunger scale, breaking the sample into quartiles based on total agricultural production. Hunger is more severe for households with lower levels of agricultural production. Whereas overall, 94.66% of households fall into the "little to no hunger in household" category, only 85.35% of households in the bottom quartile are classified that way. On the other end of the spectrum, 1.43% of households report severe hunger overall, but that rate increases to 4.22% when considering only the households in the first quartile, and up to 5.74% when considering only female-headed households in that first quartile. There are no households in the top quartile of agricultural production reporting severe hunger.

Household Hunger Score		Male-Headed	Female-Headed	Total
0–1	*1st Quartile*	86.48%	82.79%	85.36%
	2nd Quartile	97.31%	92.38%	96.02%
	3rd Quartile	97.76%	97.78%	97.76%
	4th Quartile	100.00%	97.62%	99.50%
2–3	*1st Quartile*	9.96%	11.48%	10.42%
	2nd Quartile	1.35%	6.67%	2.74%
	3rd Quartile	1.92%	2.22%	1.99%
	4th Quartile	0.00%	2.38%	0.50%
4–6	*1st Quartile*	3.56%	5.74%	4.22%
	2nd Quartile	1.35%	0.95%	1.24%
	3rd Quartile	0.32%	0.00%	0.25%
	4th Quartile	0.00%	0.00%	0.00%

Table 45: Household Hunger Scale, by agricultural production quartile

A closer analysis of the 5% of households that do report food insecurity (shown in Table 46) is revealing. Households with heads that are female, uneducated, or unmarried are twice as likely to be food insecure as their counterparts. Households that own livestock (especially cows), and households headed by an individual who has worked over the last 12 months are all significantly more likely to be food-secure.

Category		N	Rate of Food Insecurity	Std. Err.	Difference	P-value
HH Head is Female	*no*	1206	4.31%	0.58%	3.85%	0.003
	yes	392	8.16%	1.39%		
HH Head has no formal education	*no*	1096	4.01%	0.59%	4.18%	0.0005
	yes	513	8.19%	1.21%		
HH Head is single	*no*	1169	4.19%	0.59%	4.21%	0.0008
	yes	440	8.40%	1.32%		
HH owns livestock	*no*	513	7.99%	1.20%	3.88%	0.0012
	yes	1096	4.11%	0.60%		
HH owns a cow	*no*	1099	6.55%	0.75%	3.8%	0.0016
	yes	509	2.75%	0.73%		
HH Head worked in past 12 months	*no*	150	9.33%	2.38%	-4.50%	0.019
	yes	1448	4.83%	0.56%		

Table 46: Food security for vulnerable groups

9.2 Women's Dietary Diversity Score

Most women reported consuming food from 4 of the 9 food categories during the recall period. 75% of females reported 5 or less food groups. 34% of women reported consuming food from 3 or less of the 9 food groups.

The most commonly consumed food groups are legumes, starchy staple foods, fruits and vegetables (excluding leafy greens and vitamin-A rich fruits or vegetables). The correlation between nutrition / micronutrient access and dietary diversity is clear. As Table 47 shows, women with low levels of dietary diversity relied on staple food and beans, and most are not consuming nutrient rich foods such as fish, vitamin-A rich fruits and vegetables, dark green vegetables, and meat or dairy products. Only women with high dietary diversity (7% of the population) are likely to consume protein and iron-rich foods.

Food Groups Consumed by ≥50% of women by Dietary Diversity Category		
Lowest Dietary Diversity (≤3 groups)	*Medium Dietary Diversity (4 – 5 food groups)*	*High Dietary Diversity (≥6 food groups)*
Starchy Staples Legumes, Nuts, Seeds Other Fruits & Vegetables	Starchy Staples Legumes, Nuts, Seeds Other Fruits & Vegetables Dark Green Vegetables	Starchy Staples Legumes, Nuts, Seeds Other Fruits & Vegetables Dark Green Vegetables Vit. A Rich Fruits & Vegetables Other Meat & Fish Milk & Dairy Products
n = 549	*n = 661*	*n = 399*
34.12%	*41.08%*	*24.80%*

Table 47: Women's Dietary Diversity - Proportion of women consuming significant food groups

Table 48 shows more detail on the distribution of dietary diversity scores, breaking down the sample into quartiles of total agricultural production. Women in households in the bottom quartile are more likely to have low levels of dietary diversity than average: 37.22% of

households in the bottom quartile have low WDDS, compared to 34.12% of households overall. The opposite is true as well: households in the top quartile are significantly more likely to have high levels of dietary diversity: 31.34% of households in the top quartile, compared to 24.8% of households overall. However, at medium levels of dietary diversity there is little difference across production quartiles. Interestingly, the WDDS score pattern is driven by the male-headed households. Differences across the distribution are smaller for female-headed households, and patterns are less clear, indicating that differences in dietary diversity have important gender dimensions.

		Male-Headed	Female-headed	Total
Lowest Dietary Diversity (≤3 groups)	*1st Quartile*	39.50%	31.97%	37.22%
	2nd Quartile	37.37%	34.29%	36.57%
	3rd Quartile	34.94%	23.33%	32.34%
	4th Quartile	32.08%	23.81%	30.35%
Medium Dietary Diversity (4 – 5 food groups)	*1st Quartile*	37.72%	51.64%	41.94%
	2nd Quartile	41.08%	45.71%	42.29%
	3rd Quartile	38.46%	53.33%	41.79%
	4th Quartile	36.16%	46.43%	38.31%
High Dietary Diversity (≥6 food groups)	*1st Quartile*	22.78%	16.39%	20.84%
	2nd Quartile	21.55%	20.00%	21.14%
	3rd Quartile	26.60%	23.33%	25.87%
	4th Quartile	31.76%	29.76%	31.34%

Table 48: Women's Dietary Diversity, by agricultural production quartile

Table 49 shows the overall proportion of women consuming different types of foods. The majority of women consumed either a plant or animal source of Vitamin A rich foods (green leafy vegetables, orange fruits or vegetables, organ meat, eggs, or dairy products). However, only 1 out of 8 women consumed at least one category of heme-iron rich foods (organ meat, flesh meat, or fish/seafood).

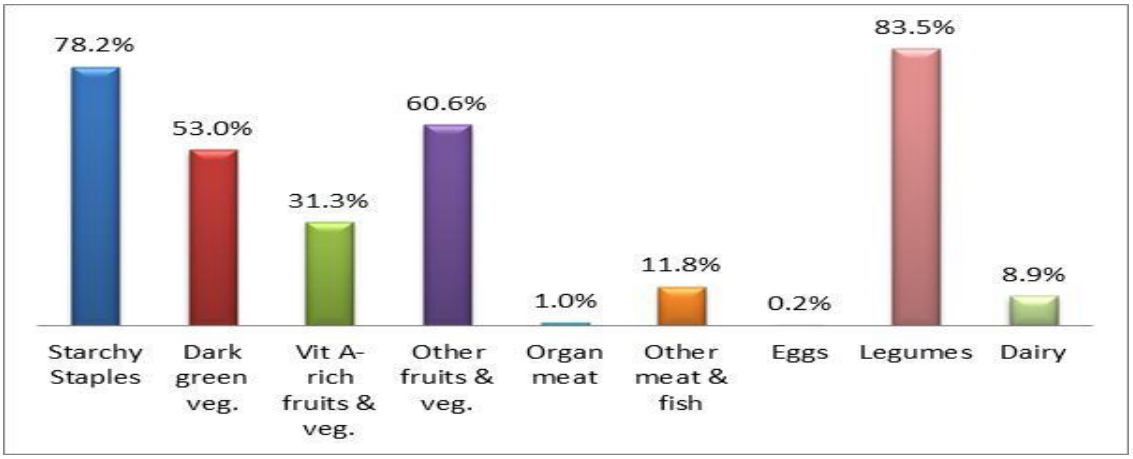

Table 49: Proportion of adult women consuming from basic food groups

Dietary diversity and the household hunger scale are clearly related. 43.02% of households classified as food-insecure by the HHS have low WDDS scores, compared to 33.62% of

households classified as food secure. The average WDDS for food-insecure households was 3.6, compared to 4.1 for food-secure households.

Months of Adequate Household Food Provisioning69% of households reported no shortages of food in the past year. For the sample as a whole, the months of adequate household food provisioning was 11.2 out of 12. For the one-third of the sample reporting any food shortages, the average MAHFP is 9.4. Households classified as food insecure by the HHS were much more likely than average to have had inadequate food: 95.34% of food-insecure households reported at least one month of food insecurity, compared to only 27.91% of food-secure households. Food insecure households had an average MAHFP of 8.3. The relationship between adequate food provisioning and dietary diversity is weaker. Households with low levels of dietary diversity were no more likely to report inadequate food over the past year than households with medium to high diversity.

9.3 Food sources and expenditures

More detailed data was collected on food consumption and expenditures over the week prior to the interview. Figure 6 shows details on which food categories the household consumed from its own production and from outside purchases. Table 50 shows that households consume from their own production items whenever possible. Most purchases are reserved for items not commonly produced at household level. Most households consumed beans (84%), vegetables (81%), starchy staples such as matoke, cassava, or potatoes (78%) and flour (52%) from their own production. The most frequently purchased items are salt or other spices (purchased by 94% of households), oil (92%), and sugar (54%).

	Consumed from own production in last week	Purchased for consumption in last week	Expenditure in last week (conditional on purchase)	Standard Error	N
Flour	52.21%	30.83%	RWF 1,309	RWF 65	496
Bread	0.25%	21.81%	RWF 549	RWF 30	351
Rice	0.25%	43.19%	RWF 1,432	RWF 69	695
Meat/ Fish	0.31%	41.08%	RWF 2,796	RWF 93	661
Poultry / Eggs	4.16%	2.73%	RWF 723	RWF 134	44
Milk/ Dairy	8.27%	12.62%	RWF 725	RWF 40	203
Oil	0.12%	91.98%	RWF 1,974	RWF 22	1480
Fruits	8.76%	8.83%	RWF 553	RWF 95	141
Beans	83.47%	14.42%	RWF 1,491	RWF 99	230
Vegetables	80.73%	10.63%	RWF 401	RWF 40	169
Matoke, Cassava, Potatoes	77.63%	21.63%	RWF 1,250	RWF 50	347
Beverages (non-alcoholic)	8.89%	11.56%	RWF 1,283	RWF 127	186
Sugar / honey	0.37%	54.44%	RWF 776	RWF 20	875
Salt / spices	0.00%	93.66%	RWF 214	RWF 6	1507
Meals prepared outside HH	---	2.49%	RWF 1,728	RWF 328	39

Table 50: Food expenditures in past 1 week

The household consumption data aligns with the women's dietary diversity indicator; most households reported consuming beans, vegetables and matoke (or other starches) in the past week, the large majority of which came from their own production. The largest expenditures were on meat / fish products, at a total of RWF2,796 ($4) for the past week.

There is a strong relationship between food consumption patterns and the HHS, as shown in

	Consumed from own production				**Purchased for consumption**			
	food secure	*food insecure*	*Difference*	*P-value*	*food secure*	*food insecure*	*Difference*	*P-value*
Flour	53.64%	26.74%	26.90% (5.50)	0.00%	29.68%	51.16%	-21.48% (5.09)	0.00%
Bread	0.26%	0.00%	0.26% (0.55)	63.44%	22.65%	6.98%	15.68% (4.56)	0.06%
Rice	0.26%	0.00%	0.26% (0.55)	63.44%	44.32%	23.26%	21.06% (5.47)	0.01%
Meat/Fish	0.33%	0.00%	0.33% (0.62)	59.49%	42.22%	20.93%	21.29% (5.43)	0.01%
Poultry/Eggs	4.33%	1.16%	3.17% (2.21)	15.23%	2.82%	1.16%	1.66% (1.81)	35.86%
Milk/Dairy	8.60%	2.33%	6.28% (3.05)	3.98%	12.80%	9.30%	3.50% (3.68)	34.17%
Oil	0.13%	0.00%	0.13% (0.39)	73.69%	92.84%	76.74%	16.10% (2.98)	0.00%
Fruits	9.00%	4.65%	4.34% (3.13)	16.59%	9.26%	1.16%	8.10% (3.14)	1.00%
Beans	84.70%	61.63%	23.07% (4.08)	0.00%	13.33%	33.72%	-20.39% (3.86)	0.00%
Vegetables	81.35%	69.77%	11.59% (4.36)	0.80%	10.77%	8.14%	2.63% (3.42)	44.19%
Matoke/Cassava/etc	78.59%	60.47%	18.13% (4.6)	0.01%	20.81%	36.05%	-15.23% (4.55)	0.08%
Juice & non-alcoholic drinks	9.19%	3.49%	5.70% (3.15)	7.06%	11.95%	4.65%	7.30% (3.54)	3.95%
Sugar & other sweeteners	0.39%	0.00%	0.39% (0.68)	56.01%	55.68%	32.56%	23.12% (5.49)	0.00%
Salt / spices	0.00%	0.00%	--	--	93.83%	90.70%	3.13% (2.70)	24.67%

Table 51. Households classified as food-insecure are much less likely to have had sufficient quantities of basic foodstuffs such as starchy vegetables and beans to consume from their own production. The food insecure households were significantly more likely to have to purchase starchy vegetables, beans and flours. On the other hand, they were much less likely to purchase the more 'luxury' food items, such as meat/fish, oil, and sugar.

	Consumed from own production				**Purchased for consumption**			
	food secure	*food insecure*	*Difference*	*P-value*	*food secure*	*food insecure*	*Difference*	*P-value*
Flour	53.64%	26.74%	26.90% (5.50)	0.00%	29.68%	51.16%	-21.48% (5.09)	0.00%

Bread	0.26%	0.00%	0.26% (0.55)	63.44%	22.65%	6.98%	15.68% (4.56)	0.06%
Rice	0.26%	0.00%	0.26% (0.55)	63.44%	44.32%	23.26%	21.06% (5.47)	0.01%
Meat/Fish	0.33%	0.00%	0.33% (0.62)	59.49%	42.22%	20.93%	21.29% (5.43)	0.01%
Poultry/Eggs	4.33%	1.16%	3.17% (2.21)	15.23%	2.82%	1.16%	1.66% (1.81)	35.86%
Milk/Dairy	8.60%	2.33%	6.28% (3.05)	3.98%	12.80%	9.30%	3.50% (3.68)	34.17%
Oil	0.13%	0.00%	0.13% (0.39)	73.69%	92.84%	76.74%	16.10% (2.98)	0.00%
Fruits	9.00%	4.65%	4.34% (3.13)	16.59%	9.26%	1.16%	8.10% (3.14)	1.00%
Beans	84.70%	61.63%	23.07% (4.08)	0.00%	13.33%	33.72%	-20.39% (3.86)	0.00%
Vegetables	81.35%	69.77%	11.59% (4.36)	0.80%	10.77%	8.14%	2.63% (3.42)	44.19%
Matoke/Cassava/etc	78.59%	60.47%	18.13% (4.6)	0.01%	20.81%	36.05%	-15.23% (4.55)	0.08%
Juice & non-alcoholic drinks	9.19%	3.49%	5.70% (3.15)	7.06%	11.95%	4.65%	7.30% (3.54)	3.95%
Sugar & other sweeteners	0.39%	0.00%	0.39% (0.68)	56.01%	55.68%	32.56%	23.12% (5.49)	0.00%
Salt / spices	0.00%	0.00%	--	--	93.83%	90.70%	3.13% (2.70)	24.67%

Table 51: Food consumption, food secure vs. insecure

9.4 Kitchen Gardens

More than half of the sampled households report having a kitchen garden. All kitchen garden produce is intended for the household's own consumption.

	Male-Headed	Female-Headed	Total
HH has a kitchen garden	57.53%	52.62%	56.31%
Crops used for self-consumption	99.28%	100.00%	99.45%
N	1,208	401	1,609

Table 52: Kitchen Gardens

By far the most commonly grown crop in the kitchen gardens is amaranthus, a vegetable that is popular because it is does not require a particular agronomic zone, grows well without chemical fertilizer, and self-multiplies. Less than 5% of households with kitchen gardens report growing crops other than amaranthus or onions. This may imply that the reported amount of kitchen gardens is an overestimate; households clearly consider a patch of amaranthus a kitchen garden, but it would not match the concept of kitchen garden promoted by the LWH project.

	Male-Headed	Female-Headed	Total
Amaranthus/dodo greens	95.25%	95.73%	95.36%
Onions	27.48%	14.22%	24.39%
Wheat	4.32%	5.21%	4.53%

Spinach	3.88%	2.84%	3.64%
Sweet pepper	2.16%	0.47%	1.77%
Eggplant	2.16%	1.42%	1.99%
Celery	2.01%	0.47%	1.66%
Cabbage	1.44%	2.37%	1.66%
Carrots	1.15%	1.90%	1.32%
Beets	1.15%	0.47%	0.99%
Tomatoes	1.15%	1.90%	1.32%
N	695	211	906

Table 53: Types of crops grown in kitchen gardens

4 in 5 households with kitchen gardens apply inputs. Of those, most apply animal or organic manure. 7% of households apply ash. Less than 5% of households apply chemical fertilizer or improved compost.

	Male-Headed	Female-Headed	Total
Use of inputs			
HH used any inputs in kitchen garden	80.43%	73.93%	78.92%
N	695	211	906
Types of inputs			
Animal manure	50.63%	50.64%	50.63%
Organic manure	45.08%	48.72%	45.87%
Ash	7.16%	7.05%	7.13%
Urea	3.22%	0.00%	2.52%
DAP	2.86%	0.00%	2.24%
Compost	1.61%	1.28%	1.54%
N	559	156	715

Table 54: Use of inputs in kitchen gardens

10 Irrigation

There is very little irrigation in the project areas at baseline. 4.1% of households irrigated any plot during Season A, and 4.7% did in Season B. Though overall rates are low, there are clear gender discrepancies. For example, 5.13% of male-headed households irrigated in Season B, compared to 3.24% of female-headed. Most management and maintenance of irrigation structures is done by self-help groups. However, it is important to note that the irrigation module focused on Season A and Season B. More than half of the households cultivated during Season C, but any irrigation practiced during that season is not included in the below tables. More comprehensive irrigation data will be collected during the follow-up household survey planned for May 2013.

	Season A			Season B		
	Male-Headed	Female-Headed	Total	Male-Headed	Female-Headed	Total
All sites						
Household irrigated any plot	4.30%	3.49%	4.10%	5.13%	3.24%	4.66%
Entity responsible for irrigation management						
Self help group	3.89%	3.24%	3.73%	5.13%	2.74%	4.54%
Cooperative	0.17%	0.25%	0.19%	0.00%	0.50%	0.12%

Entity responsible for irrigation maintenance						
Self help group	3.56%	2.99%	3.42%	4.39%	2.99%	4.04%
Cooperative	0.17%	0.00%	0.12%	0.00%	0.25%	0.06%
N	1,208	401	1,609	1,208	401	1,609
Rwamangana 34						
Household irrigated any plot	6.25%	0.00%	4.68%	5.68%	2.54%	4.89%
Entity responsible for irrigation management						
Self help group	5.40%	0.00%	4.04%	5.68%	2.54%	4.89%
Cooperative	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Entity responsible for irrigation maintenance						
Self help group	4.83%	0.00%	3.62%	5.40%	2.54%	4.68%
Cooperative	0.28%	0.00%	0.21%	0.00%	0.00%	0.00%
N	352	118	470	352	118	470
Rwamangana 35						
Household irrigated any plot	5.49%	8.13%	6.18%	8.57%	6.25%	7.97%
Entity responsible for irrigation management						
Self help group	5.05%	7.50%	5.69%	8.57%	5.00%	7.64%
Cooperative	0.44%	0.63%	0.49%	0.00%	1.25%	0.33%
Entity responsible for irrigation maintenance						
Self help group	4.84%	6.88%	5.37%	6.81%	5.63%	6.50%
Cooperative	0.22%	0.00%	0.16%	0.00%	0.63%	0.16%
N	455	160	615	455	160	615
Kayonza 4						
Household irrigated any plot	1.25%	0.81%	1.15%	0.75%	0.00%	0.57%
Entity responsible for irrigation management						
Self help group	1.25%	0.81%	1.15%	0.75%	0.00%	0.57%
Cooperative	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Entity responsible for irrigation maintenance						
Self help group	1.00%	0.81%	0.95%	0.75%	0.00%	0.57%
Cooperative	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N	401	123	524	401	123	524

Table 55: Irrigation use

For households that irrigate, the most common sources of water are marshland drainage ditches, streams and springs. The source of water varies seasonally, as shown in Table 56.

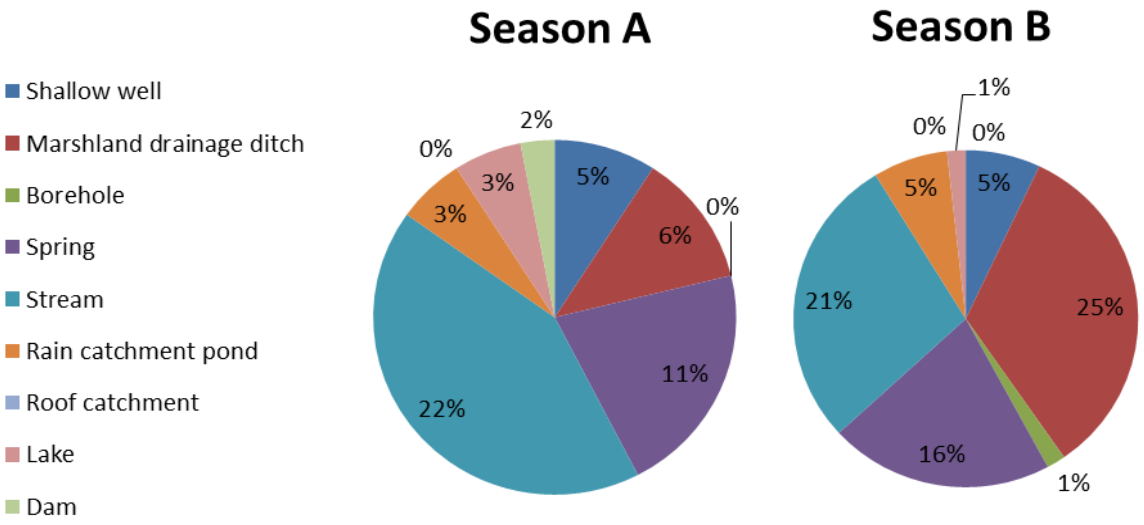

Table 56: Sources of water for irrigation

The irrigation currently practiced is very low-technology. As Table 57 shows, 70% of households rely on a watering can to transport water from the source to their plots. Of the households with irrigation, only 5% in Season A and 11% in Season B had access to mechanical pumps. Less than 2% used gravity stream diversions in either season.

	Season A			Season B		
	Male-Headed	Female-Headed	Total	Male-Headed	Female-Headed	Total
Watering can	76.47%	50.00%	70.77%	70.97%	61.54%	69.33%
Mechanical pump	3.92%	7.14%	4.62%	11.29%	7.69%	10.67%
Gravity stream diversion	0.00%	7.14%	1.54%	0.00%	7.69%	1.33%
Other method	17.65%	35.71%	21.54%	16.13%	23.08%	17.33%
N	51	14	65	62	13	75

Table 57: Method used to transfer water from source to plot