RWANDA NUTRITION, MARKETS & GENDER ANALYSIS 2015

An integrated approach towards alleviating malnutrition among vulnerable populations in Rwanda

REPUBULIKA Y'U RWANDA

UBUMWE - UMURIMO - GUKUNDA IGIHUGU

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An integrated approach towards alleviating malnutrition among vulnerable populations in Rwanda

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ADMINISTRATIVE MAP OF RWANDA

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Rwanda National Resources Authority
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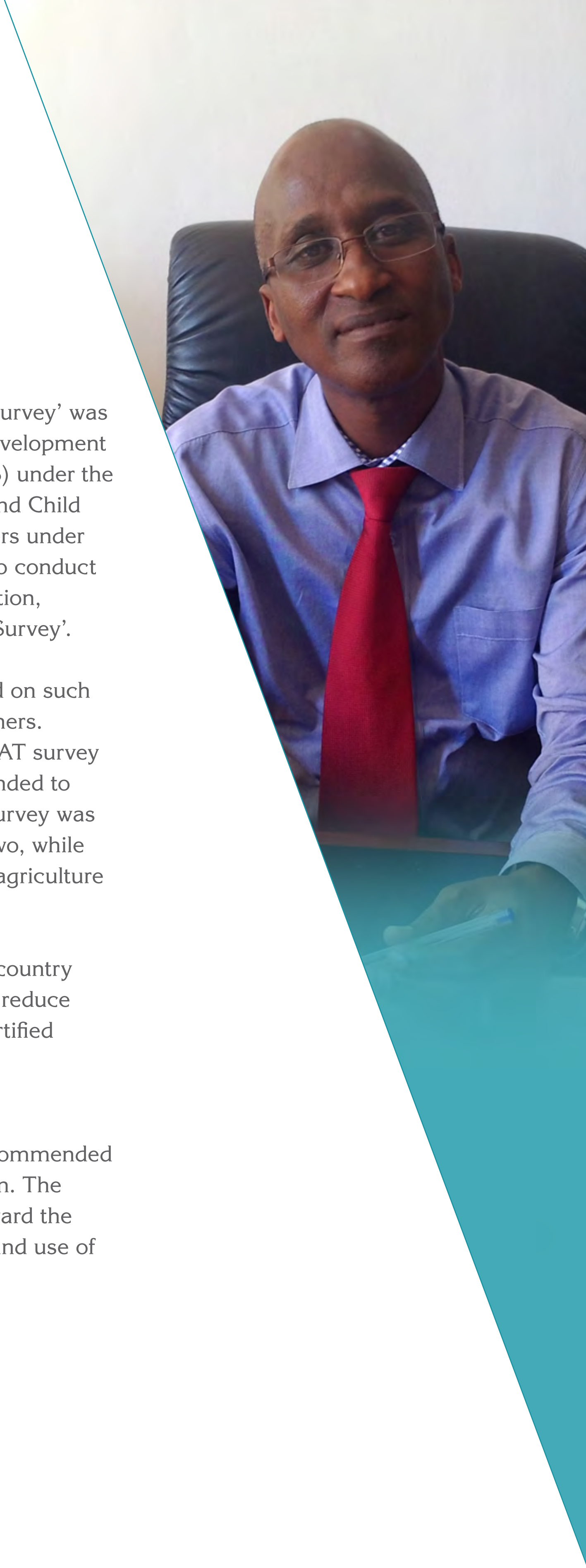
FOREWORD



The decision to undertake the 'Nutrition, Markets and Gender Survey' was made with national government authorities and international development partner agencies. Led by the Rwandan Agricultural Board (RAB) under the Ministry of Agriculture and co-led by the Division of Maternal and Child Health (MCH) under the Ministry of Health, development partners under the One UN, and CIAT came together in a unique partnership to conduct a comprehensive study into the links between agriculture, nutrition, gender and markets called the 'Nutrition, Markets and Gender Survey'.

The three-pronged survey is the first of its kind to be conducted on such a large scale and to bring together such a cross-section of partners. Originally slated to cover three of 30 districts as a joint RAB/CIAT survey under the Pan-Africa Bean Research Alliance (PABRA), it expanded to nine districts as new partners came on board. The aim of the survey was to determine the specific causes of stunting in children under two, while validating the conceptual framework of key pathways between agriculture and nutrition outcomes.

The study findings will be a basis for nutrition education in the country to improve the health of under-five children, to set strategies to reduce poverty, to promote the consumption of nutritious foods and fortified staples, and to build strategies that tackle the causes of malnutrition.

His Excellency the President of the Republic of Rwanda has recommended that greater emphasis be given to fight stunting and malnutrition. The focus and synergy between all key players should be linked toward the overall goal of improving household food security, and access and use of nutritious food.

Dr. Louis Butare
Director General
Rwanda Agricultural Board

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ACRONYMS

BMI	Body Mass Index
CI	Confidence Interval
CIAT	International Center for Tropical Agriculture
CHWs	Community Health Workers
DHS	Demographic Health Survey for Rwanda
DRIs	Dietary Reference Intakes
EE	Environmental Enteropathy
FAO	Food and Agriculture Organization of the United Nations
FCS	The Food Consumption Score
FRw	Rwandese Francs
HDDS	The Household Diet Diversity Score
HH	Household
Kg.	Kilogrammes
MINALOC	Rwanda Ministry of Local Government
MinEduc	Rwanda Ministry of Education
MUAC	Mid-Upper Arm Circumference
NISR	Rwanda National Institute of Statistics
NGOs	Non-Governmental Organisations
NMG	Nutrition Markets Gender
OR	Odds Ratio
PSU	Primary Sampling Unit
RAB	Rwanda Agricultural Board
RDCI	WHO Recommended Daily Caloric Intake
RNEC	Rwanda National Ethics Committee
ToT	Training of Trainers
UNICEF	The United Nations Children's Fund
WASH	Water, Hygiene and Sanitation
WCA	Women of Childbearing Age
WEAI	Women's Empowerment in Agriculture Index
WFP	World Food Programme
WHO	World Health Organization

GLOSSARY

Anthropometry Anthropometry is the use of body measurements such as weight, height and mid-upper arm circumference (MUAC), in combination with age and sex, to gauge growth or failure to grow, and is an indication of nutrition status.

Bilateral pitting/nutritional oedema Bilateral oedema (fluid retention on both sides of the body), caused by increased fluid retention in extracellular spaces, is a clinical sign of severe acute malnutrition. There are different clinical grades of oedema: mild, moderate and severe.

Cases Children under 24 months with stunted growth at the time of screening.

Controls Children under 24 months with normal growth at the time of screening (not stunted).

Ongera This is a sprinkle sold in sachets (like small packets of sugar) containing a blend of micronutrients in powder form, which are easily sprinkled onto foods prepared in the home. The idea is that any homemade food can be instantly fortified by adding Sprinkles. The target is children under 24 months.

Risk factors A variable associated with an increased risk of disease, infection, or outcome.

Stunting Technically defined as below minus 2 standard deviations (-2 SD) from median height-for-age of a reference population (2006 WHO reference population). Stunting is a form of growth failure that develops over a long period of time. Inadequate nutrition over long periods of time (including poor maternal nutrition and poor infant and young child feeding practices) and/or repeated infections can lead to stunting. In children, it can be measured using the height-for-age (HAZ) nutritional index.

Ubudehe Since 2006, the government of Rwanda generalised a system of socio-economic classification of all Rwandan households into six categories that reflect their economic levels. The categories should be based on criteria related to food insecurity and malnutrition. While the survey was ongoing, MINALOC was readjusting the ubudehe categories, and the new ubudehe categories were not available at the time of the analysis of the Nutrition, Markets, and Gender Survey data; so the reported ubudehe categories were analysed. Therefore findings based on ubudehe classification should be handled with care and confirmed with more accurate data as soon as the up-to-date household classification is available.

EXECUTIVE SUMMARY

The Nutrition, Markets and Gender (NMG) Survey was conducted in Rwanda to investigate the causes of malnutrition in children under 24 months. The NMG Survey was informed by the 2010 Demographic Health Survey (DHS) for Rwanda that gave some insight into the knowledge and trend of malnutrition in the country for the period 2005 to 2010. The DHS results indicated a 6 percent decline in stunting among children under the age of five years. The key findings from the 2014/2015 DHS that followed the same delineation as the DHS 2010 provided the most current status of malnutrition in Rwanda and showed further overall improvements in child growth outcomes with 37.9 percent of children under five years classified as stunted. These results again indicated a 6.3 percent decline in stunting among children under the age of five years for the period 2010 to 2015.

This progressive trend is a testament to the country's commitments to prioritise nutrition issues and nutrition programmes in its development agenda. The Government of Rwanda, through the Ministry of Health, has prioritised malaria control, nutrition education, and better public healthcare. However, in spite of the advancements made, the consensus is that high rates of chronic malnutrition among children still prevail. Thus a better understanding of risk factors that contribute to child malnutrition at the household level in Rwanda was needed to strengthen the fight against malnutrition in the country.

The 'Comprehensive Food Security and Vulnerability and Nutrition Analysis' – CFSVA 2012 – report produced by the Ministry of Agriculture and Animal Resources (MINAGRI), the National Institute of Statistics of Rwanda (NISR) and the World Food Programme (WFP) acknowledged that vulnerable households are increasingly reliant on markets as a source of food; providing on average 65 percent of the food consumed by a household. It is therefore clear that household nutrition outcomes in such households are dependent on markets. In addition, it is widely accepted that gender dynamics influence decision-making in the household. Thus gender dynamics affect decisions related to food, care, markets, and health. Therefore this survey focused on nutrition, markets, and gender to determine the factors that influence the nutrition status of children under 24 months.

Moreover, a disconnect between agricultural production and nutrition outcomes was revealed in the CFSVA 2012 report that indicated that the northern agricultural zones, considered the bread basket of the country, had stunting rates of up to 66 percent in children under 60 months.

The methodology

The NMG Survey is a case-control study that compares cases (children with stunting) with controls (children without stunting), and looks back retrospectively to compare what risk factors for stunting are present in each group so as to determine the relationship between the risk factors and stunting.

The decision regarding which geographic locations to include in the NMG Survey was based on the primary survey goals with the intent to survey each of the five provinces in Rwanda. Data from the Rwanda DHS (2010) and CFSVA (2012) documents were used to guide site selection. One district in Kigali and two districts from the other four provinces were randomly selected. In each of the districts, namely, Rubavu, Ngororero, Gakenke, Musanze, Kirehe, Nyagatare, Nyaruguru, Nyamagabe and Gasabo Districts, one sector was randomly selected. At least 16 villages were randomly selected for screening in all the sectors.

The sample was 2788 with 1388 case households representing 49.8 percent, and 1400 control households representing 50.2 percent of the total sample. This means that the case and control groups were matched well in the ratio of 1:1. The 1:1 ratio was applied in both provinces and districts and the control group resembled the case group in every way possible (sex, age and location) with the only key difference between the groups being malnutrition status.

The data collection phase was designed to generate information on the three main survey components – nutrition, markets, and gender – from questionnaires; haemoglobin from blood analysis; and more details on food consumption using the 24-hour dietary recall. Trained enumerators used tablets to collect data for the three main questionnaires on nutrition, markets and gender. Professional phlebotomists from local hospitals collected blood samples using standard operating procedures. A consultant with extensive knowledge and previous experience in Rwanda managed the 24-hour recall data collection.

Nutrition

At the sector level, stunting was evident in children 0-5 months and increased with age between 6-47 months, with a small decrease in the 48-60 month age group. Stunting in the surveyed population was of high public health concern among children aged 12-60 months. In most sectors, except Gisenyi sector, the situation was either high prevalence (30-39%) or very high prevalence ≥ 40%; with Matyazo sector being the most affected. Overall prevalence of stunting in the screened population was 32 percent (high prevalence). The prevalence was higher in boys than girls.

Anaemia was evident in both stunted and non-stunted children, and although the prevalence was higher in children with stunted growth, it was of moderate public health concern in both groups. Surprisingly, in Matyazo sector, where stunting was an important public health problem (45.2%), anaemia was not a public health problem (<4.8%). On the other hand, Gisenyi sector that had the lowest rates for stunting (16.4%) had the highest rates for anaemia (65.2%). The severity of childhood anaemia in Gisenyi sector was alarming.

Anaemia was evident in mothers in both case and control households. Although the prevalence was higher in case households, it was of moderate public health concern in both groups. Intriguingly, Gisenyi sector, which had the highest rates for childhood anaemia (65.2%) and maternal overweight (48.3%), also presented the highest rates for maternal anaemia (54.9%); making maternal anaemia of severe public health significance in this group. On the other hand, in Matyazo sector, where childhood anaemia was not a public health problem (<4.8%), maternal anaemia was of severe public health significance (45.2%). In the surveyed population, most of the anaemia was either mild or moderate with under 1 percent prevalence of severe anaemia in all the sectors except Kigarama sector with 4 percent prevalence.

For maternal nutrition, in six out of the nine sectors, the prevalence of underweight in the screened population was below 5 percent. However, in the other 3 sectors – Cyanika, Kibeho and Rusororo – the prevalence was between 5-9 percent, making this low prevalence but warning that monitoring is required. On the other hand, the prevalence of overweight in Gisenyi sector was 48 percent, which should trigger a public health concern.

When examining causes of malnutrition, it is clear that nutritional status is determined by three broad factors: (i) access to sufficient, safe and nutritious food; (ii) access to quality water, health services and sanitation (WASH); and (iii) care practices of women and children.

The study findings indicate that having sufficient and diverse foods is protective. The analysis indicates that children in households with acceptable food consumption are 23 percent less likely to be stunted than children in households with inadequate food consumption. The nutritional outcomes of children are strongly correlated with dietary diversity; children with medium diversity are 19 percent less likely to be stunted, while those with good diet diversity are 58 percent less likely to be stunted. Nonetheless, food alone is not sufficient to eradicate stunting in Rwandan households.

For WASH factors, access to improved sources of water and access to potable water was extremely important in reducing the risk of stunting in children. Children in households that sourced their drinking water from public or communal sources were three times more likely to be stunted compared to those in households whose main source of drinking water was treated.

Care was also a critical component for nutrition outcomes during the first 1000 days. Care practices such as breastfeeding, appropriate complementary feeding, as well as health-seeking behaviours support both maternal and child nutrition outcomes. Poor practices can lead to poor dietary intake and increased infection, both of which are underlying causes of undernutrition. Compared to mothers who did not attend antenatal care, children whose mothers did attend antenatal care were 42 percent less likely to have stunted growth.

Agricultural production and markets

The study findings provide evidence of access factors such as crop production and/or income from off-farm employment as the underlying barriers to alleviate malnutrition. Households that continued to have stunting were those that had relatively low production as a result of low use of land productivity-enhancing inputs such as fertilisers and, or, farming on degraded land. These households either produced less, or earned little from their off-farm related activities and consequently lacked access to sufficient quantities or diversity necessary for better nutrition outcomes. The capacity to access food by these households can be enhanced through targeted interventions to increase productivity with a package of technologies that address soil fertility, land management and improved crop variety seed. For example, intensification of livestock-crop integration would increase household access to organic manure that can be used to increase productivity. Possession of larger livestock units like cattle was rare, reported by less than 5 percent of the households in the study areas. Though organic manure on its own was not significant enough to distinguish between the two groups, it would appear that efforts at micro-dosing (with chemical fertilisers) are a major complement to the current organic manure usage. Further efforts are needed to strengthen seed systems to enable farmers' access to higher quality seed to replace seed and varieties regularly.

Gender empowerment

Results from gender analyses indicate that households with women that were unable to decide on daily tasks and take charge of their time were 18.6 percent more likely to have stunted children. While the link may not be direct, results suggest that the ability to negotiate and comprehensively make decisions enables women to access resources that affect children's nutritional outcomes. These findings suggest that there is need to identify and implement strategies that enhance women empowerment. In particular, reducing the time burden on women requires female-friendly agricultural labour-saving technologies such as mechanisation that allow women to work faster and expend less energy so that they can better care for other responsibilities, especially those related with reproductive roles and childcare. Agrimechanisation would attract more men into the farms compared to the use of rudimentary farming equipment. As evident from descriptive results, women who spend more than average time in agriculture are less likely to breastfeed their children any time or ensure sanitation of their children, which is associated with child stunting.

Further access to productive resources, like credit, was one of the most important determinants for stunting in children that emerged from the analysis. On average, households where women lacked active participation in credit groups were 46.6 percent more likely to have children that were stunted. The large magnitude of credit reflects the complementary benefits these women derive from participation in credit groups. Participation in other non-finance related groups did not have a similar significance, drawing attention to the importance of access to capital that can be used for farm production and income generation purposes or supplementing consumption. In addition to credit access, such groups are platforms for information exchange on production and childcare; and provide social insurance to deal with risks.

Lessons from the NMG Survey

Lesson 1: A small but growing body of research indicates that progress in reducing child malnutrition is substantially uneven from place to place even down to the sector or sub-district level within countries. Yet stunting prevalence data available for priority setting and planning are often only available at district level. The NMG Survey data show stunting prevalence in Gisenyi sector as 16.4 percent, relative to the key findings of the 2014/2015 DHS data for Western region at 44.9 percent. The lesson here is that there are limits to the ability to generalise large area data (provincial or district level for example) to smaller areas (sector level). In addition, a focus on large area data alone may blind public health planners and policy makers to otherwise obvious success stories. For example, what lessons can Rubavu district with a high burden of childhood stunting learn from Gisenyi sector with low levels of childhood stunting?

Lesson 2: It is clear to nutrition stakeholders that there is a global focus on stunting reduction as an explicit goal. But while this is fundamental to improving nutrition in Rwanda, or any other nation for that matter, is it enough to guarantee success? For example, the NMG Survey data on anaemia suggest that targeting stunting, while critical, may not be enough to ensure the elimination of malnutrition in all of its forms. As previously indicated, Gisenyi sector had the lowest prevalence of childhood stunting in children under 60 months (16.4%) and yet had the highest prevalence of anaemia in children under 24 months (65.2%). Clearly, improving nutrition is not just about reducing hunger; hidden hunger remains a formidable foe that cannot be ignored. The data suggest a balanced focus on childhood nutrition goals that does not only target stunting but also includes targets for key micronutrient deficiencies such as anaemia. This dual focus is the most probable formula to ensure a comprehensive nutrition plan for the eradication of all forms of malnutrition.

Lesson 3: There is consensus that preventing malnutrition of children and women needs attention on the crucial 1,000-day window – from the start of a woman's pregnancy until her child's second birthday – that can have a life-changing impact on a child's future and help break the cycle of poverty. Although the programme can often seem to focus on children under 24 months, the NMG Survey data suggest that the premier focus should be on pre-pregnancy nutrition of particularly adolescent girls, then pregnant mothers during the antenatal period, followed by the child under 24 months. A focus on the pre-conception period ensures that women enter pregnancy at optimal nutrition status. That accompanied with good antenatal care and a diverse nutrient-dense diet during pregnancy would have an influence on birth weight and gestational age of the child, both of which are drivers of stunting in children under 24 months in Rwanda.

Lesson 4: The study results provide no strong evidence that marketing part of the harvest significantly contributes to the persistent malnutrition in Rwanda. On the contrary, low use of inputs such as fertilisers, access to information on production and nutrition appear to be stronger areas of intervention to increase nutrition outcomes. Some of the interventions should account for the current imperfections in the input markets that constrain access.

Lesson 5: It is also clear that there are other complementary pathways to reducing malnutrition in Rwanda. The importance of factors such as poor health and sanitation especially among women; access to nutrition-related information; women empowerment regarding work burden, and access to financial resources such as credit facilities was evident from the analysis. Therefore there is need to mainstream gender empowerment in land intensification programmes and health education strategies to address malnutrition and achieve higher nutrition outcomes. Labour-saving technologies that are friendly for women and attractive to men, and nutrition education programmes, are examples of such complementary interventions that should be promoted.

Lesson 6: Efforts targeting nutrition education and awareness, knowledge, attitudes and practices can address the malnutrition problem, in addition to addressing agricultural productivity and gender empowerment in the households. Results strongly point to the need for multi-sectoral efforts and coordination among the different agencies involved in combating nutrition challenges.

1.0

SURVEY DESIGN AND IMPLEMENTATION

1.1 Synopsis

A case-control survey investigating the determinants of malnutrition in children under 24 months was conducted in Rubavu, Ngororero, Gakenke, Musanze, Kirehe, Nyagatare, Nyaruguru, Nyamagabe and Gasabo Districts selected from all the provinces in Rwanda.
This is a study that compares cases (children with stunting) with controls (children without stunting), and looks back retrospectively to compare what risk factors for malnutrition are present in each group so as to determine the relationship between the risk factors and stunting. Cases and respective controls were selected based on evidence of childhood malnutrition in the households. Controls were matched 1:1 to cases on the basis of sex, age, and location. Information on variables of interest for both groups was collected using questionnaires. Haemoglobin data was were also collected. The risk factors for stunting resulting from underlying and immediate causes of malnutrition including food, maternal and childcare, health, markets externalities, and household gender disparity are presented in this report.

1.2 Survey Justification

The Nutrition, Markets, and Gender (NMG) Survey was informed by the 2010 Demographic Health Survey (DHS) for Rwanda that gave some insight into the knowledge and trend of malnutrition in the country for the period 2005 to 2010. The results then indicated a 6 percent decline in stunting among children under age 5. The recalculated data from the DHS for 2005 (NISR and ORC Macro 2005) estimated the prevalence of malnutrition among children aged 6-59 months to be 51 percent, with higher levels among children living in rural areas (53%) compared to urban areas (39%). Prevalence of stunting was highest among children living in the Northern Province of Rwanda (58%). The DHS for 2010 (NISR and ORC Macro 2010) better delineated the status of malnutrition in the country; presenting data for age groups of children under age 5 by background characteristics such as sex of child, residence, mother's characteristics (education and nutritional status) and wealth quintile. Data analysis shows that although progress in nutrition is evident, stunting is apparent even among children less than 6 months of age and increases with child age. The key findings from the 2014/2015 DHS (NISR and ORC Macro 2014/2015) that follow the same delineation as the DHS 2010 provide the most current status of malnutrition in the country and show further overall improvements in child growth outcomes in Rwanda, with 37.9 percent of children under five years classified as stunted. These results again indicate a 6.3 percent decline in stunting among children under age 5 over the past 5 years.

This progressive trend is a testament to the country's commitments and priorities as they relate to nutrition issues and nutrition programmes. The Government of Rwanda, through the Ministry of Health, has prioritised malaria control, nutrition education, and better public healthcare. Through the Ministry of Agriculture, the Government has programmes that promote kitchen gardens and the consumption of animal protein. The resulting income improvements in all socio-economic groups are also likely to be associated with reduced parasite loads and lower infection rates, hence reducing levels of malnutrition. The country also recently adopted a food fortification policy for wheat flour, milled maize products, edible fats and oils, sugar and salt.

However, in spite of the advancements made, the consensus is that high rates of chronic malnutrition among children still prevail. The key findings from the 2014/2015 DHS reveal that stunting is more evident in children living in rural areas (40.6%) compared to those in urban areas (23.7%); it is more prevalent in boys (42.7%) than girls (32.9%); and that there are regional differences, for example, stunting is higher in the western region (44.9%) compared to Kigali city (22.7%) where it is lowest. Thus a better understanding of risk factors that contribute to child malnutrition at the household level in Rwanda can strengthen the fight against malnutrition in the country.

A disconnect between agricultural production and nutrition outcomes was revealed in the 'Comprehensive food security and vulnerability and nutrition analysis 2012' – CFSVA – (NISR 2012) report that indicated that the northern livelihood zones, considered the bread basket of the country, have the worst stunting rates of the country. A map from the report overlaid the prevalence of unacceptable food consumption with stunting. This map revealed the obvious – that the areas with the highest rates of households with unacceptable food consumption are also those with the highest prevalence of stunting, except in the northern volcanic areas which have very high stunting but average percentages of households with poor food consumption. Similar data specifically from the Northern Province imply that simply increasing agricultural productivity does not improve child nutrition outcomes. The same report also acknowledged that vulnerable households are increasingly reliant on markets as a source of food, providing on average 65 percent of the food consumed by a household. It is therefore clear that household nutrition outcomes in such households are dependent on markets. In addition, it is widely accepted that gender dynamics influence decision-making in the household. Thus it is plausible that gender dynamics affect decisions related to food, care, and health. Therefore this survey focused on nutrition, markets, and gender to determine the factors that influence the nutrition status of children under 24 months.

1.3 Survey Phases

The decision to undertake the NMG Survey was made with national government authorities and international development partner agencies. The survey was led by the Rwanda Ministry of Agriculture/Rwanda

Agricultural Board (RAB) and co-led by the Rwanda Ministry of Health/ Division of Maternal and Child Health. The development partners supporting this initiative included UNICEF, WHO, WFP, FAO and CIAT.

The focus of the NMG Survey was to determine factors that influence the nutrition status of children under 24 months. The survey's technical implementation was led by CIAT and overseen by a technical working group comprising members from key partner organisations. The primary survey responsibilities included:

1. Facilitation of required survey authorisation and clearances;
2. Development of a detailed survey implementation and logistics plan;
3. Development of indicators to be included in the data collection tools;
4. Development of the sampling strategy and procedures;
5. Training and supervision of survey data collection and management;
6. Data analysis and reporting; and
7. Dissemination of progress and final reports.

For ease of implementation, the survey was divided into 13 activities executed in four phases as listed in Table 1.0.

Table 1.0: Survey Key Phases and Related Activities

Survey Phase	Survey Activities
Planning	1. Technical write-up including budget and tools
	2. MoU development between RAB, CIAT & partners
	3. Paperwork: Ethics, visa, and research approvals
Data collection	4. Screening
	5. Sampling
	6. Logistics
	7. Training of survey team
	8. Data collection
	9. Data entry
Data analysis	10. Survey progress reports
	11. Survey final report
Data dissemination and publication	12. Data dissemination
	13.Manuscript development & publication

1.4 Survey Objectives

The primary goals of the NMG survey were: (i) to determine the specific causes of stunting in children under 24 months; (ii) to establish the conceptual pathways between agriculture and nutrition outcomes among households; and (iii) to establish a baseline for the nutrition status among target groups prior to the implementation of nutrition programmes in the selected sectors in the surveyed districts.

The secondary goal of the survey was to collect data that would enable the nutrition sector stakeholders to: (i) more effectively manage existing interventions; (ii) develop home-grown interventions for addressing malnutrition; (iii) adequately plan, implement and monitor new prevention programmes and evaluate their impact; and (iv) inform policy dialogue and malnutrition strategy development.

The specific survey objectives were to use a case-control approach to obtain representative estimates at sector level of:

- the prevalence of chronic malnutrition in children under 60 months of age;
- the prevalence of acute malnutrition in children under 60 months;
- household food access and security;
- the dietary adequacy of mothers and children under 24 months;
- the prevalence of anaemia in children under 24 months of age and non-pregnant women of childbearing age (WCA, 15-49 years of age).

1.5 Survey Methodology

1.5.1 Survey Background Information

Background information from the previously mentioned reports – DHS 2010 and CFSVA 2012 documents – was used to define the survey logistics.

(i) Survey sites and sample size: Prevalence of stunting from the DHS 2010 (listed districts) was referenced in the selection of the survey districts. Child stunting data from the CFSVA 2012 were used as the most recent estimation of the prevalence of malnutrition to determine the sample size for the survey.

(ii) Sampling method: The Rwanda National Institute of Statistics (NISR) advised on the enumeration villages. A list of all eligible households for screening (with at least one child under 60 months) in the enumeration villages was prepared by respective community health workers (CHWs) and the communities sensitised on the planned screening and enrolment into the study.

(iii) Maps: Maps from the Rwanda National Resources Authority were used to develop the survey implementation procedures and plans.

1.5.2 Survey Target Group

This was a household survey but specific nutrition questions such as the 24-hour dietary recall, and maternal and child health were asked of the reference mother. For markets, the questionnaire was addressed to the household head. For gender, in a two-adult household, the questions were asked to the husband and the spouse separately. In a one-adult household, the questions were asked of the household head only.

1.5.3 Survey Variables

Survey data to be collected was determined by the survey objectives, the study design and the study hypothesis about the interlinkages between nutrition outcomes, market externalities and gender dynamics in the households. The principal study indicators included agricultural production diversity, food prices and availability, household food security, consumption and income expenditure, women empowerment, infant and young child feeding, maternal time use, maternal energy expenditure, nutrition knowledge and attitudes, individual maternal and child diet diversity, target nutrient consumption, target food consumption, anthropometry and anaemia.

1.5.4 Survey Approvals and Permits

The survey team sought ethics approval from the Rwanda National Ethics Committee (RNEC), a research permit from the Rwanda Ministry of Education (MinEduc), and a research visa and data support from NISR. Letters of permission from RAB and MinEduc were sent to the local district and village leaders in the study sites introducing the survey and survey investigators to the communities.

1.5.5 Survey Geographical Locations

The decision regarding which geographic locations to include in the NMG Survey was based on the primary survey goals. The intent of the study was to survey each of the five provinces in Rwanda. Data from the Rwanda DHS (2010) and CFSVA (2012) documents were used to guide site selection. One district in Kigali and two districts from the other provinces were randomly selected to be included in the survey. In each of the districts, one sector was randomly selected. At least 16 villages were randomly selected for screening in all the sectors. The list of randomly selected villages to be screened was provided by NISR. In line with available resources, the survey was conducted in nine sectors – one sector in every district, two districts in each of the four provinces, and one district in Kigali city as listed in Table 1.1.

Table 1.1: Nutrition, Markets and Gender Rwanda Survey–Survey Sites±

Province	District	Sector	Stunting* (%)	Configuration	Villages Screened (n)
Northern	Musanze	Cyuve	45.3	Rural-Urban	18
	Gakenke	Gakenke	63.2	Rural-Urban	22
Eastern	Nyagatare	Nyagatare	42.2	Rural-Urban	19
	Kirehe	Kigarama	50.7	Rural-Urban	25
Southern	Nyamagabe	Cyanika	53.5	Rural-Urban	45
	Nyaruguru	Kibeho	45.4	Rural-Urban	24
Western	Rubavu	Gisenyi	54.9	Urban	66
	Ngororero	Matyazo	53.4	Rural	16
Kigali City	Gasabo	Rusororo	23.8	Rural-Urban	25

±See appendix 7.1 for details of site selection
**Reference: DHS 2010. Prevalence of stunting, Appendix D, Page 354*

1.5.6 Survey Sensitisation Meetings

Site visits with local leaders and discussions with CHWs were conducted as shown in Table 1.2. The goal of these meetings was to ensure adequate community sensitisation for efficient survey implementation. The site visits were instrumental in ensuring community buy-in into the survey, ownership and continued support from local leaders and CHWs. Community feedback was important in ensuring that the survey plans were comprehensive and well developed. Site visits were led by RAB with a technical delegation from CIAT.

Table 1.2: Survey Site Visit Days

Province	District	Sector	Dates
Northern	Musanze	Cyuve	4-Jun-14
	Gakenke	Gakenke	
Eastern	Nyagatare	Nyagatare	3-Jun-14
	Kirehe	Kigarama	
Southern	Nyamagabe	Cyanika	6-Jun-14
	Nyaruguru	Kibeho	
Western	Rubavu	Gisenyi	5-Jun-14
	Ngororero	Matyazo	
Kigali City	Gasabo	Rusororo	2-Jun-14

1.5.7 Survey Sample Size Calculation

The sample size formula for the total sample size required for comparing two independent event rates was computed using the following formula, where:
n is the size of the sample drawn from the population;
P = [(1-B) P1+ BP2] is the overall event rate;
B is the proportion of the sample with X=1;
P1 and P2 are the event rates at X=0 and X=1, respectively.
Alpha is the probability of rejecting a true null hypothesis.
Beta is the probability of accepting a false null hypothesis.

Numeric Results

Power	n	B	P0	P1	Odds Ratio	Alpha	Beta
0.80	304	0.50	0.25	0.40	2.00	0.05	0.20

Summary Statements

A logistic regression of a binary response variable (stunting) on a binary independent variable (X) with a sample size of 304 observations per sector [of which 50% (152) are in the case group and 50% (152) are in the control group] achieves 80% power at a 0.05 significance level to detect a change in Prob (Y=1) from the baseline value of 0.25 to 0.40. This change corresponds to an odds ratio of 2.00.

1.5.8 Survey Sampling Methodology

The original sampling plan was to screen all households with child(ren) under 24 months, and from this survey population, select cases and controls to be enrolled into the study. However, because most country nutrition databases include children under 60 months, NISR advised that the survey sampling protocol be revised to include all households with children under 60 months in the enumeration villages they provided. So as to align with existing databases, the survey expanded to screen all households with child(ren) under 60 months; and a survey sample of cases and controls was selected from children under 24 months only.

The survey sampling methodology included:
Stage 1 – Location selection
Stage 2 – Village selection
Stage 3 – Household listing
Stage 4 – Training of anthropometry team
Stage 5 – Screening of households
Stage 6 – Data separation
Stage 7 – Selection of cases and controls

Stage 1: Location selection – In the first stage, the provinces, districts, and sectors were randomly selected based on the information from the Rwanda DHS 2010 and CFSVA 2012, and as previously described (see Appendix 7.1).

Stage 2: Village selection – The second stage involved the random selection of villages as the primary sampling unit (PSU). The list of villages to be included in the survey was requested from NISR. The minimum number of villages required per sector was set at 16 for all sectors (see Appendix 7.2).

Stage 3: Household listing – After receiving the list of villages to be included in the survey, CHWs were mobilised to list all households with children under 60 months in their respective enumeration villages.

Stage 4: Recruitment and training of anthropometry enumerators – At the conclusion of listing, 32 medical students recruited by RAB received rigorous training for anthropometry assessment. The four-day training was conducted between 08h – 17h using the following schedule; day one – classroom training; day two – field practicum; day three – field practicum; and day four – standardisation.

Classroom training covered the definition of anthropometry, its building blocks (age, sex, weight, and length/height) and the use of these measurements in defining the different forms of malnutrition and nutrition status of children. The trainees also received instruction on the identification and measurement of bilateral pitting/nutritional oedema in the field setting. Trainees were instructed to refer all identified cases to the nearest community clinic for further treatment and follow up (only six cases were identified and referred for treatment). The training also covered the use, care, handling, and calibration of equipment.

Practice sessions on day two and three allowed trainees to familiarise with the different types of anthropometric equipment. Training focused on the skills, technique, and measurement guidelines needed for correct measurements of weight, length, height and mid-upper arm circumference (MUAC). Common problems encountered while performing these measurements in field settings were also discussed. The team further discussed the allowable differences between two independent measurements for the same measure (e.g. length) of the same child and emphasised that these measurements are independent and not dependent on previous measurements. The trainees also watched the Multicentre Growth Reference Study anthropometric training video (WHO 2006) to review the concepts and skills involved in taking these measurements and as an exposure to how field implementation occurs.

The concept of standardisation was subsequently reviewed on day four and explained to all the trainees. The need and importance of the standardisation exercise was emphasised. At the end of the exercise, lead anthropometrists (16) and assistant anthropometrists were identified and grouped.

Stage 5: Screening of households – The anthropometrics team then assessed all available mothers and their children (under 60 months) recorded in the household listing. Individuals were screened for nutrition status and the following information recorded: age, gender, weight, height, MUAC, and bilateral pitting/nutritional oedema for children; and age, weight, height, MUAC, 'ubudehe', and pregnancy status for mothers (See Appendix 7.3 and 7.5 for the screening questionnaire and the list of the anthropometrics team respectively). Table 1.3 details the schedule for household listing and screening.

Table 1.3: Schedule for Household Listing and Screening

Province	District	Sector	Dates (2014)
1. Primary household listing in all sites			June: 24–27, 2014
2. Secondary household listing in all sites*			July: 22–25, 2014
3. Household screening*			August – December 2014
Northern	Musanze	Cyuve	August: 19,20,21
			23-Nov
	Gakenke	Gakenke	August: 18, 22, 26
			23-Nov
Eastern	Nyagatare	Nyagatare	August: 27, 28, 29
			September: 5, 6
	Kirehe	Kigarama	September: 2, 3, 4
Southern	Nyamagabe	Cyanika	September: 11, 12, 13, 14, 15, 16
	Nyaruguru	Kibeho	September: 9, 10, 11
Western	Rubavu	Gisenyi	August: 22, 23, 27, 28, 29, 30, 31
			September: 1, 2, 3
			November: 22, 23, 24
			December: 14, 15
	Ngororero	Matyazo	September: 9, 10, 11
Kigali City	Gasabo	Rusororo	August: 25, 26
			November: 22, 23

** Initial household listing listed households with children under 24 months. NISR requested a change in the protocol to list households with children under 60 months, hence the additional exercise.*

[a]As a result of infant mortality (unrelated to the study), relocation, and absence due to unforeseen circumstances, some households previously enrolled into the survey had to be replaced. In certain sectors, additional screening was necessary

(as indicated by the more recent screening dates). Because the main reasons for replacement are all unrelated to the outcome (stunting), there is no bias to the study from loss to follow up.

Stage 6: Data separation – Data from all screened households with children under 24 months were extracted from the anthropometry database for children under 60 months and reviewed for enrolment into the study.

Stage 7: Selection of cases and controls – Survey cases (n = 152 per sector) were randomly selected from a list of all eligible households. Study controls (n = 152 per sector) were then randomly selected to match the cases on the basis of sex (male or female), age in months (± 2 months), and location (residence in the same sector). Due to the relatively high cost of listing eligible households, screening both mothers and children for nutrition status, and conducting the actual survey, the optimal matching ratio for case: control was determined to be 1:1. In the case of households with multiple children under 24 months, these were counted as one household. In the case of households with multiple children, where one child was stunted and another not stunted, such households were classified as eligible for cases.

Screening and enrolment details are summarised in Table 1.4a and Table 1.4b. Table 1.4a shows the number of those screened and the number of households eligible for enrolment (having at least one child under 24 months). Table 1.4b splits the eligible households into eligible cases and eligible controls.

Table 1.4a: Summary of Screened Population

Province	District	Sector	Household screened (n) [a]	Eligible households (n)**
Northern	Musanze	Cyuve	1,146	500
	Gakenke	Gakenke	1,075	497
Eastern	Nyagatare	Nyagatare	1,358	728
	Kirehe	Kigarama	1,271	730
Southern	Nyamagabe	Cyanika	1,798	815
	Nyaruguru	Kibeho	1,509	747
Western	Rubavu	Gisenyi	2,449	1,244
	Ngororero	Matyazo	1,544	802
Kigali City	Gasabo	Rusororo	1,444	699

[a] All available households with child(ren) under 60 months in the enumeration villages provided by NISR

***Number of households having at least one child under 24 months*

Table 1.4b: Summary of Sample Selection

Province	District	Sector	Eligible for cases (n)*	Eligible for controls (n)***	Selected (n) (cases¥, controls)
Northern	Musanze	Cyuve	169	331	(152, 153)
	Gakenke	Gakenke	189	308	(154, 154)
Eastern	Nyagatare	Nyagatare	190	538	(152, 154)
	Kirehe	Kigarama	203	527	(152, 152)
Southern	Nyamagabe	Cyanika	199	616	(152, 152)
	Nyaruguru	Kibeho	182	565	(157, 153)
Western	Rubavu	Gisenyi	187	1,057	(153, 161)
	Ngororero	Matyazo	269	533	(153, 154)
Kigali City	Gasabo	Rusororo	175	524	(163, 167)

**Households having at least one stunted child under 24 months*
****Households with at least one child under 24 months; with no stunting*
¥Cases are stunted children under 24 months at the time of screening. Stunting is defined as below minus two standard deviations (-2 SD) from median height for age (HAZ) of reference population (2006 WHO reference population).

1.5.9 Procedures at Enrolment

Households eligible for the survey were evaluated for enrolment based on the stunting data of child(ren) that were collected at screening; and the study inclusion and exclusion criteria as detailed below:

Survey inclusion criteria into survey:
a. Household with at least one child under 24 months
b. Household in any 'ubudehe' categories (1 through 6)[2]
c. Household within the enumeration villages approved by NISR

Survey exclusion criteria:
a. Household that cannot be matched to a case/control household
b. Household outside the enumeration villages approved by NISR
c. Household that refuses to participate in the study

The survey statistician generated a list of potential households to be recruited into the study as either case or control households. The

[2]Category 1: those in abject poverty; category 2: the very poor; category 3: the poor; category 4: the resource poor; category 5: the food rich; category 6: the money rich. See also glossary.

list, which did not indicate if a household was either a case or control household, was shared with the CHWs in the respective sectors for enrolment. At enrolment, an information session was held in Kinyarwanda with the CHWs and participating households. Consent forms were issued to the households during the mapping of households and participants' questions addressed before signing the forms. For households with limited literacy, a thumbprint was used in lieu of signing.

1.6 Survey Data Collection and Entry

1.6.1 Data Types and Sources

Data collected were mainly on malnutrition and its underlying and immediate causes as depicted in the UNICEF framework for malnutrition, shown in Figure 1.1.

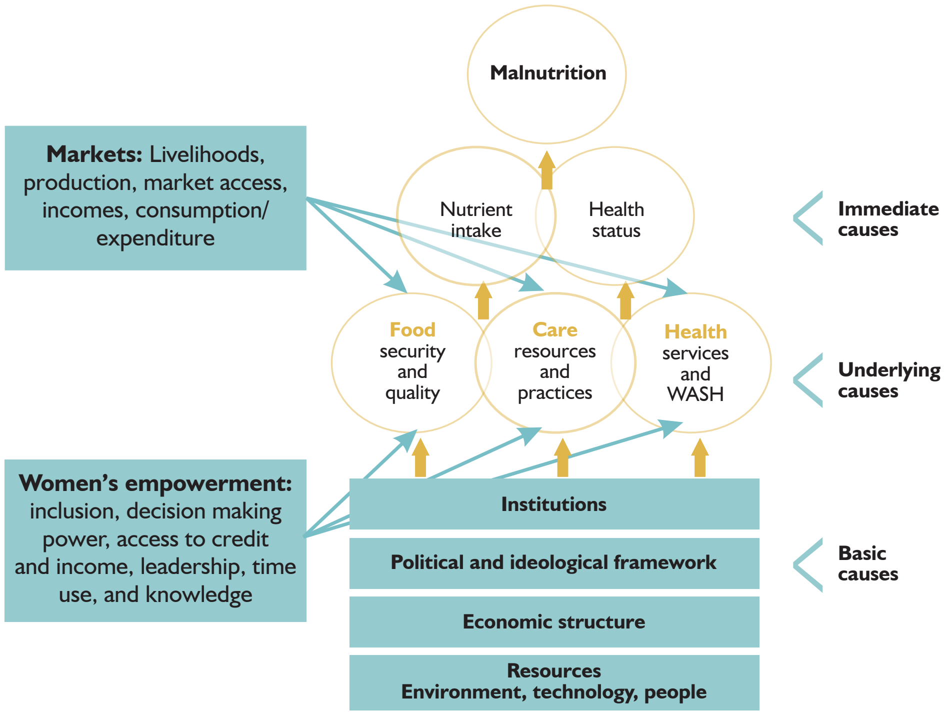

Figure 1.1: Framework for Malnutrition
Source: Adapted from UNICEF 1990

Data collection targeted the whole household, but certain sections of the data collection tools were very specific in targeting information from the reference mother and child as indicated in Table 1.5.

Table 1.5: Data Types and Quality Assessment Details

Training	Scheduled Dates	Phase
Survey Supervisors	5 – 28 March 2014	1
Survey Training of Trainers (ToT)	17 – 20 June 2014	2
Questionnaires: Data collectors	15 July – 22 October 2014	2
24 hour recall: ToT/Supervisors	29 October – 6 November 2014	3
24 hour recall: Data collectors	7 – 11 November 2014	3
24 hour recall: Data entry clerks	17 – 18 November 2014	3

1.6.2 Ensuring Quality Data Collection and Management

The data collection phase was designed to generate information on three main survey components – nutrition, markets, and gender – from questionnaires; haemoglobin from blood analysis; and more details on food consumption using the 24-hour dietary recall.

Trained enumerators used tablets to collect data for the three main questionnaires on nutrition, markets, and gender. Professional phlebotomists collected blood samples from local hospitals using standard operating procedures. A consultant with extensive knowledge and previous experience in Rwanda managed the 24-hour recall data collection. For successful data collection, training of a competent team was done in three phases as shown in Table 1.6.

Table 1.6: Training Phases for the NMG Survey

Questionnaire/ Data Set	Scheduled Dates	Focus
Nutrition questionnaire	27 October – 5 November 2014	Household, reference mother and child
Market questionnaire	25 September – 4 October 2014	Household
Gender questionnaire	7 – 20 October 2014	Household head and/or spouse
Blood / Haemoglobin	28 October – 1 November 2014	Reference mother and child
24-hour recall questionnaire	15 – 25 November 2014	Reference mother and child

The quality of the data collected during a survey depends above all on the quality of the fieldwork. This in turn depends on the ability of the survey team to create and sustain professionalism and morale in the field. Thus the quality of the data depends on the ability of the persons recruited, the training they receive, and how well they collect the data. The role of the interviewer/enumerator is very important. The process of interviewing people to collect data involves a number of skills. Without these skills, the quality of the data collected can be affected. Enumerators communicate


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the purpose of the survey, the importance of the respondent's participation, and record responses to questions. The enumerator's expectations and behaviour may have an influence on the respondent's cooperation in the survey. It is important to train enumerators well to ensure that data collection is consistent and accurate.
Skilled enumerators are able to better probe for answers and thus minimise response errors. Enumerators who are knowledgeable about the survey, as well as accurate in their data collection, will lighten the burden on respondents and improve data quality. Well-trained enumerators will also safeguard the confidentiality of all the data they collect. Obtaining data from respondents can be difficult if they are concerned that the data will be shared with others or that they will be identified in data analysis or reporting. Effective enumerators always inform respondents about confidentiality guidelines before they begin the interview.

An integral part of a well-designed survey is to plan for quality in all the steps along the way. A key goal is to keep respondent mistakes, refusals to provide data, and biases to a minimum. For quality data, skilled enumerators need to do their work well. Given the size and scope of the NMG survey, the best approach to training enumerators was determined to be: (i) training of trainers (ToT), and then (ii) supervised enumerator training by trained trainers.

1.6.3 Data Collection using Questionnaires

Training of Trainers

In choosing the most effective methods for training the enumerators, it was decided that the optimal approach would be to use trained trainers (n = 18) who would also serve as field supervisors (1 team leader and 1 assistant team leader per sector). The 18 candidates were selected from a CIAT database of university students who had participated in previous CIAT/RAB surveys (see Appendix 7.6 for list of supervisors). A round table approach was used where each data collection tool (nutrition, markets and gender separately) was reviewed line by line and the main points emphasised. The tools, which were available in both English and Kinyarwanda, were reviewed first in English then in Kinyarwanda to proof the translation of the tools. Each tool was reviewed in a separate 5-day workshop held at the CIAT offices in Kigali and led by CIAT nutrition, markets, and gender specialists respectively. The first 3 days of each workshop focused on understanding the objective of the study and gaining familiarity with the tool. This was followed by a field day to test the tool and a final day of feedback and revision of the tools.

Recruitment of Enumerators

The size of the field staff was determined by the number of households to be interviewed, the time allowed for the survey to be conducted, available resources, and the data entry tool. For the nutrition, markets and gender questionnaires, 72 enumerators were to be recruited for data collection and entry into the electronic tablets used during interviews. The recruitment team and procedures followed the standardised procedures by RAB. Details on the recruitment exercise can be sought from the Human Resource Manager at RAB (see Appendix 6.6 for the final list of recruited candidates). The intent of the recruitment process was to recruit the staff on the basis of competence. To the extent possible, within the framework of the recruitment policies of RAB, attention was given to recruiting enumerators possessing or able to acquire the skills necessary to conduct the survey as efficiently and economically as possible. The basic qualifications included sufficient education (university student or graduate), passing a written test and an oral interview conducted by RAB, Rwandan citizenship, good communication and language skills, and physically able to meet the demands of the job.

Training of Enumerators

The goal of the enumerator training was to provide clear instructions on how to use the survey questionnaires in the electronic tablets, how to conduct interviews, how to probe for responses, and perform other data collection activities. The main objective of the training was to help reduce biases in the data from non-sampling errors.

The training of enumerators took place at the RAB facilities in Mulindi, Kigali. The group of 90 individuals was divided into 9 smaller teams for the respective study sites/districts. Each team had a team leader, assistant team leader and 8 enumerators. The focus of the enumerator training was to have it take place in a structured learning environment in which the training process was designed to produce acceptable enumerator performance. The objectives of the training were as follows:

a. Provide a general overview of the methodological approach used for the study.
b. Familiarise with the survey questionnaires and use of tablets.
c. Establish the role and conduct of the field enumerators and the reporting structure.
d. Get feedback reports from mock interviews.
e. Conduct a detailed review of the survey tools.
f. Conduct field practice and feedback from exercise.
g. Establish field logistics needs and support.

The training schedule is detailed in Table 1.7. Training methods were geared towards sharpening data collection skills through interviews to, for example, tactfully ask sensitive questions and probe to clarify responses. The first day's instructions consisted of a presentation of survey objectives and design, review of survey tools, interviewing/probing methods, and feedback. Enumerators also received the data tools in Kinyarwanda.

Individuals do not all learn the same way or at the same speed, thus Day 2 of training was left open for own reading so enumerators would familiarise with the tools before rigorous training began.

Table 1.7: Enumerator Training Timetable with Details

Dates	Activity
15.07.2014	Team registration and briefing
16.07.2014	Own reading of questionnaires
17.07.2014	Nutrition
18.07.2014	Markets
21.07.2014	Gender
22.07.2014	Gender discussion and introduction to tablets
23.07.2014	Review questionnaires on tablet
24.07.2014	Simulation of the tools among enumerators
25.07.2014	Testing of the tools
	Enumerators observing supervisors survey actual households
29.07.2014	Simulation of the tool with actual household
30.07.2014	Field validation preparation and making appointments by supervisors
31.07.2014	Actual field-testing of tools
01.08.2014	Feedback from the field-testing by supervisors

It was obvious from the group size that the best training method was to have small groups review the tools. Per their assigned sites, the two site supervisors each had 4 enumerators with whom they reviewed the tool line by line. After the tools' study was completed, the teams were introduced to the survey tablets. After a review of the tools using the tablets, mock interviews were conducted with households from a nearby village adjacent to the RAB facilities.

Feedback from the statistician necessitated a repeat of the training cycle to resolve software problems and some issues related to unbiased probing. After this was completed, a field validation of tools was carried out in Rusororo sector in villages that were not in the survey enumeration zone. In addition, before the actual field data collection commenced in the sites, a one-day field validation of tools exercise was carried out in the sites to acclimatise the teams to their sites and test the site data collection procedures.

1.6.4 Blood Analysis

Hidden hunger, also known to as micronutrient deficiency, is a major public health problem in many developing countries and is caused by a lack of essential vitamins and minerals such as Vitamin A, zinc, or iron in the diet. Iron deficiency anaemia, usually defined as low haemoglobin, is the most common micronutrient deficiency among vulnerable populations. Often, the signs of this form of malnutrition are 'hidden', as individuals look presumably healthy but suffer negative health impacts. It is therefore plausible for children to have stunted growth and iron deficiency anaemia, or normal growth but have anaemia. In this study, haemoglobin levels for mothers and children were analysed to determine the prevalence of anaemia in the sample population. Experienced phlebotomists from respected hospitals in Kigali conducted the blood analysis. The chief phlebotomist from Kanombe Military Hospital, who has extensive experience in fieldwork both locally and internationally, led the exercise.

1.6.5 Dietary Assessment using the 24-hour Recall

The 24-hour hour diet recall interview is a quantitative research method used in nutritional assessment, which asks individuals to recall foods and beverages they consumed in the 24 hours prior to the interview. It may be self-administered or administered by a trained professional. The goal of this method is to document food and beverage consumption and nutrient intake in a given population/sample. This method records the daily self-reported consumption of individuals. 24-hour diet recalls are useful for research that aims to gather nutritional information from individuals, but it also allows researchers to assess what types of foods are being consumed by individuals in a specific community. The interview style of the recall allows participants and researchers to interact and discuss food and food types during the interview. When asking the participant what they ate the previous 24 hours, the following data are recorded:

a. Chronological consumption
b. The time they consumed the food in blocks of time, e.g. morning – daybreak to noon.
c. The amount of food consumed.
d. The preparation/recipe of each item where necessary.

To ensure the highest quality of data, field teams were trained in the 24-hour recall method of dietary assessment as per international standards (Gibson and Ferguson, 1999), and the interview protocol standardised through practice among enumerators for uniform implementation. The overall team trained to take part in the 24-hour recall method comprised 81 trainees (63 earmarked for field data collection and 18 for the data entry team). Due to the large number of trainees and the high level of data quality required, the overall training activity was split into 3 sub-activities:

a. Training of trainers
b. Training of enumerators
c. Training of the data entry team

Training of Trainers
The ToT aimed to qualify a small number of competent persons as trainers. The training equipped them with the advanced knowledge and practical skills they needed to be able to support the lead trainer (consultant) in the training of data collection teams (enumerators) by ensuring that all 81 members of the dietary team acquired the desired level of competency in collecting and/or entering data for the dietary assessment component.

A small group of 11 individuals was selected for the ToT training based on the level of education (university student or graduate), passing a written test and an oral interview, Rwandan citizenship, good communication and language skills, physically able to meet the demands of the job, as well as knowledge and experience in using the four pass 24-hour recall method of dietary assessment. The ToT was conducted in 8 days from the CIAT offices in Kigali, Rwanda. The major components of the workshop were introduction to dietary assessment tools, the 24-hour recall method of dietary assessment and related practice, and the trainer's skills required.

In the introduction, the trainees had a short refresher course on the concept of foods, diet, and dietary assessment covering background knowledge on the chemistry and composition of foods, nutrients, food groups, and examples based on local foods. Different possible methods of dietary assessment were also discussed. The training then focused on deepening the knowledge of the trainees on the 24-hour recall methodology. The team was also trained on how to introduce the interview to the mothers, as well the knowledge and practice of the 24-hour interview through its sections also called 'passes'.

The First Pass consists of making the list of all the foods and drinks taken by the reference mother or child in the previous 24 hours – counted from the time of waking up until the time of finally going to bed without waking up to eat/drink anything else.

The Second Pass consists of obtaining a complete description of all the foods and drinks listed in the first pass.

The Third Pass consists of using different specific measurements methods to estimate the amounts of foods/drinks consumed by the reference mother/child in the reference period.

The Fourth Pass is the review of the list of foods/drinks between the interviewer and the interviewee to check that nothing was forgotten during the recall.

The team was also trained on what is referred to as 'collection of recipes'. Recipes are mixed dishes prepared by the household. Some recipes are commonly prepared in the same way across the country and are well known; these are referred to as 'standard recipes' and are not collected during the interview. There are other recipes from mixed dishes with specific preparation that are unique to a certain household. Those dishes are known as 'unique recipes' and their information must be collected during the interview to establish the list of ingredients used, the description of each ingredient at the time it was added to the dish, and the amount added. The collection of these unique recipes also allows the team to know the final volume of the cooked dish and the amount consumed by the reference mother or child.Another important aspect of the 24-hour recall interview process is to prepare the mother for the interview, an activity known as 'mother training'. This part consists of training the mother on how the interview will be conducted, and giving her tools (picture charts, plates, cups) that will help her on the observation day – the day during which she commits to memory all the foods/drinks consumed and amounts – to finally recall this information on the interview day.

Acquiring knowledge on the interactive 24-hour recall involved 3 days of classroom work followed by 2 days of practice using simulated interviews in class and in small groups (trainee-on-trainee). On the 5th day, the 6 best trainees were selected as enumerator trainers. Day 6, 7 and 8 were spent on preparation for the enumerators' training workshop to equip the enumerator trainers with skills to competently train others and help the field enumerators understand and execute the 24-hour recall procedures. To prepare for the enumerators' training workshop, the 6 trainers were allocated different sections of the recall method based on their perceived strengths. The trainers were given copies of the training materials as well as the key tools and were asked to modify them to their style and translate them into Kinyarwanda.

Enumerator Training

The enumerator training was conducted at the RAB Agricultural Training/Demonstration Centre in Mulindi, Kigali. This was an ideal site for the training – private and away from distractions, a spacious room with adequate facilities, and expansive outdoor areas for small group-work. The training covered the 24-hour recall theory and practice, role-plays between enumerators, and a field pilot for testing and standardisation for both mother training and the 24-hour recall interview. Similar to the TOT workshop, the enumerator training employed the typical approach of classroom exercises (3 days); and small group practice and role-plays (3 days); followed by a 1-day field pilot, and a day of review and re-training. The training was conducted in Kinyarwanda language.

Day 1–3:

1. Discuss the interviewing technique.
2. Explain and discuss each step in the recall procedure.

3. Carry out a demonstration recall interview, emphasising the following technical skills of:
   a. Establishing a pattern of questioning,
   b. Stimulating memory by retracing the activities of the respondent on the preceding day,
   c. Fixing the time frame as the day immediately before the recall interview,
   d. Focusing on the detail required in terms of describing the food itself and exactly how much was eaten,
   e. Probing without bias by using standard prompts to provide more detail,
   f. Ensuring completeness but never cross-examining,
   g. Avoiding quick assumptions and conclusions, e.g., by using silence and waiting, and
   h. Avoiding providing information for the respondent.
4. Demonstrate the probes used to elicit detailed descriptions of food and beverage items.
5. Role-play Pass 1 and Pass 2 of recall interviews, and arrange for trainees to interview each other.
6. Practice generating and recording the information collected from Pass 1 and Pass 2 on the interactive 24-hour recall forms.
7. Assign homework. Interview a friend to generate a list of foods (Pass 1) and their description (Pass 2) consumed in the previous 24 hours. Record information on the 24-hour recall form.

Day 4–6:

1. Discuss the homework. Show the video designed to emphasise correct and incorrect interviewing procedures; practice interviewing techniques through role-playing.
2. Demonstrate different methods for estimating portion sizes including the use of salted food replicas, actual foods, modelling clay or play dough, graduated food models or photographs, and calibrated household utensils.
3. Practice completing the '4 Passes' of the recall using the examples given in class and record the details on the recall form.
4. Carry out a multiple-pass 24-hour recall interview on a partner and record the data on the recall form.
5. Take turns to practice recall interviews, and evaluate each other using the following criteria: manner of the interviewer, introduction, use of non-directed questioning, pacing, manner of questioning, objectivity, probing, use of tools to estimate portion sizes, documentation, memory aids, and review of the recall.

Day 7:

Pilot Test

1. Select an area and a group comparable to that of the actual study, and identify two volunteers per interviewer.
2. Assign an interviewer to each pair of consenting volunteers.

3. On the day before the intake is to be assessed (i.e. 2 days prior to the recall), visit the home of each volunteer to explain again the purpose of the 24-hour recall and to distribute the cup, plate, and picture chart.
4. Explain again the use of the cup, plate, and picture calendar to each volunteer.
5. Set up an appointment with each volunteer to visit their home on the next day.
6. Conduct a 24-hour recall on the next day on each volunteer.
7. Check the recall forms to ensure that all the information required has been recorded correctly, including the portion size consumed and recipes for mixed dishes, if required.
8. Check the recall forms to ensure that the writing is neat and all numbers and letters are legible.
9. Meet with the field supervisors for feedback.

Day 8:

Class review and re-training as needed.

Training of the Data Entry Team

Data were double-entered using the CSDietary system (developed using the CSPro software by Serpro S.A. and HarvestPlus) which calculates the nutrients consumed by the observed persons based on their reported food consumption and the databases prepared before the data collection: conversion factors, food composition, food groups, recipes and retention factors. Analysis of nutrient intake and adequacy, contribution of food groups to nutrient intake, bean intake and additional analyses were conducted. For this to be achieved, a team was trained to do the following:

Database generation: The data entry team trained on the use of CD Dietary Software, which they used to first create the list of household identity (ID) with the household head name in the database, then combine the household in clusters. 103 clusters were created for data entry.

First entry: This involved primary entry of data, identification of mistakes in the questionnaire, identification of missing information in the questionnaire and in the database, and correction of missing information and update of database (update sample and food list).

Second entry: Re-entering the data with the updated database used in data verification.

Data verification: This included the identification and correction of errors done in data entry by comparing data from the first and second entry with the data in the questionnaire.

Cover page entry: This involved the entry of household identification information and general information on appetite and food consumption of the day before for mother and child.

2.0
NUTRITION

2.1 Case Control Study Design: A Review

Case-control studies start with an outcome, and work backwards to find associations between exposures and the outcome. The study design compares individuals with and without the outcome to determine how they may differ in what they were exposed to as illustrated in Figure 2.1.

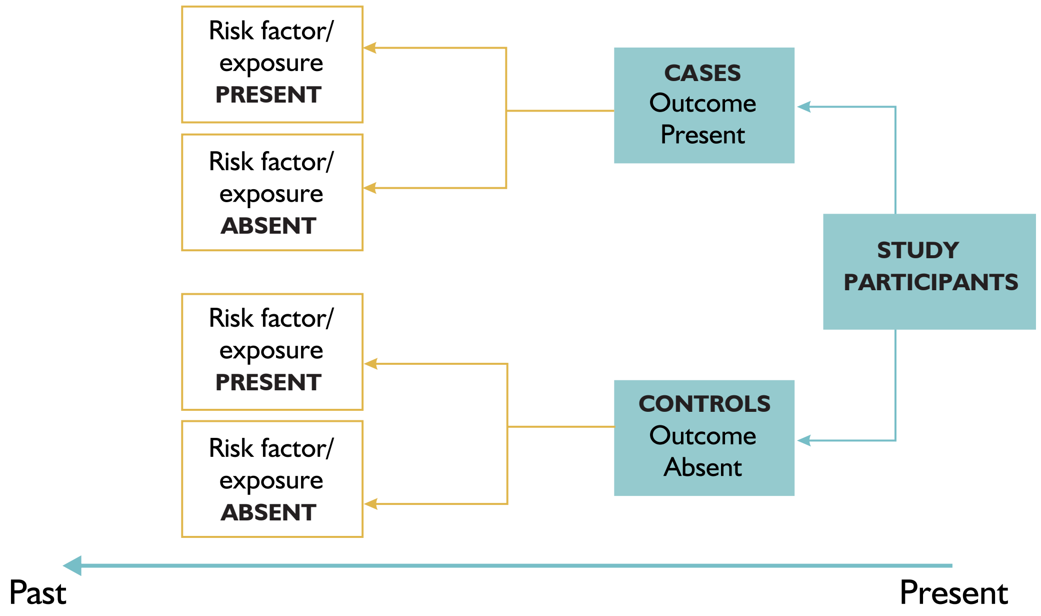

Figure 2.1: Study Design

Famous examples of case-control studies that helped establish associations include a study of lung cancer and smoking (Daff et al 1951). The study interviewed patients with diagnosed lung cancer and patients hospitalised for other disorders about smoking habits. The study eventually led to the currently foregone conclusion that cigarette smoking is the number one risk factor for lung cancer.

Case-control studies have several key components that form the backbone of the design. These were considered in this NMG Survey as follows:

Table 2.1: The NMG Survey Components

Component	Description	NMG Implementation
Study base	All people who would be in the study if they developed the outcome of interest	The study listed and screened all eligible households – with at least one child under 60 months – in the enumeration villages provided by NISR
Case definition	Clear definition	Cases were defined as stunted children under 24 months at the time of screening. Stunting was defined as below minus two standard deviations (-2 SD) from median height for age (HAZ) of reference population (2006 WHO reference population).
Controls	Random sample of those without outcome in the study base	Controls were defined as non-stunted children under 24 months at the time of screening from the same population that was screened, from the same geographic sample, matched by age, sex, and location.
Exposure	Determined from an interview of cases and controls	Nutrition, Markets, and Gender household survey.
Analysis	Odds ratio is the measure of risk used to look at odds of exposure between cases and controls; If cases have lower odds of exposure than controls, exposure may reduce risk of outcome (i.e. protective effect); If cases have higher odds of exposure than controls, exposure may increase risk of outcome; If cases and controls have equal odds of exposure, exposure is likely not related to outcome development.	**Stage 1** Assess responses to the survey questionnaire, comparing case and control households to determine how they may differ. **Stage 2** Compute odds ratios for risk factors of stunting based on areas of statistically significant differences between cases and controls. **Stage 3** Summarise the risk factors identified from the assessment in stage 1 and 2 and model the drivers of stunting in children under 24 months (see details in Chapter 5)

2.2 Prevalence Data

2.2.1 Anthropometry

Prevalence data on childhood malnutrition (representative at sector level) are presented in Table 2.2 (stunting), Table 2.3 (underweight), and Table 2.4 (wasting). The 2006 WHO reference population was used as the reference for standard deviations for nutrition status.

Prevalence data on maternal malnutrition (underweight and overweight) based on body mass index calculations are presented in Table 2.5.

Table 2.2: Prevalence of Stunting in Children Under 60 Months in the Survey Sites

	Height-for-age below -2SD (Stunting)					
	Stunted		Not stunted		Total	
	No.	%	No.	%	No.	%
Age groups						
0-5	181	9.9	1639	90.1	**1820**	**100**
6-11	380	19	1615	81	**1995**	**100**
12-23	1285	36.1	2273	63.9	**3558**	**100**
24-35	1278	36.7	2207	63.3	**3485**	**100**
36-47	1320	39.9	1987	60.1	**3307**	**100**
48-60	901	35.4	1645	64.6	**2546**	**100**
Sex of the child						
Male	2888	35.6	5232	64.4	**8120**	**100**
Female	2457	28.6	6134	71.4	**8591**	**100**
Sector						
Cyuve	588	42.7	790	57.3	**1378**	**100**
Gakenke	504	40.9	728	59.1	**1232**	**100**
Nyagatare	513	29.7	1215	70.3	**1728**	**100**
Kigarama	575	36.6	998	63.4	**1573**	**100**
Gisenyi	503	16.4	2570	83.6	**3073**	**100**
Matyazo	882	45.2	1071	54.8	**1953**	**100**
Cyanika	675	32	1434	68	**2109**	**100**
Kibeho	590	31.6	1277	68.4	**1867**	**100**
Rusororo	515	28.6	1283	71.4	**1798**	**100**
Total	**5345**	**32**	**11366**	**68**	**16711**	**100**

Source: Sector-Level Data

Public Health Significance of Indicator: Stunting

Stunting is evident in children 0-5 months and increases with age between 0-47 months with a small decrease in the 48-60 age group. According to the WHO prevalence classification (WHO 2010), levels of stunting are considered a public health concern when they reach above 20 percent and at 30-39 percent are considered as high prevalence. Stunting in this population is of high public health concern among children aged 12-60 months. The prevalence is higher in boys than girls. In most sectors, except Gisenyi sector, the situation is medium prevalence (20-29%), high prevalence (30-39%), or very high prevalence ≥ 40%, with Matyazo sector being the most affected. Overall prevalence of stunting in the screened population was 32 percent (high prevalence).

Table 2.3: Prevalence of Underweight in Children under 60 Months in the Survey Sites

	Weight-for-age below -2SD (Underweight)					
	Underweight		Normal weight		Total	
	No.	%	No.	%	No.	%
Age groups						
0-5	51	2.8	1769	97.2	**1820**	**100**
6-11	154	7.7	1841	92.3	**1995**	**100**
12-23	303	8.5	3255	91.5	**3558**	**100**
24-35	279	8	3206	92	**3485**	**100**
36-47	326	9.9	2981	90.1	**3307**	**100**
48-60	264	10.4	2282	89.6	**2546**	**100**
Sex of the child						
Male	734	9	7386	91	**8120**	**100**
Female	643	7.5	7948	92.5	**8591**	**100**
Sector						
Cyuve	113	8.2	1265	91.8	**1378**	**100**
Gakenke	102	8.3	1130	91.7	**1232**	**100**
Nyagatare	126	7.3	1602	92.7	**1728**	**100**
Kigarama	153	9.7	1420	90.3	**1573**	**100**
Gisenyi	114	3.7	2959	96.3	**3073**	**100**
Matyazo	220	11.3	1733	88.7	**1953**	**100**
Cyanika	214	10.1	1895	89.9	**2109**	**100**
Kibeho	204	10.9	1663	89.1	**1867**	**100**
Rusororo	131	7.3	1667	92.7	**1798**	**100**
Total	**1377**	**8.2**	**15334**	**91.8**	**16711**	**100**

Source: Sector-Level Data

Public Health Significance of Indicator: Underweight

Like stunting, underweight is evident in children 0-5 months and increases with age between 0-60 months. According to the WHO prevalence classification (WHO 2010), levels of underweight are considered a public health concern when they reach above 10 percent (underweight) and at 10-19 percent are considered of medium prevalence. Underweight in this population is of low public health significance among children aged 0-47 months, and of medium public health significance at 48-60 months. Again, the prevalence is higher in boys than girls. In most sectors the prevalence of underweight is of low public health significance except in Matyazo, Cyanika and Kibeho sectors where the situation is of medium public health significance; with Matyazo sector again being the most affected. Overall prevalence of underweight in the screened population was low (8.2%).

Table 2.4: Prevalence of Wasting in Children under 60 Months in the Survey Sites

	Weight-for-height below -2SD (Wasting)					
	Wasted		Not wasted		Total	
	No.	%	No.	%	No.	%
Age groups						
0-5	15	0.8	1805	99.2	**1820**	**100**
6-11	31	1.6	1964	98.4	**1995**	**100**
12-23	52	1.5	3506	98.5	**3558**	**100**
24-35	25	0.7	3460	99.3	**3485**	**100**
36-47	34	1	3273	99	**3307**	**100**
48-60	27	1.1	2519	98.9	**2546**	**100**
Sex of the child						
Male	104	1.3	8016	98.7	**8120**	**100**
Female	80	0.9	8511	99.1	**8591**	**100**
Sector						
Cyuve	4	0.3	1374	99.7	**1378**	**100**
Gakenke	7	0.6	1225	99.4	**1232**	**100**
Nyagatare	26	1.5	1702	98.5	**1728**	**100**
Kigarama	23	1.5	1550	98.5	**1573**	**100**
Gisenyi	19	0.6	3054	99.4	**3073**	**100**
Matyazo	22	1.1	1931	98.9	**1953**	**100**

Cyanika	25	1.2	2084	98.8	**2109**	**100**
Kibeho	36	1.9	1831	98.1	**1867**	**100**
Rusororo	22	1.2	1776	98.8	**1798**	**100**
Total	**184**	**1.1**	**16527**	**98.9**	**16711**	**100**

Source: Sector-Level Data

Public Health Significance of Indicators: Wasting

Wasting is evident in children 0-5 months and increases with age between 0-23 months with an almost halving in the 24-35 months age group, and then a slight increase in children aged 36-60 months. According to the WHO prevalence classification (WHO 2010), levels of wasting are considered acceptable below 5 percent (wasting). Like stunting and underweight, the prevalence of wasting is also higher in boys than girls. Commendably, prevalence of childhood wasting in all sectors remains under 2 percent with Cyuve sector recording the least prevalence at 0.3 percent, and Kibeho sector recording the highest prevalence at 1.9 percent. Overall prevalence of wasting in the screened population was acceptable (1.1%).

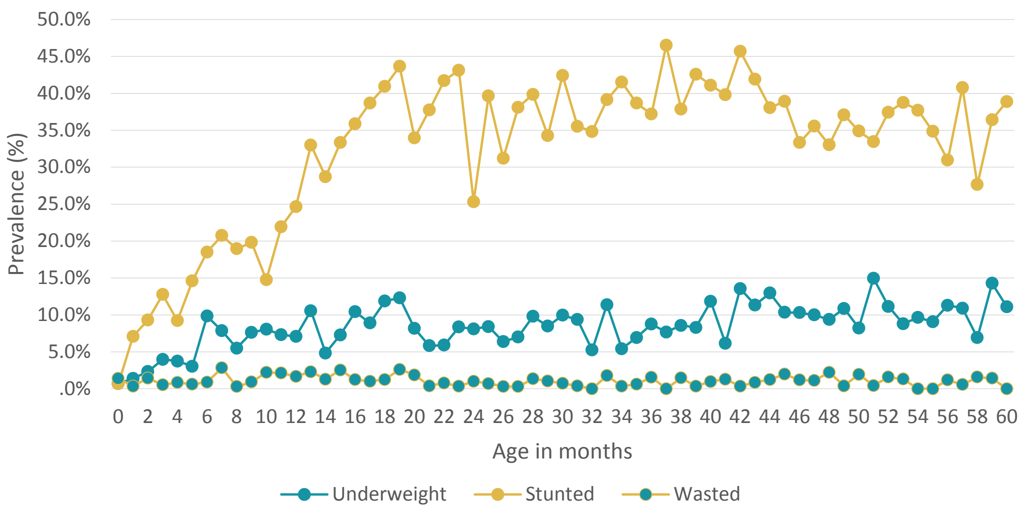

Figure 2.2: Nutrition Status of Children by Age

Summary of Indicators of Malnutrition in Children 0-60 Months

Figure 2.2 provides a summary of nutrition status of children by age. The figure provides a similar picture to the nutrition status of children by age in the DHS 2010 (NISR 2010, Figure 11.1) and shows a lower prevalence of wasting, followed by underweight, then stunting.

In the NMG survey, analysis by age group indicates that stunting is apparent even among children less than 6 months of age, and increases with the age of the child. Figure 2.2 shows that the percentage of children underweight is relatively low but present across all ages from 0-60 months. The percent of children wasted is very low and the low prevalence is stable across all ages between 0-60 months.

Prevalence data on maternal malnutrition (underweight and overweight) based on body mass index (BMI) calculations are presented in Table 2.5.

Table 2.5: Prevalence of Underweight and Overweight Among Mothers in the Survey Sites

Mother Body Mass Index, grouped							
	Underweight		Normal		Overweight		Total
	No.	%	No.	%	No.	%	
Sector							
Cyanika (n=1495)	80	5.4	1218	81.5	197	13.2	**100**
Cyuve (n=1053)	21	2	724	68.8	308	29.2	**100**
Gakenke (n=1001)	25	2.5	797	79.6	179	17.9	**100**
Gisenyi (n=1529)	47	3.1	743	48.6	739	48.3	**100**
Kibeho (n=1259)	76	6	968	76.9	215	17.1	**100**
Kigarama (n=1105)	44	4	847	76.7	214	19.4	**100**
Matyazo (n=1304)	33	2.5	1114	85.4	157	12	**100**
Nyagatare (n=1140)	34	3	786	68.9	320	28.1	**100**
Rusororo (n=1212)	78	6.4	848	70	286	23.6	**100**
Total (n=11098)	**438**	**3.9**	**8045**	**72.5**	**2615**	**23.6**	**100**

Source: Sector-Level Data

Public Health Significance of Indicators: Body Mass Index
BMI is a simple index of weight-to-height commonly used to classify underweight, overweight and obese adults. It is defined as the weight in kilogrammes (kgs) divided by the square of the height in metres (kg/m2). BMI < 18.5 indicates underweight; BMI 18.5-24.9 indicates normal weight; and BMI ≥ 25.0 indicates overweight. Cut-off values for public health significance (WHO 2010) for BMI are based on adult BMI < 18.5 (underweight) with the following prevalence cut-off values: 5-9 percent low prevalence (warning sign, monitoring required); 10-19 percent medium prevalence (poor situation); 20-39 percent high prevalence (serious situation); and ≥ 40 percent very high prevalence (critical situation).

In 6 out of the 9 sectors, the prevalence of underweight mothers in the screened population was below 5 percent. However, in the other 3 sectors

– Cyanika, Kibeho and Rusororo – the prevalence is between 5-9 percent making this a low prevalence but warns that monitoring is required. In addition, it is important to note that Kibeho sector, which has the second highest prevalence of underweight in women, also had the highest prevalence of wasting in children. Cyanika and Rusororo sectors have similarly relatively high rates of wasting in children too.

On the other hand, the prevalence of overweight is somewhat alarming as it is in the double digits in all sectors, and in at least 3 sectors it is over 20 percent; bordering 30 percent in some sectors. The prevalence of overweight in Gisenyi sector is 48 percent, which should trigger a public health concern.

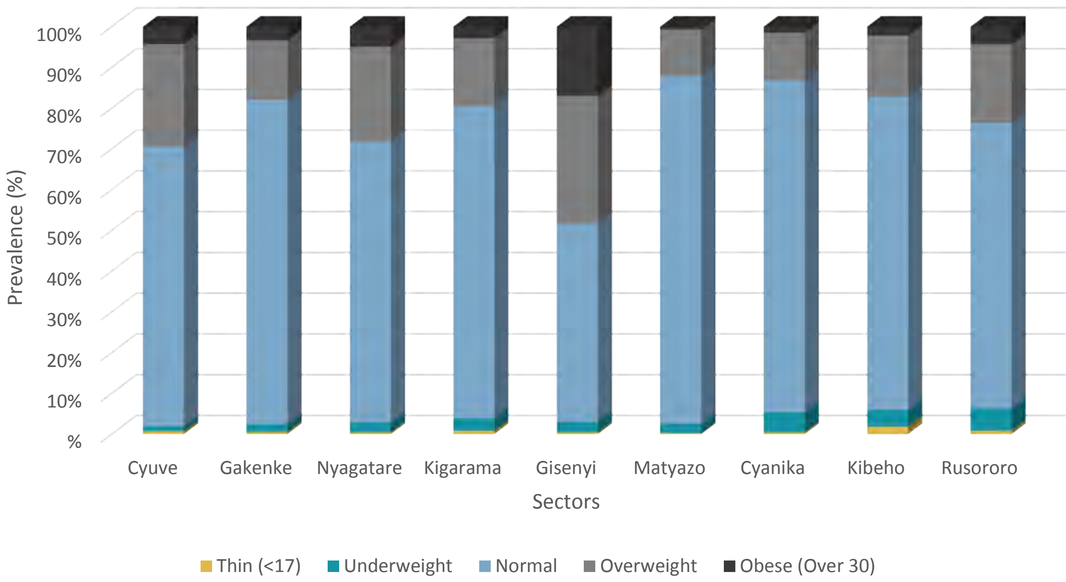

Figure 2.3: Nutrition Status of Women by Sector

Figure 2.3 provides a summary of the nutrition status of women enrolled into the survey by sector. BMI in this case is further classified to generate 5 groups for nutrition status: thinness, underweight, normal, overweight and obesity in adult women. Underweight BMI presented in Table 2.5 was further analysed to assess prevalence of thinness (BMI <17), whereas overweight BMI was further assessed for prevalence of obesity (BMI >30). In the sampled population, the prevalence of thinness in women was overall below 1 percent. Similarly, obesity in women was below 5 percent in most sectors but alarmingly high in Gisenyi sector (16.9%).

2.2.2 Anaemia

Haemoglobin Data

Anaemia was only assessed among cases and controls enrolled in the study. Anaemia is defined as a haemoglobin concentration below a specified cut-off point, which can change according to age, gender, physiological status, smoking habits and the altitude at which the population being assessed lives. WHO defines anaemia in children under

5 years of age as a haemoglobin concentration < 110 g/l at sea level. The cut-offs for severity are as follows: mild anaemia (110-109 g/l); moderate anaemia (70-99 g/l); and severe anaemia (less than 70 g/l). The data presented on childhood anaemia in Table 2.6 are from households enrolled into the study, and were adjusted for altitude (WHO 2011). Data on maternal anaemia is presented in Table 2.7.

Table 2.6: Anaemia Level in Children Enrolled in the Study

	Child adjusted haemoglobin, grouped					
	Non-anaemia	Any anaemia	Mild	Moderate	Severe	Total
Study arm						
Case (n=1,345)	61.2	38.8	17.2	19.9	1.8	**100**
Control (n=1,339)	66.9	33.1	17.8	14.2	1	**100**
Sex of the reference child						
Male (n=1,568)	62	38	18	18.4	1.6	**100**
Female (n=1,116)	66.9	33.1	16.8	15.1	1.2	**100**
Child age, grouped						
0-5 (n=277)	57	43	20.2	20.6	2.2	**100**
6-11 (n=578)	56.4	43.6	21.3	20.4	1.9	**100**
12-23 (n=1,823)	67.5	32.5	16	15.4	1.2	**100**
Sector						
Cyanika (n=302)	71.9	28.1	15.9	12.3	0	**100**
Cyuve (n=294)	78.2	21.8	14.3	6.5	1	**100**
Gakenke (n=308)	68.2	31.8	19.5	12	0.3	**100**
Gisenyi (n=273)	34.8	65.2	24.5	38.5	2.2	**100**
Kibeho (n=300)	65.7	34.3	17.3	15	2	**100**
Kigarama (n=301)	47.2	52.8	24.9	25.2	2.7	**100**
Matyazo (n=292)	95.2	4.8	2.1	2.7	0	**100**
Nyagatare (n=296)	54.4	45.6	20.6	22.6	2.4	**100**
Rusororo (n=312)	59	41	18.9	19.9	2.2	**100**
Total (n=2,684)	**64**	**36**	**17.5**	**17**	**1.4**	**100**

Public Health Significance of Indicator: Childhood Anaemia

Anaemia is evident in both cases and controls, and although the prevalence is higher in cases, it is of moderate public health concern in both groups. Like in all forms of malnutrition, the prevalence of hidden hunger is also higher in boys than girls. Alarmingly, its prevalence in children 0-11 months is above 40 percent, making childhood anaemia of severe public health significance in this group. The rates in children 12-23 months is still high (23.5%), and of moderate public health concern. Surprisingly, in Matyazo sector, where stunting is an important public health concern, anaemia is not a public health problem (<4.9%). On the other hand, Gisenyi sector that had the lowest rates for stunting has the highest rates for anaemia (65.2%). The severity of childhood anaemia in Gisenyi sector is alarming. For the other sectors, the situation is either of moderate public health significance (20-39% prevalence) or of severe public health significance (> 40% prevalence) among the surveyed households. Overall, prevalence of anaemia in the survey sample was 36 percent – of moderate public health significance. In all cases, most of the anaemia is either mild or moderate with low prevalence of severe anaemia in some sectors and 0 percent prevalence in others.

Maternal Anaemia

WHO defines anaemia in women of reproductive age as a haemoglobin concentration < 120 g/l at sea level. The cut-offs for severity are as follows: mild anaemia (110-119 g/l); moderate anaemia (80-109 g/l); and severe anaemia (less than 80 g/l). The data presented were collected from mothers in households enrolled into the study, and were adjusted for altitude.

Table 2.7: Anaemia Levels in Mothers with Child Enrolled in the Study

	Mother adjusted haemoglobin, grouped					
	Non-anaemia	**Any anaemia**	**Mild**	**Moderate**	**Severe**	**Total**
Study arm						
Case (n=1,345)	75.8	24.2	11.2	12	1.1	**100**
Control (n=1,339)	79.6	20.4	10.1	9.6	0.7	**100**
Sector						
Cyanika (n=302)	86.1	13.9	7.3	6	0.7	**100**
Cyuve (n=294)	91.8	8.2	4.8	2.7	0.7	**100**
Gakenke (n=308)	85.4	14.6	6.5	7.5	0.6	**100**
Gisenyi (n=273)	45.1	54.9	26.4	27.8	0.7	**100**
Kibeho (n=300)	90.3	9.7	5.7	3.7	0.3	**100**
Kigarama (n=301)	76.7	23.3	8.6	10.6	4	**100**
Matyazo (n=292)	54.5	45.5	22.6	22.3	0.7	**100**
Nyagatare (n=296)	89.9	10.1	5.4	4.7	0	**100**
Rusororo (n=312)	76	24	10.3	13.1	0.6	**100**
Total (n=2,684)	**77.7**	**22.3**	**10.6**	**10.8**	**0.9**	**100**

Public Health Significance of Indicators: Maternal Anaemia

Again anaemia is evident in mothers in both case and control households. Although the prevalence is higher in case households, it is of moderate public health concern in both groups. Intriguingly, Gisenyi sector that had the highest rates for childhood anaemia (65.2%) and maternal overweight (48.3%) presents also the highest rates for maternal anaemia (54.9%); making maternal anaemia of severe public health significance in this group. On the other hand, in Matyazo sector, where childhood anaemia was not a public health problem (<4.9%), maternal anaemia is of severe public health significance (45.5%). For the other sectors, the situation is either of mild public health significance (5-19%), or moderate public health significance (20-39% prevalence) among the surveyed households. Overall, the prevalence of maternal anaemia in the survey sample was of moderate public health significance (22.3%). In all cases, most of the anaemia is either mild or moderate with under 1 percent prevalence of severe anaemia in the all sectors except Kigarama sector with 4 percent prevalence.

2.3 Comparison of Cases versus Controls and Establishment of Risk Factors for Malnutrition

"Begin with the outcome and look for features of people who share that outcome, then compare characteristics with subjects who do not."
Stephen H. Gehlbach, Interpreting the Medical Literature, 1993

The first step of nutrition data analysis in the NMG study was to compare cases and controls for each of the questions asked and establish where the two groups were statistically different in their responses ($p < 0.05$). Where there was a significant difference between cases and controls, odds ratios were generated to determine association between stunting and exposure.

Establishing Risk Factors for Stunting in the Survey Population

An odds ratio (OR) is a measure of association between an exposure (e.g. lack of sufficient food) and an outcome (e.g. stunting in children). The OR represents the odds that an outcome (e.g. stunting in children) will occur given a particular exposure (e.g. lack of sufficient food), compared to the odds of the outcome (e.g. stunting in children) occurring in the absence of that exposure (e.g. food security).

Odds ratios are most commonly used in case-control studies to compare the relative odds of the occurrence of the outcome of interest (e.g. stunting in children), given exposure to the variable of interest (e.g. food, care, health). The odds ratio has been used in the NMG study to determine whether a particular exposure is a risk factor for stunting in children under 24 months, and to compare the magnitude of various risk factors for stunting:

- OR=1 Exposure does not affect odds of outcome
- OR>1 Exposure associated with higher odds of outcome
- OR<1 Exposure associated with lower odds of outcome

In addition to the OR, the NMG data tables also report the 95 percent confidence interval (CI). The CI is used to estimate the precision of the OR. A large CI indicates a low level of precision of the OR, whereas a small CI indicates a higher precision of the OR.

The data tables also report the p-value, which is a measure of the statistical significance of the data. A p-value less than 0.05 was used as the cut-off in this data to indicate statistically significant association between various variables and stunting in children under 24 months.

All studies with hypotheses ultimately use a p-value to weigh the strength of the evidence. The p-value is a number between 0 and 1 and interpreted in the following way in this study:

- A small p-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis
- A large p-value (> 0.05) indicates weak evidence against the null hypothesis
- The p-values very close to the cut-off (0.05) are considered to be marginal (could go either way).

When the OR is close to 1 (slightly higher or lower), it is possible to interpret it using percentage. For example if an OR=1.2, it can be interpreted as 20 percent higher odds in the cases than in controls. If the OR<1, for example OR=0.8, the interpretation of the result is that the exposure is protective and can reduce odds of the event by 20 percent. This can be computed as [(1-OR)*100%]. In this case, [(1-0.8)*100%] = 20%.

Confounding Factors

When a non-causal association is observed between a given exposure and outcome as a result of the influence of a third variable, it is termed confounding, with the third variable termed a confounding variable. Stratification and multiple regression techniques are two methods used to address confounding, and produce “adjusted” ORs. In this case of preliminary data discussion, only unadjusted odds are presented.

2.3.1 Nutrition Status Data (Anthropometry): Odds Ratios

Prevalence data for stunting in children under 60 months are presented in Tables 2.2 to 2.4 of this chapter. The following questions were raised from the anthropometry data and odds ratios generated as follows:

a. Is child age a risk factor for stunting in children under 60 months?
b. Is sex of the child a risk factor for stunting in children under 60 months?
c. Is place of residence a risk factor for stunting?

a. Age of child: As children grow and move from one age group to another, the risk of stunting increases. Compared to children in the 0-5 months age group, those in the 6-11 months age group are 2.13 times more likely to be stunted; those in the 12-23 months age group are 5.12 times more likely to be stunted; those in the 24-35 months age group are 5.24 times more likely to be stunted; those in the 36-47 months age group are 6.02 times more likely to be stunted, and those in the 48-60 months age group are 4.96 times more likely to be stunted.

Table 2.8: Is Age of the Child a Risk Factor for Stunting in Children Under 60 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Age groups					
0-5 (n=1,820)	181	9.9	1		
6-11 (n=1,995)	380	19	2.13	[1.76-2.58]	0.000
12-23 (n=3,558)	1285	36.1	5.12	[4.33-6.06]	0.000
24-35 (n=3,485)	1278	36.7	5.24	[4.43-6.20]	0.000
36-47 (n=3,307)	1320	39.9	6.02	[5.08-7.12]	0.000
48-60 (n=2,546)	901	35.4	4.96	[4.17-5.90]	0.000
Total (n=16,711)	**5345**	**32**			

b. Sex of child: Compared to the female child, the male child is 1.38 times more likely to be stunted.

Table 2.9: Is Sex of the Child a Risk Factor for Stunting in Children under 60 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Sex of the child					
Female (n=8,591)	2457	28.6	1		
Male (n=8,120)	2888	35.6	1.38	[1.29-1.47]	0.000
Total (n=16,711)	**5345**	**32**			

c. Locality:

(i) Sector: Compared to Gisenyi sector with the lowest prevalence of stunting, the odds of stunting in children is 3.8 times for those living in Cyuve, 3.54 times for those in Gakenke, 2.16 times for children in Nyagatare, 2.94 times for those in Kigarama, 4.21 times for those residing in Matyazo, 2.41 times for those living in Cyanika, 2.36 times for those in Kibeho, and 2.05 times for those in Rusororo.

Table 2.10: Is Place of Residence a Risk Factor for Stunting in Children under 60 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Sector					
Gisenyi (n=3,073)	503	16.4	1		
Cyuve (n=1,378)	588	42.7	3.8	[3.30-4.39]	0.000
Gakenke (n=1,232)	504	40.9	3.54	[3.05-4.10]	0.000
Nyagatare (n=1,728)	513	29.7	2.16	[1.87-2.48]	0.000
Kigarama (n=1,573)	575	36.6	2.94	[2.56-3.39]	0.000
Matyazo (n=1,953)	882	45.2	4.21	[3.69-4.80]	0.000
Cyanika (n=2,109)	675	32	2.41	[2.11-2.75]	0.000
Kibeho (n=1,867)	590	31.6	2.36	[2.06-2.71]	0.000
Rusororo (n=1,798)	515	28.6	2.05	[1.78-2.36]	0.000
Total (n=16,711)	**5345**	**32**			

(ii) Urban vs. rural areas: Compared to those living in urban areas, children in rural areas are 1.97 times more likely to be stunted.

Table 2.11: Is There a Difference Between Urban and Rural Sectors with Regard to Stunting in Children under 60 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Residence area					
Urban area (n=5,311)	1196	22.5	1		
Rural area (n=11,400)	4149	36.4	1.97	[1.83-2.12]	0.000
Total (n=16,711)	**5345**	**32**			

Observations from the data presented are consistent with 2010 and 2014/2015 DHS data and reveal that child stunting prevalence varies substantially by socio-demographic factors such as the child's age and sex. These two variables are of such fundamental importance to the study of malnutrition that they should not be ignored, especially when age- and sex-specific analyses are undertaken. This is because they show consistent differences in stunting prevalence that would have been masked by less-differentiated analyses.

In the NMG dataset, age-specific data for stunting reveal that all age groups under 59 months pose a highly significant risk for stunting. What is alarming is the magnitude of the risk between 12-47 months of age relative to 0-6 months of age. The higher odds of stunting among older children could be due to inappropriate child feeding practices and/or increased morbidity. The data do imply that nutrition programmes and interventions, though focused on the 1000 days period, should have follow-up of children until their 5th birthday as a child's age below 60 months remains an important factor in the level of risk for malnutrition. With the global focus on the first 1000 days between conception and a child's 2nd birthday, local programmes and interventions should be careful not to lose sight of the lifecycle approach to child development. Equal and not less focus should be placed on establishing effective interventions and programmes that can provide monitoring and support to vulnerable children graduating out of the first 1000 days window.

A small but growing body of research indicates that progress in reducing child malnutrition is substantially uneven from place to place, even down to the district level within countries. Yet stunting prevalence data available for priority setting and planning are often available at district level. For example the NMG survey data shows stunting prevalence in Gisenyi sector as 16.4 percent, relative to the key findings of the 2014/2015 DHS data (NISR 2015) for Western region at 44.9 percent. The lesson here is that there are limits to generalisability of large area data (district level for example) to smaller areas (sector level). In addition, a focus on large area data alone may blind public health planners and policy makers to otherwise obvious success stories. In this case, what lessons on 'what works' can Rubavu district for example learn from Gisenyi sector that can be implemented in other sectors with a high burden of childhood stunting?

The data collected suggests that access to more refined prevalence data is required to facilitate carefully targeted nutrition and health interventions to address child malnutrition in Rwanda. As a recommendation, a data audit of available prevalence data and analysis of the databases at sector level may help to further clarify and guide innovative home-grown solutions and interventions for addressing stunting in Rwanda.
It is clear to nutrition stakeholders that there is a global focus on stunting reduction as an explicit goal. But while this is fundamental to improving nutrition in Rwanda, or any other nation for that matter, is it enough to guarantee success? The data on anaemia presented here suggest that targeting stunting, while critical, may not be enough to ensure the elimination of malnutrition in all of its forms. As previously indicated, Gisenyi sector that had the lowest prevalence of childhood stunting in children under 60 months (16.4%) had the highest prevalence of any

anaemia in children under 24 months (65.2%). Clearly, improving nutrition is not just about reducing hunger; hidden hunger remains a formidable foe that cannot be ignored. The data suggest a balanced focus on childhood nutrition goals that does not only target stunting but also includes targets for key micronutrient deficiencies such as anaemia. This dual focus is the most probable formula to ensure a comprehensive nutrition plan for the eradication of all forms of malnutrition.

2.3.2 Nutrition Questionnaire Data: Odds Ratios and Risk Factors

Mapping the Questions/ Context for Nutrition

As earlier stated, the data collected in the NMG survey was mainly influenced by the UNICEF framework for malnutrition. Using the framework as a guide, the NMG nutrition questionnaire can be divided into 6 key components that influence nutrition outcomes as follows: household resources, food, health, care, WASH, and information. Table 2.12 details how the questions in the nutrition tool are mapped to the 6 key components, which is also how they were grouped for statistical analysis to determine risk factors for stunting in children under 24 months.

Table 2.12: Mapping the NMG Nutrition Questionnaire

Component	Household resources
Questions in nutrition tool	‘Ubudehe’ categories
	Household head and spouse characteristics
	House characteristics
	Household assets
	Wealth index
Component	**Health**
Questions in nutrition tool	Health facility
	Health insurance
	Mother’s health status and micronutrient intake
	Birth record of the child
Component	**Water, Hygiene, and Sanitation (WASH)**
Questions in nutrition tool	Drinking water
	Toilet facility
	Mothers hand-washing knowledge and practice
Component	**Information**
Questions in nutrition tool	Awareness and access to nutrition information
	Awareness and access to enriched foods
Component	**Care**
Questions in nutrition tool	Child breastfeeding status and history
	Complementary feeding status and history
	Vitamin, iron, micronutrient intake in children
	Child morbidity, immunization and growth record
Component	**Food**
Questions in nutrition tool	Beans consumption and household staples
	Famine and famine foods
	Food insufficiency and coping strategies
	Food consumption and diet diversity score
	Household food consumption and food source – previous 7 days
	Diet diversity of child
	24 hour dietary recall

Sample Distribution by Province and District

Table 2.13 documents the number of households sampled in the nutrition household survey.

Table 2.13: Sample Distribution by Province and District

	Study arm					
	Control		Case		Total	
	N	%	N	%	N	%
Province						
North	302	49.8	305	50.2	**607**	**100**
East	306	50.2	304	49.8	**610**	**100**
West	308	50.4	303	49.6	**611**	**100**
South	304	49.8	307	50.2	**611**	**100**
Kigali	162	51.3	154	48.7	**316**	**100**
District						
Musanze	150	49.7	152	50.3	**302**	**100**
Gakenke	152	49.8	153	50.2	**305**	**100**
Nyagatare	154	50.3	152	49.7	**306**	**100**
Kirehe	152	50	152	50	**304**	**100**
Rubavu	157	51	151	49	**308**	**100**
Ngororero	151	49.8	152	50.2	**303**	**100**
Nyamagabe	152	50	152	50	**304**	**100**
Nyaruguru	152	49.5	155	50.5	**307**	**100**
Gasabo	162	51.3	154	48.7	**316**	**100**
Total	**1382**	**50.2**	**1373**	**49.8**	**2755**	**100**

The proposed sample size for the survey was n = 152 cases and n = 152 controls. The data in Table 2.13 shows that in most cases the sample size was achieved. Because of loss to follow up, the sample size in Musanze, Rubavu, and Ngororero is less by 1-2, but given the overall sample size of n=1382, this does not negative influence statistical power.

Questionnaire review: From the data collected in the survey, preliminary data analysis was conducted on individual questions in the nutrition survey tool to determine if there were statistically significant differences between cases and controls based on their responses. Only components with significant differences are highlighted in this report.

2.4 Household Resources

Table 2.14: Household Resources – Comparison of Cases vs Controls

Component	Household resources
Questions in nutrition tool	'Ubudehe' categories
	Household head and spouse characteristics
	House characteristics, household assets, and wealth index

2.4.1 Ubudehe Categories

Q. Government-assigned Ubudehe

Ubudehe was significantly different between cases and controls (p = 0.001). Using the government-assigned Ubudehe for accuracy, it is clear that most of the randomly selected households fall within Ubudehe 2 (29%) and 3 (64%). For Ubudehe 1, 45 percent were control while 54 percent were case households. For Ubudehe 2, 46 percent were control households while 54 percent were case households. For Ubudehe 3, 52 percent were control households and 48 percent were case households. For Ubudehe 4, 39 percent of the sample were control and 61 percent were case households. All households in Ubudehe 5 were controls. For Ubudehe 6, 80 percent were control households while 20 percent were case households.

Ubudehe: Based on the data, is the Ubudehe category a risk factor for stunting in children under 24 months? Compared to Ubudehe 1 and 2, being in Ubudehe 3-6 had a protective effect on stunting, with children in those households being 22 percent less likely to be stunted.

Table 2.15: Is the Ubudehe Category a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Government-Assigned Ubudehe					
Ubudehe 1-2 categories (n=975)	525	53.8	1		
Ubudehe 3-6 categories (n=1,813)	863	47.6	0.78	[0.67-0.91]	0.002
Total (n=2,788)	**1388**	**49.8**			

2.4.2 Household Head and Spouse Characteristics

Household head and spouse characteristics in the questionnaire included sex of the household head, age of both the household head and spouse, marital status of the household head, literacy of the household head and spouse, and level of education of the household head and spouse. Of these variables, marital status of household head, literacy of household head and spouse, and level of education of the household head and spouse were significantly different between cases and control households.

Q. Marital status of the household head

Marital status was significantly different between cases and controls (p = 0.027). From the data, it is evident that most of the respondents were married and monogamous (76%), 52 percent being control households and 48 percent case households. Among polygamous homes, 56 percent were case households and 44 percent control households. 59 percent of those widowed were case households and 41 percent control households. 68 percent of those divorced were case households while 32 percent were control households. 60 percent of those separated were control households and 40 percent case households. 51 percent of those partnered were case households and 51 percent control households. Among those never married 52 percent were control households and 48 percent case households.

Q. Can head of house read/write?

Literacy of the household head was significantly different between cases and controls (p = 0.013). About 73 percent of the household heads were literate with 52 percent of these in control households and 48 percent in case households. Among those who were not literate, 54 percent were from case households and 46 percent from control households.

Q. Can spouse of household read/write?

Literacy of the spouse of the household head was significantly different between cases and controls (p = 0.002). About 71 percent of the spouses were literate with about 53 percent of these in control households and 47 percent in case households. Among those who were not literate, 54 percent were from case households and 47 percent in control households.

Q. Level of education of the household head

Level of education attained by the household head was significantly different between the two groups (p = 0.000). About 26 percent of the household heads had no schooling; 56 percent of these were from case households and 44 percent from control households. 39 percent had some primary education, and the proportion was 51 percent in case households and 49 percent in control households. 22 percent had completed primary education and 51 percent of these were from control households and 49 percent from case households. 6.7 percent had some secondary education; 59 percent of these were from control households and 41 percent from case households. 3.5 percent of the sample had completed secondary education – in this group 65 percent were from control households and 35 percent from case households. Only 35 respondents had some college or university education; 85 percent of these were from control households and 15 percent from case households. Only 44 household heads had completed university or college; 59 percent of these were from control households and 41 percent from case households.

Q. Level of education of the spouse of the household head

Level of education of the spouse of the household head was significantly different between the two groups ($p = 0.000$). 26 percent of the spouses of the household head had no schooling; 54 percent of these were case households and 46 percent control households. 39 percent of the sample had some primary education: 51 percent were case households and 49 percent control households. For those that had completed primary education, 52 percent were control households and 48 percent case households. For those that had some secondary education, 58 percent were controls while 42 percent were case households. For those that had completed secondary education, 67 percent were controls while 33 percent were case households. For women with some university or college education, 77 percent were control households while 23 percent were case households. For those that had completed university or college, 69 percent were control households while 31 percent were case households.

Two questions were raised from the household head and spouse characteristics data and odds ratios generated as follows:

i. Is the marital status of the mother a risk factor for nutrition?
ii. Is household literacy a risk factor for stunting in children under 24 months?
iii. Is maternal education a risk factor for stunting in children under 24 months?

i. Marital status: Compared to households where there is a monogamous union, children in households with other forms of marital union or a lack of union are 1.37 times more likely to be stunted ($p = 0.000$).

ii. Literacy: Compared to a situation where both husband and wife are literate, children are 1.28 times more likely to be stunted if only one parent is literate and 1.48 times more likely to be stunted if none of the parents are literate.

If the head of the household cannot read/write, children in the household are 1.23 times more likely to be stunted. And if the spouse of the head of the household cannot write, children in such households are 1.32 times more likely to be stunted.

Table 2.16: Is Literacy a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Literacy head and spouse, combined					
Both are literate (n=1,457)	677	46.5	1		
One is literate (n=1,018)	535	52.6	1.28	[1.09-1.50]	0.003
None is literate (n=313)	176	56.2	1.48	[1.16-1.89]	0.002
Can head of household read/write					
Yes (n=2,027)	980	48.3	1		
No (n=761)	408	53.6	1.23	[1.04-1.46]	0.013
Can the spouse of head of household read/write					
Yes (n=1,795)	846	47.1	1		
No (n=750)	405	54	1.32	[1.11-1.56]	0.002
Total (n=2,788)	**1388**	**49.8**			

iii. Maternal education: Maternal education has a protective effect on stunting. Compared to situations where mothers have no education, children whose mothers have primary level education are 17 percent less likely to be stunted while those whose mothers have secondary education and higher are 51 percent less likely to be stunted.

Table 2.17: Is the Level of Maternal Education a Predictor of Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Level of education of the spouse of household head					
No education (n=665)	362	54.4	1		
Primary education (n=1,540)	767	49.8	0.83	[0.69-0.99]	0.046
Secondary and higher (n=339)	125	36.9	0.49	[0.37-0.64]	0.000
Total (n=2,788)	**1388**	**49.8**			

2.4.3 House Characteristics and Household Assets

House characteristics: House characteristics probed in the questionnaire were about major materials for roof, walls, and floor, and the number of sleeping rooms in a dwelling unit. There was no significant difference between cases and controls for major materials for roof or walls.

Q. Please indicate what major materials for floor are.

The flooring materials were significantly different between cases and controls (p = 0.000). For 78 percent of the respondents, their flooring material was made of earth/mud with about 53 percent of these being case households and 47 percent being controls. For 21 percent of the sample, flooring was made of cement; about 60 percent of these were control households while 40 percent were case households. For about 30 respondents, their flooring was made from other materials; 67 percent of these were from control households while 33 percent were from case households.

Q. How many sleeping rooms are in the dwelling unit?

The number of bedrooms in the dwelling unit was significantly different between cases and controls (p = 0.004). 24 households had no sleeping rooms in their dwelling units; 63 percent of these were case households and 37 percent were control households. 25 percent of the households had dwellings with 1 sleeping room; 52 percent were cases and 48 percent were control households. 37 percent of the sample had dwellings with 2 sleeping rooms; 53 percent were case households while 47 percent were control households. 30 percent of the households had 3 sleeping rooms in their dwelling units; 53 percent of these were control households and 47 percent were case households. 6 percent of the sample had 4 sleeping rooms in their dwelling units; 61 percent were control households while 39 percent were case households. About 1 percent of the households had 5 sleeping rooms in their dwelling units; 58 percent were control households while 42 percent were case households. Ten households reported 6 sleeping rooms in their dwelling units. Of these 80 percent were from control households, and 20 percent from case households. 4 households reported 7 sleeping rooms; these were evenly divided between the two groups. Only 1 – a case household – reported 9 sleeping rooms in the dwelling unit.

Household assets: Household assets assessed included ownership of home, whether a household had electricity, radio, television, refrigerator or mobile phone; whether members of the household owned a bicycle, motorcycle, car or truck; and what type of fuel the household mainly used for cooking. There was no significant difference between cases and controls for whether the house was owned or rented. There was no significant difference between the two groups for ownership of a refrigerator or bicycle.

Q. Does your house have the following?

Electricity: Electricity in household was significantly different between cases and control (p = 0.001). A minority of the sample (about 12%) had electricity in their households; of these about 57 percent were control households and 43 percent were case households. Of those without electricity, 52 percent were case households and 48 percent were control households..

Radio: Ownership of a radio was significantly different between cases and controls (p = 0000). Of the 45 percent of the households that owned a radio, 54 percent were from control households and 46 percent were case households. Of the 55 percent who did not own a radio, 53 percent were from case households and 47 percent were control households.

Television (TV): Ownership of a TV was significantly different between cases and controls (p = 0000). Of the 9 percent of the households that owned a TV, 63 percent were from control households and 37 percent from case households. Of the 91 percent who did not own a TV, 51 percent were from case households and 49 percent from control households.

Mobile phone: Ownership of a mobile phone was significantly different between cases and controls (p = 0000). Of the 58 percent of the households who had a mobile phone, 54 percent were from control households while 46 percent from case households. Of the 42 percent who did not own a mobile phone, 55 percent were from case households while 45 percent were from control households.

Q. Does any member of your household own:

Motorcycle: Ownership of a motorcycle was significantly different between cases and controls (p = 0005). Of the about 2 percent of the households who had a motorcycle, 71 percent were from control households and 29 percent were case households. Of the 98 percent who did not own a motorcycle, 50 percent were from case households while 50 percent were control households.

Car or truck: Ownership of a car/truck was significantly different between cases and controls (p = 0001). Of the 1 percent of households who had a car/truck, 82 percent were from control households while 18 percent were case households. Of the 99 percent who did not own a car/truck, 50 percent were from case households and 50 percent were control households.

Q. What type of fuel does your household mainly use for cooking?

The type of fuel used for cooking was significantly different between the two groups (p = 0.001). 82 percent of the sample used firewood; 51 percent of whom were case households while 49 percent were control households. 16 percent of the sample used charcoal; 58 percent of whom were control households and 42 percent case households. Only 1 household indicated using gas – a case household. 11 households used dung; 73 percent of whom were case households and 27 percent were control households. Another 44 households reported using other forms of fuel – 61 percent of whom were control households and 39 percent case households.

2.4.4 Wealth Quintile

The wealth index was not a direct question but was constructed from household characteristics and assets – and is similar to the DHS wealth index (Rutstein and Kiersten 2004), which has five quintiles. From the data, it is clear that the survey sample is evenly distributed across the wealth quintiles with each taking about 20 percent of the sample: lowest (n=557), second (n=557), middle (n=558), fourth (n=557), highest (n=558). The wealth index is significantly different between the two groups (p = 0.000) with case households making up at least 50 percent of all quintiles except the highest quintile (41%) where control households were 59 percent of the group.

Compared to the lowest wealth quintile, status has a protective effect as children in those households in the highest wealth quintile were 30 percent less likely to be stunted. However, in spite of its protective effect, it is evident that stunting levels among the highest wealth quintile are still unacceptably high. This data confirm that malnutrition, although linked to poverty, is multifactorial in its causes and no one factor alone can fully explain it. Thus, although poverty reduction is a definite strategy in reducing stunting, it must be complemented by a package of pro-nutrition interventions for impact.

Table 2.18: Is the Wealth Quintile a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Wealth index					
Lowest (n=557)	279	50.1	1		
Second (n=557)	308	55.3	1.23	[0.97-1.56]	0.082
Middle (n=558)	289	51.8	1.07	[0.85-1.35]	0.570
Fourth (n=557)	282	50.6	1.02	[0.81-1.29]	0.857
Highest (n=558)	230	41.2	0.7	[0.55-0.89]	0.003
Total (n=2,788)	**1388**	**49.8**			

2.5 Health

Table 2.19: Health – Comparison of Cases vs. Controls

Component	Health
Questions in nutrition tool	Health facility
	Health Insurance
	Mothers health status and micronutrient intake
	Birth record of the child

The questions related to health/healthcare inquired about the distance to the nearest health facility, how much time it takes to get there, what means of transport is used to get there, and how many individuals in the household had health insurance/mutuelle cover (Mutuelle de Santé is a Rwandan community-based health insurance). There was no significant difference between case and control households for distance from home to health facility or how long it takes to get there.

2.5.1 Health Facility

Q. What means of transport do you use to go to the nearest clinic or dispensary?

Means of transport to the nearest clinic or dispensary was significantly different between the two groups ($p = 0.003$). 90 percent of the sample walked to get to the nearest health facility. 51 percent of these were from case households while 49 percent were control households. 6 percent used a vehicle to get to the nearest health centre – 61 percent of these were from control households and 39 percent from case households. 2 percent used a bicycle – 52 percent of these were from control households and 48 percent from case households. Another 2 percent used motorcycles – 65 percent of these were from control households and 35 percent from case households.

2.5.2 Health Insurance

Compared to households where less than half of the members have health coverage, health insurance is protective in homes where 50-100 percent of the members of the household have coverage. In such households, the risk of a child being stunted reduces by 26 percent.

Table 2.20: Is the Proportion of Household Members Covered by Health Insurance a Risk Factor for Stunting?

	Household with a stunted child		OR	95% CI	p
	N	%			
Proportion of household members covered by health insurance, grouped					
< 50% (n=1,086)	590	54.3	1		
50-100% (n=1,699)	797	46.9	0.74	[0.64-0.87]	0.000
Total (n=2,785)	**1387**	**49.8**			

2.5.3 Mother's Health Status and Micronutrient Intake

The questions in this section were directed to the mother of the child under 24 months. The questionnaire inquired about her pregnancy status, breastfeeding status, current supplement intake including vitamin A and iron supplementation, morbidity over the past 7 days, hospitalisation for illness, decision-making on healthcare and use of mosquito net. Intake of other supplements and decision-making on healthcare were significantly different between case and control households.

Q. Since the beginning of this year 2014, have you taken any other supplements?

In the interview, women were shown pictures of different supplements available at the health centres routinely given to women with micronutrient deficiencies and asked about current supplementation. There was no significant difference in the intake of Vitamin A and iron supplements between cases and controls.

There was a significant difference between the two groups for intake of other supplements (p = 0.043). 94 percent of women responded that they did not take other supplements – 51 percent of these were from control households and 49 percent from case households. Only 3 percent of the sample responded positively, and of these 54 percent were from case households and 46 percent were control households. The other 3 percent did not know if they had taken any other supplements – 64 percent of these were from case households and 36 percent were control households.

Q. When you are sick, where do you go first for treatment?

Seeking treatment behaviour was significantly different between cases and controls (p = 0.023). 97 percent of mothers would go the health centre doctor first; 50 percent of this group were from control households and 50 percent from case households. 1 percent of the sample would go to traditional doctors first; 64 percent of this group were control households and 36 percent were from case households. 2 percent of the

sample would seek treatment elsewhere; 67 percent of this group was from case households and 33 percent were control households.

Q. Who decides where you go to seek treatment?

Decision-making linked to health-seeking behaviour was significantly different in the two groups (p = 0.005). 80 percent of the respondents would make this decision themselves. 51 percent of these were case households and 49 percent from control households. 18 percent of the respondents depended on their spouse to make this decision; 57 percent of these were from control households and 43 percent were case controls. 2 percent of the respondents relied on other persons to make this decision; 58 percent of these were from case households while 42 percent were control households.

2.5.4 Birth Record of the Child

The questionnaire first sought to establish the identity of the respondent and their relationship to the child under 24 months. Questions relevant to the child included: actual birth date, if the child was a twin, gestational age at birth, birth weight, birth length, maternal perceptions on child birth weight, maternal parity, live births, living children, antenatal care, diet during pregnancy, birth health facility, maternal employment status, time away from child, breastfeeding at the workplace, and childcare when mother is away. There was a significant difference between cases and control for the following variables: twins, gestational age, birth weight, antenatal care, diet diversity during pregnancy, and maternal perceptions of child's birth weight.

Where available information about reference child was taken directly out of the child's health card.

Q. Is the child a twin?

This characteristic was significantly different between the two groups (p = 0.000). Of the 3 percent who answered yes, 79 percent were from case households and 21 percent from control households. Of the 97 percent who answered no, 51 percent were from control households and 49 percent were case households.

Twins: Compared to singletons, a child is 3.98 times more likely to be stunted when they are a twin (p = 0.000).

Q. At what gestational age was this child born?

Gestational age at birth was significantly different between cases and controls (p = 0.000). 2 percent of the sample indicated that the reference child was born between 6-8 months of pregnancy. Of this group, 72 percent were case households while 20 percent were control households. Of the 98 percent who responded 9 months, 51 percent were control households and 49 percent were case households.

Gestational age: Compared to children born at full term, children born between 6-8 months of pregnancy are 2.68 times more likely to be stunted when they are a twin (p = 0.000).

Q. What was the birth weight of the child?

Birth weight of reference child was significantly different between the two groups (p = 0.000). 10 percent of the sample did not know the birth weight of the reference child. 54 percent of this group was from case households and 46 percent were control households. 8 percent of the children were born at less than 2.5kg; 79 percent of these were cases while 21 percent were controls. 69 percent of the children were born at between 2.5 and 3.9 kg; 51 percent of these were controls and 49 percent were cases. 13 percent of the sample was born with 4+ kg; 65 percent of these were control and 35 percent were cases.

Birth weight: Compared to children born with between 2.5 – 4+ kg, children born with less than 2.5kg are 2.09 times more likely to be stunted when they are a twin (p = 0.000).

Q. If birth records were not available, how would you characterise the child's weight at birth?

Perception of child's weight was significantly different between the two groups (p = 0.000). 5 percent of the sample classified the child at birth as extremely bigger than other children (52% were controls and 48% were cases), 6 percent as somewhat bigger than other children (57% were control households and 43% were case households), and 38 percent as same size as other children (51% were control households and 49% as case households). 6 percent perceived the child as somewhat smaller than other children (58% of these were case households and 42% were control households). 3 percent perceived the child as extremely smaller than other children (78% of these were case households and 22% were control households). Of the 5 percent who did not know, 52 percent were from control households and 48 percent were case households.

Q. During the reference mother's pregnancy, did the mother attend antenatal care?

Antenatal care was significantly different between the two groups (p = 0.018). 95 percent of the mothers had antenatal care during pregnancy; of these 51 percent were control households and 49 percent were case households. Of the 4 percent who did not attend antenatal care, 62 percent were from case households and 38 percent were control households. Of the 1 percent who did not know, 55 percent were from case households and 45 percent were control households.

Antenatal care: Compared to mothers who did not attend antenatal care, children whose mothers did attend antenatal care are 42 percent less likely to have stunted growth (p = 0.005).

Q. During the reference child's pregnancy, did the mother eat a diverse diet?

Diet diversity during pregnancy was defined as regular consumption of at least 5 food groups. This indicator was significantly different between the two groups ($p = 0.000$). 63 percent of the sample responded yes – 54 percent of these were control households while 46 percent were case households. Of the 35 percent that responded no, 57 percent were from case households and 43 percent were control households. 2 percent of the respondents did not know – 55 percent of these were case households and 45 percent were control households.

Diverse maternal diets during pregnancy: Compared to mothers who did not have a diverse diet during pregnancy, children whose mothers had diverse diets during pregnancy are 36 percent less likely to have stunted growth ($p = 0.000$).

There is consensus that preventing malnutrition of children and women needs attention on the crucial 1,000-day window – from the start of a woman's pregnancy until her child's second birthday – that can have a life-changing impact on a child's future and help break the cycle of poverty. Although the programme can often seem to focus on children under 24 months, the data presented here suggests that the premier focus should be the pregnant mother and the antenatal period to ensure that she has good antenatal care and a diverse nutrient-dense diet during pregnancy both of which have an influence on birth weight and gestational age of the child, and are clear risk factors in the data presented.

Interestingly, being a twin is also a risk factor for stunting in children under 24 months. Given the data presented, it is indeed plausible because more often than not multiple birth pregnancy babies are pre-term and have lower birth weight relative to single birth pregnancies. In addition, it is plausible that less one-on-one time with the mother and a strain on limited family resources can contribute to stunting in twins. Postnatal maternal and child support should thus differentiate between mothers with single versus multiple births and give targeted support on infant feeding and care, including family support for the mother, for the prevention of stunting.

2.6 Water, Hygiene, and Sanitation (WASH)

Table 2.21: WASH – Comparison of Cases vs. Controls

Component	Water, Hygiene, and Sanitation
Questions in nutrition tool	Drinking water
	Mothers hand-washing knowledge and practice

2.6.1 Drinking Water

Questions on water included inquiry on the main source of drinking water for the household, the main alternative source of drinking water for the household, how long it takes to go to the main water source and come back home, who usually goes to fetch water for the household, and what the household normally does to water prior to drinking for use by the household and for use by children under 24 months. There was no significant difference between cases and controls for the main alternative source of drinking water for the household, how long it takes to go to the main water source and come back home, and who usually goes to fetch water for the household.

Q. What is the main source of water for members of your household?

The source of drinking water was significantly different between cases and controls ($p = 0.009$). Only 1 percent of the population had piped water in their dwelling units; 74 percent of these were control households and 26 percent were case households. 10 percent of the sample had water piped into their yard or plot – of these 54 percent were control households and 46 percent were case households. 4 percent of the households sampled sourced water from boreholes with pumps – 55 percent of these were control households and 45 percent were case households. 19 percent of the households got water from unprotected dug wells – 55 percent of these were control households and 45 percent were case households. 53 percent of the sample got drinking water from a public tap – of these 52 percent were case households and 48 percent were control households. 9 percent of the sample sourced water from a pond, river or stream – of these 54 percent were case households and 46 percent were control households. The rest of the sample (4%) had other sources for drinking water – 53 percent of this group was case households and 47 percent were control households.

Q. What does your household normally do to water prior to drinking?

There was a significant difference between the practices of the two groups ($p = 0.010$). 51 percent of the sample did not do anything to the water prior to drinking – 53 percent of this group were case households and 47 percent were control households. 40 percent of the sample boil water prior to drinking – 54 percent of this group were control households and 46 percent were case households. 7 percent of the sample add chlorine to water prior to drinking – of these 51 percent were control households and

49 percent were case households. 2 percent of the sample use a ceramic filter to treat their water prior to drinking – of these 52 percent were control households and 48 percent were case households. Only 11 households let water stand and settle before drinking – of these 64 percent were case households and 36 percent were control households. 18 households use other treatment percent; 67 percent of this group were case households and 33 percent were control households.

Q. How do you treat the water you give to the child to drink or use to mix his cold drinks?

There was a significant difference between the practices of the two groups ($p = 0.000$). 40 percent of the sample did not do anything to the water prior to use – 55 percent of this group were case households and 45 percent were control households. 55 percent of the sample boil water prior to use – 56 percent of this group were control households and 44 percent were case households. 1 percent of the sample use a cloth/fabric filter to treat their water prior to drinking – of these 60 percent were control households and 40 percent were case households. 3 percent of the sample add a chemical agent to water prior to use – of these 50 percent were case households and 50 percent were control households. 1 percent of the households use other treatment – 64 percent of this group were case households and 36 percent were control households.

Water: Compared to households whose main source of drinking water is piped water into their dwelling units, children in households that sourced their drinking water from public taps were 3.09 times more likely to be stunted, children in households that got their drinking water from ponds, rivers or streams were 3.34 times more likely to be stunted, while those that got their water from other sources such as unimproved or surface water were 3.17 times more likely to be stunted.

Treatment of water: Compared to households that have some form of water treatment prior to drinking water, children in households that do not treat their water before drinking were 1.31 times more likely to be stunted.

2.6.2 Sanitation

Questions on sanitation asked about the kind of toilet facility the household normally uses, where the facility is located, whether the facility is shared, and what happens to the stool of children 0-36 months when they do not use the toilet facility. Location of facility, sharing of facility, and what happens to the stool of children 0-36 months when they do not use the toilet facility were not significantly different between cases and controls.

Compared to households that have the flush to sewer/septic tank sanitation systems, children in households that have other unimproved or open defecation system were 2.81 times more likely to be stunted.

Table 2.22: Is Access to Water, Sanitation, and Hygiene a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
What is the main source of drinking water for members of your household?					
Piped water in dwelling (n=27)	7	25.9	1		
Piped into yard or plot (n=264)	122	46.2	2.45	[1.01-6.00]	0.049
Public tap (n=1,477)	767	51.9	3.09	[1.30-7.34]	0.011
Borehole with pump (n=121)	55	45.5	2.38	[0.94-6.05]	0.068
Unprotected dug well (n=541)	246	45.5	2.38	[0.99-5.73]	0.052
Pond, river or stream (n=243)	131	53.9	3.34	[1.36-8.19]	0.008
Other (n=114)	60	52.6	3.17	[1.25-8.09]	0.016
Total (n=2,787)	**1388**	**49.8**			
How long does it take to go to the main water source, and come back?					
Less than 60 minutes (n=2,607)	1287	49.4	1		
More than 60 minute (n=180)	101	56.1	1.31	[0.97-1.78]	0.081
Total (n=2,787)	**1388**	**49.8**			
What does your household normally do to water prior to drinking?					
Water treatment prior drinking (n=1,334)	618	46.3	1		
No water treatment prior drinking (n=1,453)	770	53	1.31	[1.13-1.52]	0.000
Total (n=2,787)	**1388**	**49.8**			
What kind of toilet facility does your household normally use?					
Flush to sewage system or septic tank (n=26)	8	30.8	1		
Pour flush latrine (water seal type) (n=138)	71	51.4	2.38	[0.97-5.85]	0.058
Improved pit latrine (VIP) (n=111)	45	40.5	1.53	[0.61-3.83]	0.359
Traditional pit latrine (n=2,379)	1197	50.3	2.28	[0.99-5.26]	0.054
No facilities or bush or field (n=61)	27	44.3	1.79	[0.67-4.73]	0.243
Other (n=72)	40	55.6	2.81	[1.08-7.30]	0.034
Total (n=2,787)	**1388**	**49.8**			
Is this facility located within your dwelling, or yard or compound?					
Yes (n=2,210)	1088	49.2	1		
No (n=520)	276	53.1	1.17	[0.96-1.41]	0.115
Total (n=2,730)	**1364**	**50**			
Do you share the toilet facility with other households?					
Yes (n=659)	333	50.5	1		
No (n=2,068)	1029	49.8	0.97	[0.81-1.16]	0.730
Total (n=2,727)	**1362**	**49.9**			

2.6.3 Mother's Hand-Washing Knowledge and Practice

The questionnaire probed the mother/caregiver of the child under 24 months to mention all occasions when it is important to wash hands. The questionnaire included 22 possible responses. In addition, the respondent was asked if they wash their hands after using the toilet, and what they use to wash their hands after using the toilet. The enumerator also asked to be shown where the household most often washed their hands. The enumerator then indicated if water was available, what type of container the water was in, what type of facilities were available for the wash water, if there was a cleaning agent, and what type of cleaning agent was observed. Hand-washing knowledge and practices were significantly different between case and control households.

Q. Please list all occasions when it is important for one to wash hands?

The respondent was asked this question and allowed to give as many answers as they could think of. Most of the responses were similar between case and control households. The following responses were significantly different:

a. **After blowing nose** (p = 0.005): 93 percent of the sample did not mention this response. Of the 7 percent that mentioned it 58 percent were control households and 42 percent were case households.
b. **After cleaning toilet or potty** (p =0.016): 64 percent of the sample did not mention this response. Of the 36 percent that did, 53 percent were from control households and 47 percent were case households.
c. **After collecting and disposing faecal matter** (p = 0.001): 57 percent of the sample did not mention this response. Of the 43 percent that did, 54 percent were control households and 46 percent were case households.
d. **After handling farm or domestic animals** (p = 0.049): 93 percent of the sample did not mention this response. Of the 7 percent that did, 57 percent were from control households and 43 percent were case households.
e. **After visiting a health facility** (p = 0.008): 96 percent of the sample did not mention this response. Of the 4 percent that did, 62 percent were from control households and 38 percent were case households.

Q. If you wash hands after using the toilet, what do you use to wash your hands?

Hand-washing practices were significantly different between the two groups (p = 0.001). 80 percent of the sample used washing soap and water – 52 percent of these were control households and 48 percent were case households. 19 percent of the sample used water only – 60 percent of this group were case households and 40 percent were control households. 1 percent of the sample used ash or homemade soap and water – 60% of this group were case households and 40% were control households.

Hand-washing practices: Compared to mothers who washed their hands frequently (more than 5 occasions per day), children of mothers who washed their hands less were 1.24 times more likely to be stunted. Compared to mothers who use soap and water to wash hands, children of mothers that did not use soap to wash hands after using the toilet were 1.49 times more likely to be stunted.

Table 2.23: Is Maternal Hand-washing Knowledge and Practice a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Number of occasions when it is important to wash hands					
5+ occasions (n=1,402)	662	47.2	1		
<5 occasions (n=1,353)	711	52.5	1.24	[1.07-1.44]	0.005
Total (n=2,755)	**1373**	**49.8**			
Do you wash hands after using the toilet?					
No (n=329)	169	51.4	1		
Yes (n=2,426)	1204	49.6	0.93	[0.74-1.17]	0.554
Total (n=2,755)	**1373**	**49.8**			
If you wash hands after using the toilet, do you use soap and water?					
With soap and water (n=1,929)	918	47.6	1		
No soap used (n=506)	291	57.5	1.49	[1.22-1.82]	0.000
Total (n=2,435)	**1209**	**49.7**			

The links between nutrition status, and WASH, have been increasingly promoted. Although it was initially understood that WASH interventions impact stunting by reducing diarrhoea in children, a new hypothesis is that a major cause of child stunting and anaemia that results from poor WASH is environmental enteropathy (EE).

EE is an asymptomatic condition of the small intestine caused by exposure to poor environmental sanitation, and is extremely common among people living in developing countries. EE causes much of the food ingested not to be absorbed. This is mainly attributed to bacterial infections and parasites that damage the small intestines and reduce their capacity to absorb nutrients. Furthermore, diarrhoea dehydrates and evacuates unabsorbed nutrients, while worms and other intestinal parasites steal the absorbed nutrients. To add to this predicament, the body continually produces antibodies to fight recurrent infections that diverts nutritional energy and proteins from growth to defence. Thus the current hypothesis is that children with EE use much of the nutrients they eat to fight these chronic low-grade infections, therefore using less nutrients from their diet for growing.

Although the role of WASH in preventing stunting in children is not well articulated and there are “blind spots” in our current understanding and available data, it is evident from the NMG data that there is a clear need for an integrated approach to improving nutrition that recognises that food and diet alone will not make a substantial dent in reducing the number of stunted children in Rwanda. This is evident in our data analysis, where the odds ratios linked to the WASH indicators are of a relatively higher magnitude compared to those linked to the food indicators alone.

From the data, it is clear that children in households that access their drinking water from a public tap, pond, river, or stream have a higher risk for stunting. It is surprising that public taps, which are considered an improved category of WASH, are associated with stunting. It is possible that the poor quality of the water containers (for both collection and storage) and lack of treatment of the collected water may pose this risk. In addition, although open defecation was not common, it is associated with stunting in children. Frequent hand washing, especially using soap and water to wash hands after visiting the toilet are important practices associated with reducing stunting in children.

There is plausibly enough evidence to support integration of WASH in all nutrition programming. The key opportunity is for the integration of social behaviour change communication, targeting, and monitoring and evaluation for WASH. To adequately impact stunting, we need a new paradigm of WASH within the first 1000 days programming. There is a need for evidence-based interventions that can lead to the development of an integrated package of interventions with the concept of ‘baby WASH’ as a key component of early childhood development and education programmes. Some key WASH research in Africa such as the SHINE (Sanitation, Hygiene, Infant Nutrition Efficacy) Project in Zimbabwe are at the forefront of establishing the link between child stunting and anaemia, and exposure to poor environmental sanitation.

2.7 Information

Table 2.24: Information – Comparison of Cases vs. Controls

Component	Information
Questions in nutrition tool	Awareness and access to nutrition information
	Awareness and access to enriched foods

2.7.1 Awareness and Access to Nutrition Information

The questionnaire investigated whether various household members had received any information on nutrition, diets, health or 'Ongera'; what the source of the information was, whether respondents had knowledge of community meetings that address nutrition and health, and how many times in a month they attended these meetings. The source of information and attendance to community meetings that address nutrition and health was not significantly different between case and control households.

Q. Have you personally received any information on nutrition, diet, and health?

The two groups were significantly different for this characteristic ($p = 0.04$). 71 percent of the sample responded NO – 51 percent of these were case households and 49 percent were control households. For those that responded YES (about 29%) – 54 percent were from case households while 46 percent were control households. Only 5 respondents said they did not know; 3 were from case households.

Q. Do you know of community meetings that address nutrition and health?

Knowledge of community meetings that address nutrition and health was significantly different between the two groups ($p = 0.007$). 81 percent of the sample responded NO to this question – 51 percent of these were case households and 49 percent were control households. For the 19 percent that responded YES to the question, 55 percent were control households and 45 percent were case households.

It should be noted that the percentage of case households that received information was higher than that of control households that received similar information. These data thus emphasise the fact that information receipt is not sufficient until it changes behaviour. This has implication then for the indicators and metrics used to monitor and evaluate nutrition education programmes and activities especially within the 1000 days programme. The indicators used should be outcome-oriented, for example not just how often and type of message conveyed to mothers but should also capture shifts in knowledge, attitudes, and most importantly practices. Regular and consistent follow-up on children with poor growth is key. Capacity building for community health workers in nutrition, and maternal and young child counselling is critical to ensure that these frontline workers can identify and further support mothers with at-risk children and whose behaviour is slow to change.

2.7.2 Awareness and Access to Enriched Foods

The questionnaire investigated if the respondent could correctly identify the official symbol for fortified food sold in Rwanda, and if the respondent had knowledge of fortified foods and bio-fortified foods. All variables were significantly different between case and control households.

Q. Can you please tell me what this symbol stands for?

For this question, the official symbol for fortified foods was shown to the respondents, and they were asked to state what the symbol stands for. There was a significant difference between the two groups based on their responses to this question ($p = 0.001$). 81 percent of the sample could not recognise the symbol. Of the 19 percent who could recognise the symbol, 61 percent were control households while 39 percent were case households.

Q. If you have received information on fortified foods, which foods do you know have been fortified?
Of the four foods asked, three had significant differences between the two groups: maize flour ($p = 0.048$), salt ($p = 0.010$), and vegetable oil ($p = 0.012$). Maize flour was mentioned by 38 percent of the respondents – 53 percent of these were control households and 47 percent were case households. Salt was mentioned by only 12 percent of the respondents – 57 percent of these were from control households and 43 percent were from case households. Vegetable oils and fat were mentioned by only 15 percent of the sample – 56 percent of these were control households and 44 percent were case households.

Q. Have you heard about bio-fortified foods?
The response to this question was significantly different between the two groups ($p = 0.002$). 41 percent of the sample had heard about bio-fortified foods, with 54 percent being control households and 46 percent being case households. 59 percent had not heard about bio-fortified food – 52 percent of these were case households while 48 percent were control households.

Information: Compared to households that had no information on nutrition and health, children in households that had information were 23 percent less likely to be stunted ($p = 0.007$).

2.8 Care

Table 2.25: Care – Comparison of Cases vs. Controls

Component	Care
Questions in nutrition tool	Child breastfeeding status and history
	Complementary feeding
	Child morbidity, immunization, and growth record

2.8.1 Child Breastfeeding Status and History

The variables of interest for breastfeeding were: how long after birth was the child first put to the breast, if the child was still breastfeeding, and how many times the child breastfed the previous day. If the child was not breastfeeding, at what age were they off the breast, and what were the reasons for taking the child off the breast. Mothers outside work and breastfeeding were also investigated. The main reason for taking the child off the breast and time away from child were significantly different between cases and controls. Figure 2.4 presents data for percentage of children breastfeeding. The data was collected in response to the question: Is the child still breastfeeding?

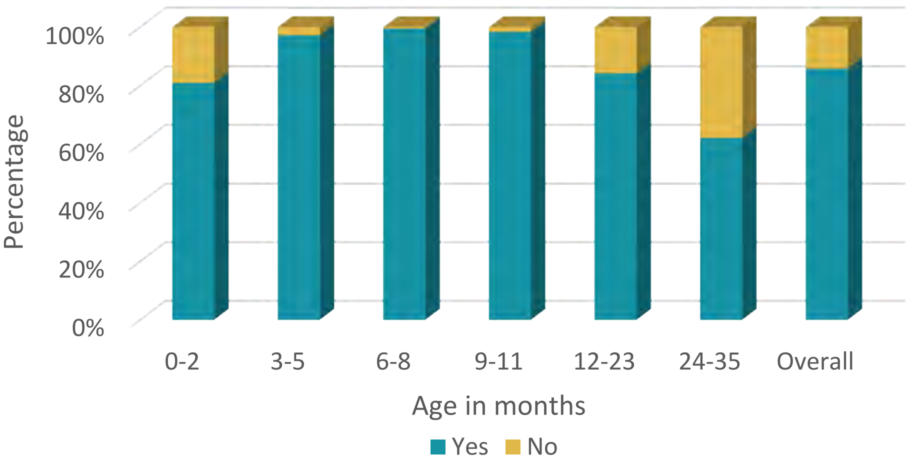

Figure 2.4: Percent of Breastfeeding Children

Breastfeeding is very common in Rwanda, which is in line with the WHO recommendations on breastfeeding. The recommendation for exclusive breastfeeding is that infants receive nothing but breast milk for the first six months of life. From the data in Figure 2.4, it is clear that there are challenges for breastfeeding in children 0-2 months as 19 percent of the survey sample were off the breast at the time the survey was conducted. For the other age groups, the percentage of children not breastfeeding is similar to that reported in the DHS data. Figure 2.5 presents the same data by study arm, that is, either case or control children. The proportion of children breastfeeding was similar between cases and controls.

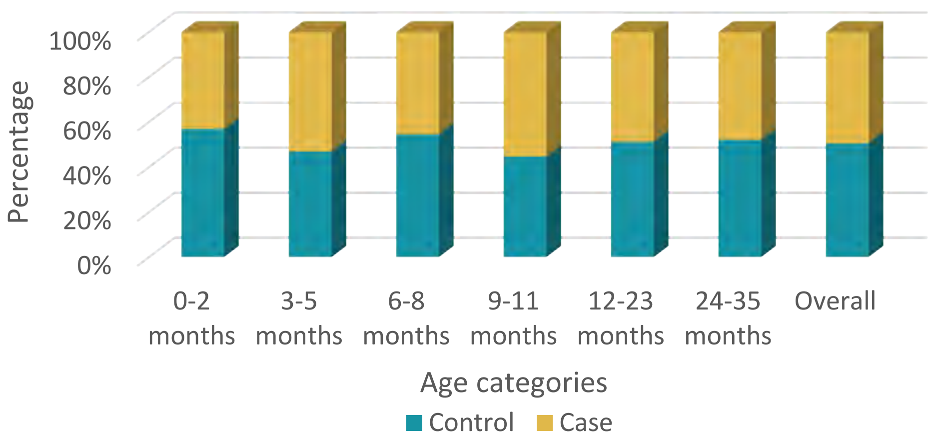

Figure 2.5: Proportion of Breastfeeding Children Controls vs Cases

Q. If child is not breastfeeding, what was the main reason for taking the child off breast milk?

14 percent of the sample indicated that the reference child was no longer breastfeeding. Although this was not significantly different between the two groups, the main reason for taking the child off breast milk was significantly different (p = 0.004). 45 percent of the sample said the child was taken off breast milk because the mother became pregnant – 58 percent of this group were from case households and 42 percent were control households. 19 percent reported that the child was old enough to be taken off breast milk – 68 percent of this group were from case households and 32 percent were from control households. 12 percent of the sample responded that the mother had been sick – 58 percent of these were from case households and 42 percent were control households. 6 percent of the sample said it was because the mother could not produce any more milk – 58 percent of this group were from case households and 42 percent were from control households. Another 6 percent said it was because the child refused breast milk – 63 percent of this group were from case households and 37 percent were from control households. Only 1 percent of the sample said it was because a doctor advised against breastfeeding – 80 percent of this group were case households and 20 percent from control households. 11 percent of the sample had other reasons as to why the child was taken off breast milk, for example that the mother left the child with a relative or the mother had an illness – 64 percent of these were case households and 36 percent were from control households.

Q. If yes, do you take the child with you when you go to work?

The previous question in the questionnaire had asked if the mother of the reference child worked outside or far away from home. 49 percent of the sample answered YES. There was a significant difference between the two groups on whether the mother goes with the child when she leaves for work (p = 0.043). 60 percent of the respondents said YES – 50 percent in each of the two groups. About 40 percent said NO – 53 percent of these were control households and 47 percent were case households.

Q. How long are you from your child during the work day?

Number of hours spent away from the child was significantly different between cases and controls (p = 0.000). 47 percent of the respondents indicated that they were away from their children for less than 3 hours – 60 percent were control households and 40 percent were case households. 21 percent indicated that they were gone for 3-6 hours – 58 percent were case households and 42 percent were from control households. 32 percent of the respondents said they were away for more than 6 hours – 53 percent of these were case households and 47 percent were control households.

Time away from reference child: Compared to children whose mothers were away for 3 hours or less, children whose mothers were gone for more than 3 hours are 1.79 times more likely to be stunted (p = 0.000).

Q. When you are away from home, who is the reference child left with?
Childcare in the absence of the mother was significantly different between the two groups (p = 0.035). In 21 percent of the sample, the father would take care of the child in the absence of the mother – 51 percent of these were case households and 49 percent were control households. In 17 percent of the sample, the grandmother remained in charge – 51 percent of these were control households and 49 percent were case households. In only 12 households did the grandfather provide care – 75 percent of these were case households and 25 percent were control households. In 18 percent of the sample, a female adult sibling provided care – 55 percent of these were case households and 45 percent were control households. In only 134 households was a male adult sibling left to provide care – 54 percent of these households were case households and 46 percent were control households. In 5 percent of the sample, a female child sibling was left to care for the child – 53 percent of these were control households and 47 percent were case households. In 1 percent of the sample, a male child sibling was left to care for the child – 57percent of these were control households and 43 percent were case households. In another 4 percent of the sample, another female adult relative provided childcare – 53 percent of these were control households and 47 percent were case households. In only 1 percent of the households did another male adult relative provide childcare – 53 percent of these were case households and 47 percent were control households. Only 5 households had another female child relative provide childcare – 80 percent were control households and 20 percent were case households. 1 percent of the households had another male child relative provide care in the absence of the mother – 57 percent of these were control households and 43 percent were case households. 3 percent of the sample had a female adult non-relative care for the child – 66 percent were case households and 34 percent were control households. Only 5 households had a male adult non-relative care for the child – 80 percent were case households and 20 percent were control households. 5 percent of the sample left the child with a neighbour – 57 percent were control households and 43 percent were case households. 15 percent of the sample had other persons take care of child – split evenly between the two groups.

2.8.2 Complementary Feeding

Questions on complementary feeding sought to find out at what age complementary feeding was initiated, foods that are important to give to children 6-23 months, foods that are taboo to give to children 6-23 months, porridge given to children 6-23 months, additives used to enrich the porridge, number of meals offered to the reference child, and feeding practices of the mother when the child refuses to eat. The following variables were significantly different between cases and controls: list of all foods which mothers think are important to give a child who is 6-23 months, type of flour usually used to prepare child's porridge, and other ingredients usually added to the child's porridge.

Q. List all foods which you think are important to give a child who is 6-23 months.

Food group	Food item	p-value
Formula and porridges	Commercial infant formula	0.046
Vegetables	Green leaves	0.034
Roots, tubers, bananas	Orange-fleshed sweet potatoes	0.038
	Bananas	0.001
Animal protein	Cow milk	0.003

The above list of foods was significantly different between the two groups as indicated above.
Commercial infant formula: Only 1 percent of the sample mentioned this product. 67 percent of these were control households and 33 percent of these were case households.

Green vegetables: 48 percent of the respondents mentioned this food. 52 percent of this group were from control households and 48 percent were case households.
Orange-fleshed sweet potatoes: Only 1 percent of the sample mentioned this food. 67 percent of these were control households and 33 percent were case households.
Banana (igitoki – green bananas for cooking): 13 percent of the respondents mentioned this food. 58 percent of these were from control households and 42 percent were case households.

Cow milk: 24 percent of the sample mentioned cow milk. 55 percent were from control households. Of the 76 percent that did not mention it, 51 percent were from case households and 49 percent were control households.

Using the example of banana (igitoki), it is important to note that foods that are appropriate for complementary feeding of children and widely available are seldom mentioned as important to give a child who is 6-23 months. This may highlight the need for better sensitisation of mothers and caregivers on locally available appropriate foods for complementary feeding.

Q. Please list the type of flour you usually use to prepare child's porridge.

Additive	p-value
Cow milk	0.014
Bean flour	0.036
Fish powder	0.017
Vegetable oil	0.042

The previous question had inquired if the mother prepares porridge for the reference child. 81 percent of the respondents said YES. This was not significantly different between the groups, but the next question in the questionnaire was for Sosoma flour ($p = 0.022$); 13 percent of the sample said they use Sosoma flour to prepare porridge for the child – 57 percent of these were from control households and 43 percent were case households.

Q. Please list other ingredients that you usually add to the child's porridge.

Only 4 out of 12 additives were significantly different between the two groups as shown above. 17 percent of the respondents mentioned cow milk; of these 57 percent were from control households. Only 1 percent of the respondents mentioned bean flour; of these 65 percent were from case households. Only 9 respondents mentioned fish powder – 89 percent were from case households. Only four respondents mentioned vegetable oil, and all were from case households.

2.8.3 Child Morbidity

The questionnaire sought to inquire of the child's morbidity since birth, morbidity over the last 7 days prior to the survey, deworming, intake of antimalarial medication, intake of iron supplements, child hospitalisation, visits by community health worker, use of mosquito net, and immunization record. History of child morbidity since birth was significantly different between cases and controls.

Q. Since birth, how many times has the child suffered from fever?

This characteristic was significantly different between the two groups ($p = 0.041$). 31 percent of the households said not at all – 51 percent were case households and 49 percent were control households. 50 percent of the sample said 1-5 times – 53 percent of these were control households and 47 percent of these were case households. 12 percent of the sample said 5-10 times – 50 percent were case households and 50 percent were control households. 4 percent of the sample said 11-20 times; 60 percent were case households and 40 percent were control households. 3 percent of the sample said more than 20 times; 51 percent were cases and 49 percent were control households.

Morbidity: Frequent incidences of illness such as fever and diarrhoea are a risk factor for stunting. Frequent fever increases likelihood of stunting in children by 1.57 times. On the other hand, children with frequent episodes of diarrhoea are 1.50 times more likely to be stunted.

Table 2.26: Is Child Morbidity History a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Since birth, number of times the child has suffered from fever					
1-10 times (n=2,519)	1237	49.1	1		
11+ times (n=171)	103	60.2	1.57	[1.14-2.15]	0.005
Total (n=2,690)	**1340**	**49.8**			
Since birth, number of times the child has suffered from diarrhoea					
1-10 times (n=2,463)	1207	49	1		
11+ times (n=232)	137	59.1	1.5	[1.14-1.97]	0.004
Total (n=2,695)	**1344**	**49.9**			

2.8.4 Child Growth Record

Child growth charts are a visible display of a child's physical growth and development. While for most children growth falls within normal percentile ranges on standard growth curves, some children deviate from their previously established growth curve indicated by a drop in the growth curve. Abnormal growth in the child growth chart is colour-coded for severity as follows: yellow for moderate severity, and red for very severe.

75 percent of records reviewed did not have a child period in either red or yellow or where the curve dropped. 21 percent of the households had missing records. For households that had records, the data collected was significantly different between the groups (p = 0.000). 4 percent of the sample had records with a period when the curve was dropping – 53 percent of these were case households and 47 percent were control households. Another 4 percent had records with a period in yellow – 74 percent of these were case households and 26 percent were control households. Of the other 4 percent that had records with a period in red, 71 percent were case households and 29 percent were control households.

Growth Monitoring

Abnormal growth in children is a risk factor for stunting and a good predictor for stunted growth. Compared to children with normal growth, children whose records indicate a drop in the growth curve are 2.10 times more likely to be stunted. Those that have a growth period in yellow are

3.17 times more likely to be stunted. And those with a growth period in red are 2.64 times more likely to have stunted growth.

Table 2.27: Is Abnormal Growth Associated with Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Was there a period in red?					
No (n=2,098)	1016	48.4	1		
Yes (n=94)	67	71.3	2.64	[1.68-4.165]	0.000
Total (n=2,192)	**1083**	**49.4**			
Was there a period in yellow?					
No (n=2,041)	977	47.9	1		
Yes (n=125)	93	74.4	3.17	[2.10-4.77]	0.000
Total (n=2,166)	**1070**	**49.4**			
Was there a period when the curve was dropping?					
No (n=2,026)	974	48.1	1		
Yes (n=112)	74	66.1	2.1	[1.41-3.14]	0.000
Total (n=2,138)	**1048**	**49**			

Care practices such as breastfeeding, appropriate complementary feeding, as well as health-seeking behaviours support good nutrition. Poor practices can lead to poor dietary intake and increased infection, both of which are underlying causes of undernutrition.

Not surprising, a key association was identified between child morbidity and stunting. Frequent episodes of diarrhoea and fever are significant risk factors for stunting in children. In addition, growth-monitoring data are accurately linked and associated with stunting, as any deviations from the norm are significant risk factors for stunting.

We recommend that a formative review be conducted on UNICEF's Knowledge, Attitude and Practices study to evaluate the actual practices of caregivers and inform a stronger childcare education programme. There is also a need to further reinforce the national health system support to CHWs who are frontline agents for improved maternal and child health. The capacity of CHWs should be additionally enhanced so that their efforts better support appropriate care and healthcare-seeking behaviour in the community as well as better align with maternal and child health extension including growth monitoring carried out by community health services and centres.

2.9 Food

Table 2.28: Food – Comparison of Cases vs. Controls

Component	Food
Questions in nutrition tool	Bean consumption
	Household staples
	Famine and famine foods
	Food insufficiency and coping strategies
	Food consumption and diet diversity score
	Household food consumption and food source – previous 7 days
	Diet diversity of child
	24-hour dietary recall for mother and child

2.9.1 Bean Consumption

The Rwanda Comprehensive Food Security and Vulnerability Analysis (CFSVA) and Nutrition survey of 2012 implied an association between beans consumption in children and childhood stunting. The NMG questionnaire thus sought to clarify this matter by asking questions related to the access, preparation, utilization and consumption of beans in the context of other staple foods. The following variables were significantly different between case and control households: number of days in a week beans consumed in the household, main source of beans consumed by the household, rating of the number of times beans are consumed in the household, other parts of the bean consumed by the household, and the main food staples other than beans consumed by the household.

Q. On average, how many days in a week are beans consumed in this household?

Beans are a staple food in Rwanda, and a mainstay of the Rwandan diet. In the CFSVA 2012 report, bean consumption was significantly associated with stunting in children 12-23 months old hence the inclusion of questions about beans in the NMG Survey. 97 percent of the sample indicated that beans are consumed in their household, and this characteristic was not significantly different between cases and controls. However, the number of times beans were consumed in the households was significantly different ($p = 0.017$). 36 percent of the respondents said 7 days a week – 54 percent of these were control households and 46 percent were case households. 18 percent indicated 3 days per week

– 52 percent of these were case households and 48 percent were control households. 12 percent indicated 2 days a week – 54 percent of these were case households and 46 percent were control households. 10 percent of the respondents indicated 5 days a week – 51 percent were from control households and 49 percent were case households. 9 percent of the respondents said 4 days per week – of these 52 percent were control households, 48 percent were case households. 6 percent of the responses indicated 1 day a week – 60 percent of these were from case households, 40 percent were control households. 5 percent of responses indicated 5 days per week – 51 percent were control households, 49 percent were case households. Only 3 respondents said they did not know and all were from case households.

Q. What is the main source of beans consumed by this household?

The source of beans consumed was significantly different between the two groups (p = 0.015). 68 percent of the respondents said markets (cash) purchase – 51 percent of these were case households and 49 percent were control households. 30 percent of the responses were own production; 54 percent of these were control households, 46 percent were case households. Of the 8 households that said gathering, 6 were case households and 2 were control households. 13 respondents said borrowing – 7 were case households and 6 were control households. 10 responded as labour for food exchange – all were case households. 2 households said gift from family and friends – 1 from each group. 1 control household said food aid, and 8 households said other sources – 4 in each group.

Q. How do you rate the number of times beans are consumed in your household?

Rating of consumption	p-value
By self	0.000
By adults in household	0.000
By children below 5 years	0.000
By reference child	0.000

The rating of number of times beans are consumed in the household was significantly different between the two groups as shown above (p = 0.000)

a. Consumption rating by self: 45 percent of the respondents said just enough – 55 percent of these were control households and 45 percent were case households. 54 percent of the respondents said less than desired – 54 percent of these were case households and 46 percent were control households. Only 12 respondents said more than desired – 6 in each group.

b. Consumption rating by adults in household: 45 percent of the respondents said just enough – 55 percent of these were control households, 45 percent were case households. 54 percent of the respondents said less than desired – 54 percent of these were case households, 46 percent were control households. Only 5 respondents said more than desired – 3 in the control households and 2 in case households.

c. Consumption rating by children below 5 years: 44 percent of the respondents said just enough – 55 percent of these were control households, 45 percent were case households. 55 percent of the respondents said less than desired – 54 percent of these were case households, 46 percent were control households. About 1 percent of respondents said more than desired – 64 percent were from control households and 36 percent were from case households.

d. Consumption rating by reference child: 44 percent of the respondents said just enough – 54 percent of these were control households and 46 percent were from case households. 55 percent of the respondents said less than desired – 54 percent of these were case households and 46 percent were from control households. About 1 percent of the respondents said more than desired – 69 percent were from control households and 31 percent from case households.

Q. Apart from the seed, what other part of the bean do members of your household consume?

Bean part	p-value
leaves	0.001
pods	0.014

a. Leaves: 68 percent of the respondents said they consumed bean leaves. Of these, 52 percent were from case households and 48 percent were from control households.

b. Pods: 52 percent of the respondents said they consumed bean pods. Of these, 53 percent were from control households and 47 percent were from case households.

2.9.2 Household Staples

Q. Other than beans, please tell me the main food staples consumed by this household.

Food group	p-value
pulses	0.000
cereals	0.022

Roots and tubers and leafy vegetables were not significantly different between the two groups, but pulses and cereals were.
a. Pulses: 81 percent of the sample mentioned pulses – 52 percent of these were control households, 48 percent were from case households.
b. Cereals: 90 percent of the sample mentioned cereals – 51 percent of these were control households, 49 percent were from case households.

2.9.3 Famine or Shortage of Food

Although the questionnaire asked about famine or food shortages, it is clear from the data that food shortage rather than famine was more of a concern for the surveyed households. The questions also focused on the months when food shortage was a concern, what foods were consumed when there was a shortage of food, and where these foods were sourced. The following variables were significantly different between case and control households: experience of shortage of food ever, experience of shortage of food in the last 12 months prior to the survey, and specific months when shortage of food was a concern.

Q. Has your household ever experienced famine or shortage of food?

Experience of famine or shortage of food was significantly different between the two groups ($p = 0.006$), with 60 percent of the samples indicating that they had experienced shortage of food. 52 percent of these were case households, 48 percent were control households. Of those who had not experienced shortage of food, 54 percent were control households and 46 percent were case households.

Q. Did your household experience famine or a lack of enough food in the last 12 months (October 2013 to September 2014)?

Experience of a lack of enough food in the last 12 months was significantly different between the two groups ($p = 0.025$). Of those households that had experienced shortage of food, 91 percent indicated that they had experienced a lack of food in the past 12 months (between October 2013 and September 2014). 53 percent of these were case households and 47 percent were control households.

Q. Which months did you experience famine or food shortage (between October 2013 and September 2014)?

Four months stood out in which there was a significant difference between the two groups: December 2013: 16 percent of the respondents reported experiencing food shortages – 61 percent of these were from case households and 39 percent were control households ($p = 0.009$). January 2014: 15 percent of the respondents reported experiencing a lack of food – 63 percent of these were from case households and 37 percent were control households ($p = 0.001$). February 2014: 17 percent of the respondents reported experiencing a shortage of food – 61 percent of these were from case households and 39 percent were control households ($p = 0.008$); and in March 2014: 23 percent of the respondents reported experiencing food shortage – 59 percent of these were from case households and 41 percent were control households (p = 0.013).

2.9.4 Food Insufficiency and Coping Strategies

Food insufficiency, its causes and coping strategies over the last 30 days prior to the survey were assessed. These variables were significantly different between case and control households.

Q. In the past 30 days, was there any day or days when food was not sufficient for your household consumption?

Food insufficiency was significantly different between the two groups (p = 0.000). 48 percent of the sample responded that they had experienced food shortages in the past 30 days prior to the survey. Of this group, 54 percent were case households and 46 percent were control households.

Q. What do you think were the causes for the food shortage?

Limited production (p = 0.026) and sale of food stocks (p = 0.011) were the only two out of five causes for food shortage that were significantly different between the two groups. 56 percent of the respondents cited limited production – of these 51 percent were from case households and 49 percent were control households. 3 percent of the respondents cited sale of food stocks as cause of food insufficiency – of these 73 percent were case households and 27 percent were control households.

Q. In the past 30 days, did you ever worry that your household would not have enough to eat?

Concern about food/a lack of food was significantly different between the two groups (p = 0.000). 48 percent of the respondents worried that their household would not have enough to eat. 54 percent of these were case households, 46 percent were control households.

Q. In the past 30 days, did you ever worry that your children below 24 months would not have enough to eat?

Concern about food/a lack of food for children under 2 years of age was significantly different between the two groups (p = 0.000). 42 percent of the respondents did worry about this, and 55 percent of these were case households while 45 percent were control households.

Short-term Coping Strategies

Q. In the past 30 days, as a result of not having sufficient food, did your household resort to any of the following strategies?

Of the 7 strategies listed in the questionnaire, 6 were significantly different between the two groups.

Coping strategy	p-value: Reliance	p-value: Frequency
Reliance on less preferred or inexpensive foods	0.009	Not significant
Reduced the variety of food consumed	0.012	Not significant
Reduce the portion size served at meal times	0.004	0.001
Reduce the number of meals consumed per day	0.000	0.004
Borrow food or rely on friends and relatives for food	0.022	0.034
Spend an entire day without eating food	0.005	0.000

a. Reliance on less preferred or inexpensive foods: 45 percent of the sample indicated that they had relied on less preferred or inexpensive foods to cope with food insufficiency. 77 percent of these had used this strategy for the whole household (55% of these were case households, 45% were control households); 21 percent had used the strategy for adults only (52% were case households, 48% were control households); and only 1 percent had used it for children under 24 months only (59% were case households, 41% were control households).

b. Reduced the variety of food consumed: 47 percent of the sample reduced the variety of food consumed to cope with shortage of food. 75 percent of this group reduced the variety of food for the whole household (54% of these were from case households, 46% were control households), 22 percent reduced the variety of food for adults only (53% were control households, 47% were case households), and 3 percent reduced the variety of food for children under 24 months only (60% were from case households, 40% were control households).

c. Reduced the portion size served at meals: 46 percent of the sample reduced the portion size served at meals to cope with shortage of food. 67 percent of this group reduced the variety of food for the whole household (55% of these were from case households, 45% were from control households), 32 percent reduced the variety of food for adults only (50% were control households, 50% were case households), and 1 percent reduced the variety of food for children under 24 months only (68% were from case households, 32% were control households).

The number of days that this strategy was employed was also significant between the two groups. 31 percent of the respondents reduced the portion size served at meals for more than 20 days out of the 30 days (58% of these were case households, 42% were control households). 19 percent applied this strategy for 10-20 days (55% were case households, 45% were control households). 32 percent used this strategy for 4-10 days (52% were case households, 48% were control households). And 18 percent of the group employed the strategy for 1-3 days (53% were control households, 47% were case households).

d. Reduced the number of meals consumed per day: 39 percent of the sample reduced the number of meals consumed per day to cope with shortage of food. 53 percent of this group reduced the number of meals consumed per day for the whole household (56% were from case households, 44% were control households), 45 percent reduced the number of meals consumed per day by adults only (50% were control households, 50% were case households), and 2 percent reduced the number of meals consumed per day by children under 24 months only (75% were from case households, 25% were control households).

The number of days that this strategy was employed was also significant between the two groups. 25 percent of the respondents reduced the number of meals consumed per day all the time in those 30 days (57% of these were case households, 43% were control households). 19 percent applied this strategy most of the time (55% were case households, 45% were control households). 34 percent used this strategy for many days (56% were case households, 44% were control households). And 22 percent of the group employed the strategy for 1-3 days (47% were case households, 53% were control households).

e. Borrow food or rely on friends and family for food: 17 percent of the sample borrowed food or relied on friends and family for food to cope with shortage of food. 64 percent of this group borrowed food or relied on friends and family for food to feed the whole household (57% of this group were from case households, 43% were from control households), 30 percent borrowed food or relied on friends and family for food to feed adults only (58% were case households, 42% were control households), and 6 percent borrowed food or relied on friends and family for food to feed children under 24 months only (52% were from control households, 48% were from case households).

The number of days that this strategy was employed was also significant between the two groups. 19 percent of the respondents borrowed food or relied on friends and family for food all the time in those 30 days (53% of these were case households, 47% were from control households). 12 percent applied this strategy most of the time (59% were case households, 41% were control households). 28 percent used this strategy for many days (58% were case households, 42% were control households). And 41 percent of the group employed the strategy for a few days (41% were control households while 59% were case households).

f. Spend an entire day without eating food: 14 percent of the sample would spend an entire day without eating food to cope with shortage of food during the last 30 days prior to the survey. For 42 percent of this group the whole household would spend an entire day without eating food to cope with shortage of food (60% of this group were from case households, 40% were control households), for 53 percent of the group only adults in the household would spend an entire day without eating food to cope with a lack of food (58% were case households, 42% were case households), and in 5 percent of the group only children under 24 months would spend an entire day without eating food to cope with lack of food (63% of these were from control households, 37% were case households).

Distress Coping Strategies

Other coping strategy	p-value: Reliance
Purchased food on credit or borrowed food	0.009
Begged for food	0.012

Q. In the past 30 days, as a result of not having sufficient food, did your household resort to any of the following strategies?
Of the 14 strategies listed in the questionnaire, only 2 were significantly different between the two groups.

a. Purchased food on credit or borrowed food: 35 percent of the sample indicated that they had purchased food on credit or borrowed food to cope with food insufficiency (52% of these were from case households, 48% were control households).

b. Begged for food: 5 percent of the sample indicated that they had begged for food to cope with food insufficiency (60% of these were from case households, 40% were control households).

Coping strategies: Coping strategies are associated with stunting among children under 24 months. Compared to food-sufficient households, children in households that lacked food and had to resort to borrowing money to buy foods were 1.21 times more likely to be stunted. Also children in households that had to beg for food due to a lack of food were 1.52 times more likely to be stunted.

Table 2.29: Is Type of Household Coping Strategy a Risk Factors for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Borrowed money to buy food					
No (n=2,068)	1005	48.6	1		
Yes (n=678)	362	53.4	1.21	[1.02–1.44]	0.03
Begged for food					
No (n=2,603)	1282	49.3	1		
Yes (n=146)	87	59.6	1.52	[1.08–2.13]	0.016

2.9.5 Food Consumption Score

The Food Consumption Score (FCS) is a composite score based on dietary diversity, food frequency, and the relative nutritional importance of different food groups. FCS is calculated using the frequency of consumption of different food groups consumed by a household during the seven days before the survey. Scores are clustered into three groups; the results of the analysis categorise each household as having poor food consumption (score = 0-21), borderline food consumption (score = 21.5-35), or acceptable food consumption (score = 35). The FCS was significantly different between the two groups (p = 0.001). 18 percent of the sample had poor food consumption – 52 percent of these were case households, 48 percent were control households. 36 percent of the sample had borderline food consumption (54% were case households, 46% were control households), and 46 percent had acceptable food consumption (54% were control households, 46% were case households).

Household food consumption score: An acceptable food consumption score has a protective effect against stunting. Compared to households with a poor food consumption score, children in households that have acceptable food consumption scores are 23 percent less likely to be stunted.

Table 2.30: Is Household Food Consumption Score a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Food consumption score					
Poor (n=480)	250	52.1	1		
Borderline (n=956)	511	53.5	1.06	[0.85-1.32]	0.624
Acceptable (n=1,190)	543	45.6	0.77	[0.62-0.95]	0.017
Total (n=2,626)	**1304**	**49.7**			

2.9.6 Diet Diversity Score

The Household Diet Diversity Score (HDDS) provides an approach to measuring household dietary diversity as a proxy measure of household food access. To better reflect a quality diet, the number of different food groups consumed is calculated rather than the number of different foods consumed. The HDDS is often used as a proxy measure of the socioeconomic status of the household. The data collected with the dietary diversity questionnaire can be analysed in several ways. A dietary diversity score can be created, which is the sum of the different food groups consumed. In this case, the HDDS was summarised into three groups – poor diversity (1-4 food groups consumed), medium diversity (5-6 food groups consumed), and good diet diversity (7 food groups consumed). The HDDS was significantly different between the two groups (p = 0.000). 69 percent of the sample had low diet diversity (53% of these were case households, 47% were control households). 25 percent of the sample had medium diet diversity (53% were control households, 47% were case households), and 6 percent of the sample had good diet diversity (68% of these were control households, 32% were case households).

2.9.7 Household Food Consumption and Food Source – Previous 7 Days

Q. How many days of the previous 7 days did members of your household consume the following food items and what was their source?

Food item	p-value:	p-value:
	Number of days consumed	Source
Cereal and grains	0.002	Not significant
Legumes and nuts	0.025	Not significant
Coloured vegetables	0.003	0.036
Green leafy vegetables	Not significant	0.008
Other vegetables	0.000	Not significant
Orange fruits	0.004	Not significant
Other fruits	0.033	Not significant
Meats	0.017	Not significant
Fish or shell fish	0.004	Not significant
Eggs	0.000	Not significant
Milk and other dairy products	0.000	Not significant
Oils and fats	0.003	0.019
Sugar or sweets	0.000	Not significant

a. Cereals and grains: the number of days the households ate cereals and grains was significantly different between cases and controls. 14 percent of the sample had cereals and grains 6-7 days in the week – 57 percent were control households, 43 percent were case households. 56 percent of the sample had cereals and grains 1-5 days in the week – split evenly between the two groups. 30 percent of the sample did not have cereals or grains the week previous to the survey – 54 percent were from case households, 46 percent were control households.

b. Legumes and nuts: the number of days the households consumed legumes and nuts was significantly different between cases and controls. 42 percent of the sample had this food group for 6-7 days in the week, split evenly between the two groups. 55 percent of the sample ate legumes and nuts 1-5 days in the week – 51 percent were from control households, 49 percent were case households. 3 percent of the sample did not have this food group the week previous to the survey – 59 percent were from case households, 41 percent were from control households.

c. Coloured vegetables: the number of days the households consumed vitamin A rich vegetables, and the source of those vegetables, were significantly different between cases and controls. 4 percent of the sample had this food group for 6-7 days in the week – 63 percent were from control households, 37 percent were from case households. 23 percent of the sample ate vitamin A rich vegetables 1-5 days in the week – 53 percent were from control households, 47 percent were from case households. 73 percent of the sample did not have this food group the week previous to the survey – 51 percent were from case households, 49 percent were from control households.

Regarding the source of coloured vegetables, 79 percent of the sample made cash purchases at the market – 57 percent of these were control households, 43 percent were from case households. 16 percent consumed their own production – 50 percent of these were from both groups. For the other 5 percent of the sample, 3 households borrowed vegetables – all were case households; 6 households exchanged labour for food – 4 control and 2 case households; and 4 households received the vegetables as a gift – 3 were case households and 1 was a control household. 1 family received food aid – a control household.

d. Green leafy vegetables: Although the number of days the households consumed green leafy vegetables was not significantly different between cases and controls, the source of the vegetables was. 37 percent of the sample made cash purchases at the market – 52 percent of these were control households, 48 percent were case households. 48 percent consumed their own production – 50 percent of these were from both groups. 13 percent sourced the vegetables through gathering – 55 percent were case households, 45 percent were control households. For the other 2 percent of the sample, 3 households borrowed vegetables – all were case households. 7 households exchanged labour for food – all were case households. 30 households received the vegetables as a gift – 53 percent were case households, 47 percent were control households. 4 families received food aid – all were case households.

e. Other vegetables: the number of days the households ate other vegetables was significantly different between cases and controls. 15 percent of the sample consumed other vegetables 6-7 days in the week – 60 percent of these were control households, 40 percent were case households. 40 percent of the sample had other vegetables 1-5 days in the week – 51 percent were case households, 49 percent were control households. 45 percent of the sample did not have other vegetables the week previous to the survey – 52 percent were from case households, 48 percent were from control households.

f. Orange fruits: the number of days the households ate orange fruits was significantly different between cases and controls. 1 percent of the sample consumed vitamin A-rich fruits 6-7 days in the week – 55 percent of these were control households, 45 percent were case households. 11 percent of the sample had other vegetables 1-5 days in the week – 59 percent were control households, 41 percent were case households. 82 percent of the sample did not have orange fruits the week previous to the survey – 51 percent were from case households, 49 percent were control households.

g. Other fruits: the number of days the households ate other fruits was significantly different between cases and controls. 2 percent of the sample consumed other fruits 6-7 days in the week – 52 percent of these were case households, 48 percent were control households. 24 percent of the sample had other fruits 1-5 days in the week – 54 percent were control households, 46 percent were case households. 74 percent of the sample did not have orange fruits the week previous to the survey – 51 percent were from case households, 49 percent were control households.

h. Meats: the number of days the households ate meat was significantly different between cases and controls. Only 7 households consumed meat 6-7 days in the week – 57 percent of these were control households, 43 percent were case households. 12 percent of the sample had meat 1-5 days in the week – 58 percent were control households, 42 percent were case households. 88 percent of the sample did not have meat the week previous to the survey – 51 percent were from case households, 49 percent were control households.

i. Fish or shellfish: the number of days the households ate fish was significantly different between cases and controls. Only 7 households consumed fish 6-7 days in the week – 57 percent of these were case households, 43 percent were control households. 8 percent of the sample had fish 1-5 days in the week – 61 percent were control households, 39 percent were case households. 91 percent of the sample did not have fish the week previous to the survey – 51 percent were from case households, 49 percent were control households.

j. Eggs: the number of days the households ate eggs was significantly different between cases and controls. Only 9 households consumed eggs 6-7 days in the week – 78 percent of these were control households, 22 percent were case households. 6 percent of the sample had eggs 1-5 days in the week – 66 percent were control households, 34 percent were case households. 93 percent of the sample did not have eggs the week previous to the survey – 51 percent were from case households, 49 percent were from control households.

k. Milk and dairy products: the number of days the households had milk and dairy products was significantly different between cases and controls.

Only 7 percent of households consumed milk and dairy products 6-7 days in the week – 69 percent of these were control households, 31 percent were case households. 12 percent of the sample had milk and dairy products 1-5 days in the week – 55 percent were control households, 45 percent were case households. 81 percent of the sample did not have milk and dairy products the week previous to the survey – 52 percent were from case households, 48 percent were control households.

l. Oils and fat: the number of days the households consumed oils and fat, and the source of those oils and fat were significantly different between cases and controls. 28 percent of the sample had this food group for 6-7 days in the week – 56 percent were from control households, 44 percent were from case households. 31 percent of the sample consumed oils and fat 1-5 days in the week – 49 percent were from control households, 51 percent were from case households. 41 percent of the sample did not have this food group the week previous to the survey – 52 percent were from case households, 48 percent were from control households.

As for the source of oils and fat, 99 percent of the sample made cash purchases at the market – 52 percent of these were control households, 48 percent were from case households. For the other 1 percent, 13 households had oils and fat from their own production – 92 percent of these were from control households, 8 percent were from case households. 2 households exchanged labour for food – 1 control and 1 case household. 2 households received the oil and fats as a gift – these were case households. 1 family received food aid – a case household.

m. Sugar or sweets: the number of days that households had sugars or sweets was significantly different between the two groups. 15 percent of the sample consumed sugars or sweets 6-7 days in the week – 58 percent of these were control households, 42 percent were case households. 23 percent of the sample had sugars or sweets 1-5 days in the week – 54 percent were case households, 46 percent were control households. 62 percent of the sample did not have sugars or sweets the week previous to the survey – 53 percent of these were from case households, 47 percent were control households.

Household food security: The WHO defines food security as existing when household members have access to sufficient, safe and nutritious food to maintain a healthy and active life. This concept of food security implies both physical and economic access to food that meets individuals' dietary needs as well as their food preferences. Food security indicator was generated from hunger coping strategies employed by households – stress, emergency, and/or crisis coping strategies. Based on the data generated, 4 groups were computed – group 1: food secure; group 2: marginally food secure; group 3: moderate food insecure; and group 4: severe food insecure. For the analysis in Table 2.31, group 3 and 4 were merged to form a composite group of food insecure households. Compared to food secure households, children in marginally food secure homes are 1.33 times more likely to be stunted, while those in food insecure homes are 1.56 times more likely to have stunted growth.

Table 2.31: Is Household Food Security a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Food security					
Food secure (n=458)	193	42.1	1		
Marginally food secure (n=1,020)	501	49.1	1.33	[1.06-1.66]	0.013
Food insecure (n=1,277)	679	53.2	1.56	[1.26-1.93]	0.000
Total (n=2,755)	**1373**	**49.8**			

2.9.8 Diet Diversity of Child – Previous 24 Hours

Q. I would like to ask you about the type of food the child ate yesterday during the day and night. Please include all foods purchased outside the home.

Food item	p-value:
	Number of days consumed
Plain water	0.001
Milk – tinned, powdered, or fresh	0.024
Eggs	0.007

a. Plain water: 55 percent of the sample offered plain water to the reference child during the day and/or night previous to the survey. 53 percent of these were control households, 47 percent were case households. 45 percent did not offer plain water to the child – 54 percent of these were case households, 46 percent were control households.

b. Milk – tinned, powdered, or fresh milk: Only 3 percent of the sample offered milk to the reference child during the day and/or night previous to the survey. 68 percent of these were control households. 97 percent did not offer milk to the child, 51 percent of these were case households.

c. Eggs: 12 percent of the sample offered eggs to the reference child during the day and/or night previous to the survey. 58 percent of these were control households, 42 percent were case households. 88 percent did not offer eggs to the child – 50 percent from both groups.

Child diet diversity: Diet diversity among children 6-24 months is protective against stunting. Compared to children with low diet diversity, children with medium diet diversity are 19 percent less likely to be stunted, while those with good diet diversity are 58 percent less likely to be stunted.

Table 2.32: Is Child Diet Diversity a Risk Factor for Stunting in Children under 24 Months?

	Household with a stunted child		OR	95% CI	p
	N	%			
Dietary diversity groups					
Low diet diversity (n=1,896)	995	52.5	1		
Medium diet diversity (n=680)	321	47.2	0.81	[0.68–0.96]	0.018
Good diet diversity (n=179)	57	31.8	0.42	[0.31–0.59]	0.000
Total (n=2,755)	**1373**	**49.8**			

In most cases, statistically significant associations were found between all indicators of food insecurity and stunting in children. The risk for child stunting increases in a dose-response way as indicators for food insecurity become more severe. It is clear that without food, malnutrition thrives. And although having sufficient and diverse foods may be protective, food alone is not sufficient to eradicate stunting in Rwandan households as food secure households and those with good diet diversity still have relatively high rates of stunting in children under 24 months. This notion is further emphasised in the 24-hour dietary recall data analysis.

2.10 24-hour Dietary Recall: Data Analysis

The 4-pass, 24-hour dietary recall has been widely used and validated in a number of settings including Rwanda. The dietary recall included a comprehensive assessment of the quality and quantity of foods (excluding breast milk) that the reference child and caregiver consumed the previous 24 hours.

2.10.1 Number of Meals per Day

The number of meals per day (Table 2.33) in the dietary data can serve as a proxy indicator of dietary quality. The 'meals' in this sense are defined as [1] Morning (daybreak-12.00pm), [2] Afternoon (12.00-5.00pm), [3] Evening (5.00pm-Sunset), and [4] Night (7pm-daybreak). While this lumps eating episodes together so that, for example, a mid-morning snack is lumped with 'breakfast'; in practice snacking is not common in Rwanda (with the exception of breastfeeding children) and for the most part each 'meal' is in fact a discrete meal.

All Children

Around 80 to 89 percent of the sample among children had two to three meals per day. The number of meals per day was not significantly different between cases and controls. However, in 35 percent of the sample, girls had more meals than boys; in 50 percent of the sample boys had more meals than girls; and in 15 percent of the sample, boys and girls had the same number of meals.

Breastfed Children

The recommendation for the breastfed child is that starting from 6-8 months complementary meals be provided 2-3 times per day, and 3-4 times per day for infants 9-24 months with snacks offered 1-2 times. Food intake in breastfed children is similar between cases and controls. From the data generated, it is evident that complementary foods are introduced before 6 months of age, and that some children in this age group have up to 4 meals a day. Among control households, 7 percent of children 0-2 months old received 4 meals during the observation day and among cases the proportion was about 6 percent. Among children 3-5 months, about 3 percent of cases and 9 percent of controls were offered food other than breastmilk four times in the day. For children 6-8 months, 78 percent of cases and 80 percent of control households met the recommended meal frequency for the breastfed child. For children 9-11 months, 54 percent of cases and 66 percent of control households met the recommended meal frequency for the breastfed child. For children 12-23 months, 66 percent of cases and 65 percent of control households met the recommended meal frequency for the breastfed child.

Non-breastfed Children

The recommendation for the non-breastfed child is that complementary meals be provided 4-5 times per day, with snacks offered 1-2 times. None of the children sampled had 5 meals. Only about 15 percent of the non-breastfed children sampled had 4 meals per day. None of the children were offered food more than 4 times in the observation day. Among children 0-2 months old, only 8 percent of cases and 13 percent of control households met the recommend minimum meal frequency. Among children 3-5 months, only 13 percent of case households offered food four times in the day. For children 6-8 months, only 25 percent of case households met the recommended meal frequency for the non-breastfed child. For children 9-11 months, 10 percent of cases and 25 percent of control households met the recommended meal frequency for the non-breastfed child. For children 12-23 months, 15 percent of cases and 21 percent of control households met the recommended meal frequency for the breastfed child.

Table 2.33: Number of 'Meals' per Child on Observed Day

Is the child still breast feeding			Age group											
			0-2 months		3-5 months		6-8 months		9-11 months		12-23 months		Over 24 months	
			STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM	
			Case	Control	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
Child not breastfed	Meals	1						16.70%			0.90%		1.90%	5.10%
		2	8.30%	13.00%	37.50%	25.00%	12.50%	50.00%	30.00%	37.50%	24.80%	17.90%	20.40%	13.60%
		3	83.30%	73.90%	50.00%	75.00%	62.50%	33.30%	60.00%	37.50%	59.60%	61.20%	64.80%	67.80%
		4	8.30%	13.00%	12.50%		25.00%		10.00%	25.00%	14.70%	20.90%	13.00%	13.60%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Child breastfed	Meals	1	5.70%	8.00%	15.30%	13.80%	16.20%	15.40%	10.60%	11.30%	6.30%	7.10%	6.70%	5.00%
		2	35.60%	34.70%	32.20%	37.90%	37.30%	25.90%	36.50%	34.50%	27.80%	28.30%	24.80%	25.00%
		3	52.90%	50.70%	49.20%	39.70%	40.10%	53.80%	45.90%	49.30%	57.30%	55.60%	61.00%	62.50%
		4	5.70%	6.70%	3.40%	8.60%	6.30%	4.90%	7.10%	4.90%	8.60%	9.00%	7.60%	7.50%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Total	Meals	1	5.10%	6.10%	13.40%	12.10%	15.30%	15.50%	10.00%	10.70%	5.40%	6.30%	5.00%	5.00%
		2	32.30%	29.60%	32.80%	36.40%	36.00%	27.70%	36.10%	34.70%	27.30%	27.20%	23.30%	21.20%
		3	56.60%	56.10%	49.30%	43.90%	41.30%	52.30%	46.70%	48.70%	57.70%	56.20%	62.30%	64.20%
		4	6.10%	8.20%	4.50%	7.60%	7.30%	4.50%	7.20%	6.00%	9.60%	10.20%	9.40%	9.50%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

2.10.2 Meal Pairs per Day and Energy Density per Meal

We hypothesise that in most instances caregivers will have the same as, or fewer, meals than the reference child. For the non-breastfed child, in 30 percent of the sample the caregiver had more meals than the reference child (Table 2.34). This implies that 70 percent of caregivers are aware that children require more frequent feedings and should not be fed only when the households sits down to eat.

Table 2.34: Number of 'Meal Pairs' per Child on Observed Day

Is the child still breast feeding?			Age group											
			0–2 months		3–5 months		6–8 months		9–11 months		12–23 months		24–45 months	
			STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM	
			Case	Control	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
No	Meals	C1W1						20.00%					1.90%	1.70%
		C2W1		4.30%							3.70%	6.20%		1.70%
		C3W1	8.30%	4.30%					20.00%		2.80%	3.10%	3.70%	1.70%
		C4W1							10.00%		1.90%			
		C1W2												1.70%
		C2W2			28.60%	12.50%	12.50%	30.00%	20.00%	12.50%	14.00%	6.20%	16.70%	3.40%
		C3W2	33.30%	17.40%	28.60%		50.00%	10.00%		25.00%	15.90%	12.30%	13.00%	20.70%
		C4W2									1.90%			
		C1W3									0.90%			
		C2W3	8.30%	8.70%	14.30%	12.50%		20.00%	10.00%	25.00%	7.50%	4.60%	3.70%	8.60%
		C3W3	41.70%	43.50%	14.30%	62.50%	12.50%	20.00%	40.00%	12.50%	35.50%	43.10%	42.60%	39.70%
		C4W3	8.30%	13.00%	14.30%		25.00%			12.50%	8.40%	13.80%	7.40%	10.30%
		C2W4										1.50%		
		C3W4		8.70%		12.50%					4.70%	3.10%	5.60%	6.90%
		C4W4								12.50%	2.80%	6.20%	5.60%	3.40%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Is the child still breast feeding?			Age group											
			0–2 months		3–5 months		6–8 months		9–11 months		12–23 months		24–45 months	
			STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM	
			Case	Control	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
Yes	Meals	C1W1	1.10%		1.70%		3.50%	2.80%	3.50%	3.50%	1.30%	2.10%	1.00%	3.40%
		C2W1	5.70%	1.30%	3.40%		2.80%	2.10%	1.80%	3.50%	2.10%	2.10%	1.00%	2.50%
		C3W1	1.10%	2.70%			2.10%	1.40%		0.70%	1.20%	0.30%	1.00%	1.70%
		C1W2	2.30%	2.70%	6.80%	6.90%	4.30%	4.90%	4.70%	2.10%	1.50%	2.60%	2.90%	1.70%
		C2W2	16.10%	18.70%	16.90%	15.50%	19.10%	14.80%	20.00%	14.10%	13.40%	14.00%	13.30%	13.60%
		C3W2	12.60%	21.30%	11.90%	17.20%	12.10%	19.00%	15.30%	11.30%	16.90%	17.20%	26.70%	17.80%
		C4W2	3.40%	2.70%	1.70%		2.10%	0.70%	2.40%	2.10%	1.00%	1.40%	1.90%	0.80%
		C1W3	2.30%	5.30%	5.10%	6.90%	8.50%	7.00%	2.40%	4.90%	3.30%	2.40%	2.90%	
		C2W3	12.60%	13.30%	11.90%	19.00%	14.20%	8.50%	14.10%	14.80%	10.70%	11.60%	9.50%	9.30%
		C3W3	35.60%	24.00%	35.60%	15.50%	24.10%	28.90%	27.60%	31.00%	35.90%	34.00%	32.40%	36.40%
		C4W3	2.30%	4.00%	1.70%	6.90%	3.50%	2.80%	3.50%	2.10%	6.30%	5.50%	5.70%	3.40%
		C1W4			1.70%			0.70%		0.70%	0.20%			
		C2W4	1.10%	1.30%		3.40%	0.70%	0.70%	0.60%	2.10%	1.50%	0.70%	1.00%	
		C3W4	3.40%	2.70%	1.70%	6.90%	2.10%	4.20%	2.90%	6.30%	3.50%	4.20%	1.00%	6.80%
		C4W4				1.70%	0.70%	1.40%	1.20%	0.70%	1.20%	1.90%		2.50%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Table 2.34 continued...

Is the child still breast feeding?			Age group											
			0–2 months		3–5 months		6–8 months		9–11 months		12–23 months		24–45 months	
			STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM		STUDY ARM	
			Case	Control	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
Yes	Meals	C1W1	1.00%		1.50%		3.40%	3.90%	3.30%	3.30%	1.10%	1.90%	1.30%	2.80%
		C2W1	5.10%	2.00%	3.00%		2.70%	2.00%	1.70%	3.30%	2.40%	2.50%	0.60%	2.30%
		C3W1	2.00%	3.10%			2.00%	1.30%	1.10%	0.70%	1.40%	0.60%	1.90%	1.70%
		C4W1							0.60%		0.30%			
		C1W2	2.00%	2.00%	6.10%	6.10%	4.00%	4.60%	4.40%	2.00%	1.30%	2.30%	1.90%	1.70%
		C2W2	14.10%	14.30%	18.20%	15.20%	18.80%	15.80%	20.00%	14.00%	13.50%	13.20%	14.50%	10.20%
		C3W2	15.20%	20.40%	13.60%	15.20%	14.10%	18.40%	14.40%	12.00%	16.70%	16.70%	22.00%	18.80%
		C4W2	3.00%	2.00%	1.50%		2.00%	0.70%	2.20%	2.00%	1.10%	1.20%	1.30%	0.60%
		C1W3	2.00%	4.10%	4.50%	6.10%	8.10%	6.60%	2.20%	4.70%	2.90%	2.20%	1.90%	
		C2W3	12.10%	12.20%	12.10%	18.20%	13.40%	9.20%	13.90%	15.30%	10.20%	10.90%	7.50%	9.10%
		C3W3	36.40%	28.60%	33.30%	21.20%	23.50%	28.30%	28.30%	30.00%	35.80%	34.90%	35.80%	37.50%
		C4W3	3.00%	6.10%	3.00%	6.10%	4.70%	2.60%	3.30%	2.70%	6.70%	6.40%	6.30%	5.70%
		C1W4			1.50%			0.70%		0.70%	0.20%			
		C2W4	1.00%	1.00%		3.00%	0.70%	0.70%	0.60%	2.00%	1.30%	0.80%	0.60%	
		C3W4	3.00%	4.10%	1.50%	7.60%	2.00%	3.90%	2.80%	6.00%	3.70%	4.00%	2.50%	6.80%
		C4W4				1.50%	0.70%	1.30%	1.10%	1.30%	1.40%	2.30%	1.90%	2.80%
	Total		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Breastfed Children

The minimum energy density (kcal/g) for the breastfed child is based on their age and meal frequency.

Table 2.35: Meal Energy Density for Breastfed Children

	Age in months		
Number of meals	**6-8**	**9-11**	**12-23**
5	0.26 - 0.44 kcal/g	0.34 - 0.49 kcal/g	0.45 - 0.60 kcal/g
4	0.36 - 0.56 kcal/g	0.42 - 0.61 kcal/g	0.56 - 0.70 kcal/g
3	0.48 - 0.82 kcal/g	0.56 - 0.82 kcal/g	0.75 - 0.99 kcal/g
2	0.17 - 1.11 kcal/g	0.84 - 1.23 kcal/g	1.12 - 1.49 kcal/g

The range for energy density in the survey sample for child 6-8 months should range between 0.17 – 1.11 kcal/gram based on the number of meals. From the data generated (Table 2.37), it is clear that the mean energy density for meals offered to breastfed children 6-8 months (0.11 – 0.12 kcal/g) is low compared to the recommendations. For children 9-11 months, the recommended range is between 0.42-1.23 kcal/g and for children 12-23 months the range is between 0.56-1.49 kcal/g. None of the meals offered in the study sample can meet the recommended energy density recommended for children 9-23 months.

Non-breastfed Children

The minimum energy density (kcal/g) for non-breastfed children is based on their age and meal frequency.

Table 2.36: Meal Energy Density for Non-breastfed Children

	Age in months		
Number of meals	**6-8**	**9-11**	**12-23**
5	0.62 kcal/g	0.60 kcal/g	0.65 kcal/g
4	0.77 kcal/g	0.75 kcal/g	0.81 kcal/g
3	1.03 kcal/g	1.00 kcal/g	1.08 kcal/g

The range for energy density in the survey sample for children 6-8 months should range between 0.77 – 1.03 kcal/gram based on the number of meals offered. From the data generated (Table 2.37), it is clear that the mean energy density for meals offered to non-breastfed children 6-8 months (0.21 – 0.23 kcal/g) is less than half the recommendations. For children 9-11 months, the recommended range is between 0.60-1.0 kcal/g and for children 12-23 months the range is between 0.65-1.08 kcal/g. None of the meals offered can meet the recommended energy density recommended for non-breastfed children 9-23 months.

The data imply that meal energy density is as significant as meal frequency. Nutrition education and counselling for mothers should have as a focus culinary demonstration to guide mothers on how to prepare affordable nutrient and energy dense complementary foods from locally available ingredients.

Table 2.37: Mean and Median Energy Density of Meal Offered (kcal/gram) to Children

Is the child still breast feeding		Mean			Median		
		STUDY ARM			STUDY ARM		
		Case	Control	Total	Case	Control	Total
Child not breastfed	0-2 months	0.19	0.28	0.25	0.18	0.24	0.23
	3-5 months	0.28	0.23	0.25	0.3	0.18	0.22
	6-8 months	0.21	0.23	0.22	0.21	0.26	0.23
	9-11 months	0.24	0.37	0.3	0.21	0.32	0.25
	12-23 months	0.24	0.24	0.24	0.21	0.2	0.21
	Over 24 months	0.29	0.29	0.29	0.24	0.27	0.26
Child breastfed	0-2 months	0.16	0.17	0.16	0.13	0.14	0.13
	3-5 months	0.13	0.17	0.15	0.11	0.15	0.13
	6-8 months	0.12	0.11	0.12	0.09	0.09	0.09
	9-11 months	0.12	0.13	0.13	0.09	0.1	0.1
	12-23 months	0.16	0.18	0.17	0.14	0.15	0.15
	Over 24 months	0.2	0.22	0.21	0.19	0.2	0.19
Total	**0-2 months**	**0.16**	**0.2**	**0.18**	**0.13**	**0.18**	**0.14**
	3-5 months	**0.15**	**0.18**	**0.16**	**0.12**	**0.15**	**0.14**
	6-8 months	**0.13**	**0.12**	**0.12**	**0.09**	**0.09**	**0.09**
	9-11 months	**0.13**	**0.15**	**0.14**	**0.09**	**0.11**	**0.1**
	12-23 months	**0.18**	**0.18**	**0.18**	**0.15**	**0.16**	**0.15**
	Over 24 months	**0.23**	**0.24**	**0.24**	**0.2**	**0.22**	**0.21**

2.10.3 Intake of Foods by Food Groups

A snapshot of the diet can be captured through summarizing each age group's diet according to the weight of foods consumed classified into 14 distinct food groups.

All Children (Table 2.38)
Intake by food groups is shown below. The mean intake in grams is shown for consumers only. Most of the 24-hour recalls (82%) had items from legumes and nuts, about 74 percent had cereals and grains, and about 79 percent had roots and tubers. There were few consumers (<5%) of coloured vegetables (rich in Vitamin A), eggs or meat. In addition, the mean intake of coloured vegetables, meat, fish, and eggs is higher in controls compared to cases while dairy, and roots and tubers were a major contribution to the diet by weight.

Table 2.38: Intake of Foods by Food Groups

Food group	Percent consuming	Mean intake (grams)		
		Case	Control	Total
Cereals and grains	73.5	58.1	66.7	**62.5**
Roots and tubers	78.8	198.9	201.4	**200.2**
Legumes and nuts	82	112	103.9	**107.9**
Coloured vegetables	3.7	63.5	82.5	**72.7**
Green leafy vegetables	33.3	19.4	19.2	**19.3**
Other vegetables	48.4	65	59.9	**62.3**
Orange fruits	9.3	111.8	103.6	**107.3**
Other fruits	32.3	108.2	112.1	**110.2**
Meats	2.2	40.4	47.4	**44**
Fish or shellfish	5.3	7.9	12.4	**10.6**
Eggs	1.8	39.8	41.2	**40.7**
Milk and other dairy products	19.8	280.4	288.7	**285.2**
Fats and oils	45.9	5.7	6	**5.8**
Sugar	25.1	40.2	44.9	**42.7**
Condiments and spices	2.5	69.9	89.4	**82.2**

Breastfed Children (Table 2.39)
Table 2.39 shows median intake in grams for breastfed children only. Similarly, there were few consumers (<5%) of coloured vegetables (rich in Vitamin A), eggs or meat. In addition, the median intake of coloured vegetables, meat, and fish was still higher in controls compared to cases while dairy and roots and tubers formed the majority of the diet by weight.

Table 2.39: Intake of Foods by Food Groups for Breastfed Children

Food group	Percent consuming	Median intake		
		Case	Control	Total
Cereal and grains	71.70%	32	36.3	**33.8**
Root and tubers	78.00%	134	138.5	**138.5**
Legumes and nuts	80.80%	72.3	71	**71.5**
Coloured vegetables Vitamin A	3.70%	49	58.9	**56.5**
Green leafy vegetables	32.40%	8.3	9.4	**8.5**
Other vegetables	46.60%	35.9	36.7	**36.2**
Orange fruits	9.10%	74.3	74.3	**74.3**
Other fruits	32.80%	73.1	82	**75.8**
Meats	2.00%	31.1	57.1	**41.6**
Fish or shellfish	5.40%	3.4	4.2	**3.7**
Eggs	1.80%	35	33.2	**34.1**
Milk and other dairy products	18.00%	191.6	216.2	**205.9**
Fats and oils	43.90%	3.5	4.2	**3.9**
Sugar	23.10%	19.7	18.7	**18.7**
Condiments and spices	2.20%	58.5	66.9	**59.4**

Non-breastfed Children (Table 2.40)

Table 2.40 shows median intake in grams for non-breastfed children only. The food consumption pattern in this group is similar to that of breastfed children. There were few consumers (<5%) of coloured vegetables (rich in Vitamin A), eggs, fish, and meat. In addition, the mean intake of these foods was surprisingly higher in cases compared to controls. Again, dairy and roots and tubers formed the majority of the diet by weight.

Table 2.40: Intake of Foods by Food Groups for Non-breastfed Children

Food group	Percent consuming	Median intake		
		Case	Control	Total
Cereal and grains	82.50%	67.2	79.9	**73.3**
Root and tubers	84.90%	221.5	238.9	**228.5**
Legumes and nuts	89.40%	118.8	122.8	**120.6**
Coloured vegetables	4.20%	70.3	43.8	**52**
Green leafy vegetables	38.10%	18.2	13.4	**14.6**
Other vegetables	58.70%	47.7	47.6	**47.6**
Orange fruits	10.80%	74.3	81.6	**81.6**
Other fruits	30.70%	108.2	97.5	**102.3**
Meats	3.20%	45.4	22.1	**41**
Fish or shellfish	5.00%	5.6	4.7	**4.8**
Eggs	2.10%	70.8	33.2	**33.2**
Milk and other dairy products	29.10%	375.8	308.9	**334.6**
Fats and oils	57.70%	6	6.4	**6.2**
Sugar	35.70%	21.9	20.9	**21.9**
Condiments and spices	4.20%	58.5	81.5	**69**

2.10.4 Energy & Nutrient Intakes: Cases vs. Controls

The energy, macronutrient, and micronutrient intake of all children is as shown in Table 2.41. There was a significant difference in intake between cases and controls for most of the nutrients.

Table 2.41: Energy and Nutrient Intake of all Children

	Controls			Case			p-value
	Median	Mean	SD	Median	Mean	SD	
Food weight consumed	399.54	482.2	364.77	357.58	444.76	343.18	0.004
Energy (kcal)	531.54	616.93	459.2	470.79	563.17	409.78	0.004
Protein (g)	15.51	19.13	15.91	14.12	17.53	14.89	0.005
Lipid (g)	7.39	10.85	12.64	5.21	8.89	10.51	0.000
Carbohydrate (g)	97.44	114.61	85.23	89.22	107.04	79.13	0.018
Vitamin C (mg)	22.63	39.69	51.24	23.99	40.21	56.82	0.544
Vitamin A (IU)	707.1	1699.01	2915.88	610.62	1767.31	3400.32	0.035
Iron (mg)	3.87	4.84	4.03	3.75	4.7	3.88	0.286
Zinc (mg)	2.22	2.7	2.24	2.03	2.53	2.14	0.033
Calcium (mg)	109.9	188.48	228.67	96.56	163.32	206.81	0.003

Energy Intake vs Adequacy

The WHO recommended daily caloric intake (RDCI; kilocalories) for children under 24 months is shown in Figure 2.6:

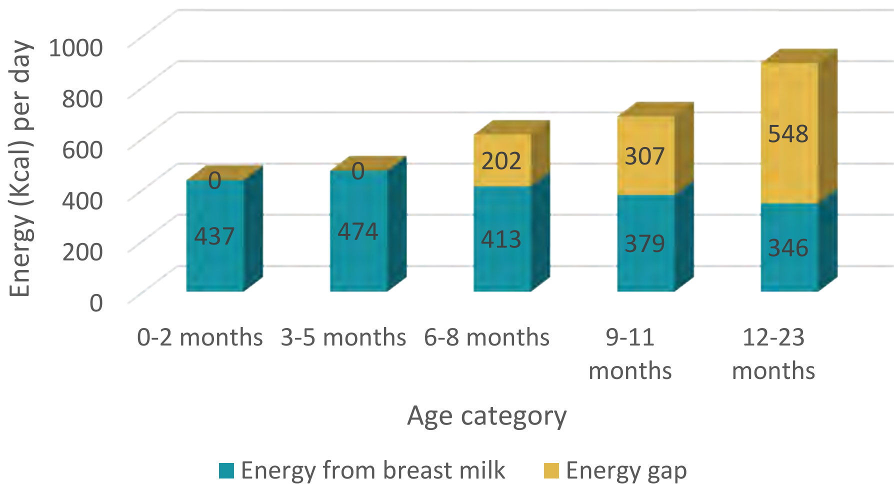

Figure 2.6: Energy Requirement by Age

From the data generated through the 24-hour dietary recall (Table 2.42, Table 2.43), it is clear that although there is a significant difference in energy intake between cases and controls, the energy intake from food (minus breastmilk) is below the recommended caloric intake for each age group when the observed day's median energy intakes for children are compared to the RDCI.

Table 2.42: Median Energy Intake (kcal/day) for Breastfed Children & Proportion Meeting the RDCI

				% meeting required RDCI		
	Overall (n=2221)	Case (n=1107)	Control (n=1114)	Overall	Case	Control
Energy (kcal/day)						
0-5 months	106	82.4	155.1			
6-8 months	175.1	177.1	173.2	44.1	45.8	42.6
9-11 months	287.2	290.8	278.4	46.3	46.6	45.9
12-23 months	505.7	464.8	536.2	44.4	40.6	48
24 months and above	608.5	576.9	651.3			

For breastfed child, less than half of the sample between 6-23 months meet the recommended daily caloric intake from food other than breastmilk.

Table 2.43: Median Energy Intake (kcal/day) for Non-breastfed Children & Proportion Meeting the RDCI

				% meeting required RDCI		
	Overall (n=299)	Case (n=154)	Control (n=145)	Overall	Case	Control
Energy (kcal/day)						
0-5 months	406.1	-	406.1			
6-8 months	348	348	-	50	50	-
9-11 months	152	238.1	152	40	50	0.0
12-23 months	797.2	787.9	865.1	74.7	73.4	76.5
24 months and above	938.6	884.8	1009			

For the non-breastfed child, about half of the sample 6-11 months meet the recommended daily caloric intake from food (other than breastmilk); while for children 12-23 months over 70 percent meet the recommendation.

The data imply that overall mothers and caregivers need more sensitisation on appropriate preparation of age-appropriate energy-dense complementary foods.

Macronutrient Intake vs. Adequacy

Dietary Reference Intakes (DRIs): Estimated Average Requirements Food and Nutrition Board, Institute of Medicine and National Academies were used as references for this section.

a. Protein:

Table 2.44a: Protein Intake Recommendations

Age group	DRI
0-5months	9.1 g/d
6-11 months	11 g/d
12-35 months	13 g/d

From the data, 48 percent of cases had adequate protein intake based on their age group DRI while 52 percent of controls had adequate intake based on their age group DRI.

Table 2.44b: Median Protein Intake (grams)

<table>
<tr><th rowspan="3">Age group</th><th colspan="4">STUDY ARM</th><th colspan="2" rowspan="2">Adequate Intake</th></tr>
<tr><th>Case</th><th>Case</th><th>Control</th><th>Control</th></tr>
<tr><th>Male</th><th>Female</th><th>Male</th><th>Female</th><th>Case</th><th>Control</th></tr>
<tr><td>0-5 months</td><td>14.1</td><td>9.2</td><td>14.6</td><td>15.2</td><td>46.20%</td><td>53.80%</td></tr>
<tr><td>6-11 months</td><td>7.9</td><td>8.6</td><td>8.8</td><td>9.3</td><td>52.10%</td><td>47.90%</td></tr>
<tr><td>12-23 months</td><td>15</td><td>16</td><td>16.3</td><td>16.3</td><td rowspan="2">47.30%</td><td rowspan="2">52.70%</td></tr>
<tr><td>24 months and over</td><td>24</td><td>19.6</td><td>23.9</td><td>22.8</td></tr>
</table>

b. Carbohydrates:

Table 2.45a: Carbohydrates Intake Recommendations

Age group	DRI
0-5 months	60 g/d
6-11 months	95 g/d
12-35 months	100 g/d

From the data, 47.4 percent of cases had adequate carbohydrate intake based on their age group DRI while 52.6 percent of controls had adequate intake based on their age group DRI.

Table 2.45b: Median Carbohydrate Intake (grams)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	94.1	64.9	98.7	88	47.00%	53.00%
6-11 months	50.8	60.7	51.8	54.8	47.30%	52.70%
12-23 months	98.6	92.2	106.8	98.1	47.50%	52.50%
24 months and over	144.9	120.9	129.3	147.3		

c. Fat:

Table 2.46a: Fat Intake Recommendations

Age group	DRI
0-5 months	31 g/ d
6-11 months	30 g/ d
12-35 months	Not determined

From the data, 51.2 percent of cases had adequate lipid intake based on their age group DRI while 48.8 percent of controls had adequate intake based on their age group DRI.

Table 2.46b: Median Fat Intake (grams)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	4.7	3.4	4.5	6.9	41.20%	58.80%
6-11 months	3.1	3.7	3.9	3.5	58.30%	41.70%
12-23 months	6.1	6.5	8	8.5		
24 months and over	8.6	5.7	13.2	9.7		

Micronutrient Intake vs Adequacy

Dietary Reference Intakes (DRIs): Estimated Average Requirements Food and Nutrition Board, Institute of Medicine and National Academies were used as references for the following micronutrients: Vitamin C (mg/d), Vitamin A (µg/d), Iron (mg/d), Zinc (mg/d), Calcium (mg/d).

a. Vitamin C (mg/d):

Table 2.47a: Vitamin C Intake Recommendations

Age group	Vitamin C
0-5 months	40 mg/d
6-11 months	50 mg/d
12-35 months	15 mg/d

From the data, 49.4 percent of cases had adequate Vitamin C intake based on their age group DRI while 50.6 percent of controls had adequate intake based on their age group DRI.

Table 2.47b: Median Vitamin C Intake (mg)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	23.7	18.4	20.3	23.1	45.00%	55.00%
6-11 months	12.7	13	13.2	15.3	48.00%	52.00%
12-23 months	26.6	25.9	26.3	20.9	49.80%	50.20%
24 months and over	40	37.1	41	40.2		

b. Vitamin A (µg/d):

Table 2.48a: Vitamin A Intake Recommendations

Age group	Vitamin A
0-5 months	400 mg/d
6-11 months	500 mg/d
12-35 months	300 mg/d

From the data 49 percent of cases had adequate Vitamin A intake based on their age group DRI while 51 percent of controls had adequate intake based on their age group DRI.

Table 2.48b: Median Vitamin A Intake (µg)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	47.2	44.7	51.3	69.2	54.20%	45.80%
6-11 months	42.6	43.5	58	49	50.00%	50.00%
12-23 months	72.4	66.7	86.4	85.1	48.40%	51.60%
24 months and over	103.8	102.9	149.6	122.9		

c. Iron (mg/d):

Table 2.49a: Iron Intake Recommendations

Age group	Iron
0-5 months	0.27 mg/d
6-11 months	11 mg/d
12-35 months	7 mg/d

From the data, 50.6 percent of cases had adequate iron intake based on their age group DRI while 49.4 percent of controls had adequate intake based on their age group DRI.

Table 2.49b: Median Iron Intake (mg)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	3.5	2.4	4.1	3.8	50.60%	49.40%
6-11 months	2.2	2.3	2.1	2.3	60.00%	40.00%
12-23 months	4.2	4	4.3	4.1	50.10%	49.90%
24 months and over	6.9	5.6	5.7	5.7		

d. Zinc (mg/d):

Table 2.50a: Zinc Intake Recommendations

Age Group	Zinc
0-5 months	2 mg/d
6-11 months	3 mg/d
12-35 months	3 mg/d

From the data, 48.7 percent of cases had adequate zinc intake based on their age group DRI while 51.3 percent of controls had adequate intake based on their age group DRI.

Table 2.50b: Median Zinc Intake (mg)

<table>
<tr><th rowspan="3">Age group</th><th colspan="4">STUDY ARM</th><th colspan="2" rowspan="2">Adequate Intake</th></tr>
<tr><th>Case</th><th>Case</th><th>Control</th><th>Control</th></tr>
<tr><th>Male</th><th>Female</th><th>Male</th><th>Female</th><th>Case</th><th>Control</th></tr>
<tr><td>0-5 months</td><td>2.1</td><td>1.5</td><td>2.1</td><td>2.2</td><td>45.20%</td><td>54.80%</td></tr>
<tr><td>6-11 months</td><td>1.1</td><td>1.2</td><td>1.2</td><td>1.3</td><td>49.60%</td><td>50.40%</td></tr>
<tr><td>12-23 months</td><td>2.2</td><td>2.2</td><td>2.3</td><td>2.3</td><td rowspan="2">49.40%</td><td rowspan="2">50.60%</td></tr>
<tr><td>24 months and over</td><td>3.5</td><td>2.8</td><td>3.5</td><td>3.2</td></tr>
</table>

e. Calcium (mg/d):

Table 2.51a: Calcium Intake Recommendations

Age group	Calcium
0-5 months	200 mg/d
6-11 months	260 mg/d
12-35 months	700 mg/d

From the data 41.6 percent of cases had adequate calcium intake based on their age group DRI while 58.4 percent of controls had adequate intake based on their age group DRI.

Table 2.51b: Median Calcium Intake (mg)

Age group	STUDY ARM				Adequate Intake	
	Case	Case	Control	Control		
	Male	Female	Male	Female	Case	Control
0-5 months	84.6	90.3	105.2	106.2	42.10%	57.90%
6-11 months	61.7	75.1	59.2	75	43.60%	56.40%
12-23 months	101.3	105.2	107.7	109.2	38.40%	61.60%
24 months and over	137.9	129.6	179.2	189.5		

2.10.5 Maternal Dietary Intake

Table 2.52 shows median intake in grams for women of reproductive age by study arm. The food consumption pattern in this group is similar to that the children. There were few consumers (≤ 5%) of coloured vegetables (rich in Vitamin A), eggs, fish, and meat. In addition, the mean intake of these fish and eggs was surprisingly higher in cases compared to control households. Dairy and roots and tubers formed the majority of the women's diet by weight. The data imply that the diets of children follow a similar partner to maternal diets. Hence improving household diets, especially for the mother, can have a positive effect on diets of children in the households.

Table 2.52: Dietary Intakes (based on 24 hour dietary recall data) for Women of Reproductive Age

Food group	Percent consuming	Mean intake (grams)		
		Case	Control	Total
Cereal and grains	61.80%	210	214	212
Root and tubers	92.20%	826	819	823
Legumes and nuts	89.50%	362	355	359
Coloured vegetables	4.70%	268	304	285
Green leafy vegetables	37.00%	64	56	60
Other vegetables	54.60%	192	183	187
Orange fruits	7.50%	239	203	220
Other fruits	26.80%	217	182	199
Meats	3.30%	129	173	154
Fish or shellfish	5.10%	40	32	35
Eggs	0.70%	95	56	66
Milk and other dairy products	11.70%	479	523	506
Fats and oils	53.20%	17	18	17
Sugar	34.30%	306	264	284
Condiments and spices	2.50%	219	213	215

Maternal Nutrient Intakes

The energy, macronutrient, and micronutrient intake of all women is as shown in Table 2.53. From the data, the only differences between the dietary intake of case and control households is for energy, protein, and lipids.

Table 2.53: Energy and Nutrient Intake for Women

	Case	Control	All	
	Median	Median	Median	p-values
Energy (kcal)	1,786.40	1,895.90	1,838.50	0.016
Proteins	51.7	55.5	53.7	0.017
Lipids	16	18.8	17.4	0.000
Carbohydrates	354.5	365.5	360.8	0.124
Calcium (mg)	388.5	386.2	387.4	0.188
Iron (mg)	15.5	16.1	15.8	0.514
Zinc (mg)	7.9	8.2	8.1	0.068
Vitamin C (mg)	89.2	87.7	88.2	0.202
Vitamin A (mcg)	238.4	245.2	240.8	0.751

Nutrient Adequacy

The proportion of women meeting the daily required intake for key nutrients by age group is presented in Table 2.54. From the data, it is clear that few women (<50%) meet their iron and zinc requirements. In fact none of the control households' women aged 14-18 met their daily zinc intake. On the other hand, most women (> 90%) meet the carbohydrates and vitamin C intake.

Table 2.54: Proportion of Females Meeting the Required DRI

		Study arm		
	Age (years)	Overall	Case	Control
PROTEIN	14-18	71.9	64.7	80
	19-30	63.8	62.7	65
	31-50	60	55.7	64.2
CARBOHYDRATE	14-18	96.9	1.0	93.3
	19-30	95.6	95.6	95.6
	31-50	94.8	94.6	95
CALCIUM	14-18	87.5	88.2	86.7
	19-30	92.6	93.5	91.8
	31-50	92.4	91.1	93.6
IRON	14-18	50	47.1	53.3
	19-30	39.4	38.5	40.4
	31-50	36.2	35.2	37.1
ZINC	14-18	12.5	23.5	0.0
	19-30	23.4	24.3	22.5
	31-50	22.4	20.5	24.2
VITAMIN C	14-18	90.6	88.2	93.3
	19-30	96.7	96.9	96.6
	31-50	97.1	97.2	97.1
VITAMIN A	14-18	37.5	29.4	46.7
	19-30	48.3	47.5	49.1
	31-50	49.9	49.6	50.1

2.11 Summary of Risk Factors

Below is a summary of risk factors identified from an assessment of the individual questions posed to respondents during the nutrition survey. The data suggest that underlying causes of stunting in Rwanda are diverse. Chapter 5 of this report synthesises the listed determinants of stunting in children under 24 months in Rwanda and presents the drivers of stunting in this population.

Table 2.55: Determinants of Stunting

Nutrition status	List of determinants for stunting
Anthropometry	Age of child
	Sex of child
	Rural residence
Household resources	**Family factors**
Ubudehe categories	Poverty/ wealth quintile
Household head and spouse characteristics	Marital status
House characteristics and household assets	Literacy
Wealth index	Maternal education
Health	**Health factors**
Health facility	Health insurance coverage
Health insurance	Twin siblings
Mother's health status and micronutrient intake	Pre-term birth
Birth record of the child	Low birth weight
	Poor antenatal care
	Poor maternal diet during pregnancy
Water, Hygiene, and Sanitation	**WASH factors**
Drinking water	Use of unimproved water sources
Toilet facility	Lack of treatment of drinking water
Mothers hand-washing knowledge and practice	Use of unimproved sanitation /open defecation
	Maternal hand-washing practices
Information	**Information factors**
Awareness and access to nutrition information	Lack of information on nutrition and health
Awareness and access to enriched foods	
Care	**Care factors**
Child breastfeeding status and history	Mother's absence from child
Complementary feeding	Frequent illness
Vitamin, iron, micronutrient intake in children	Abnormal growth
Child morbidity, immunization and growth record	
Food	**Food factors**
Beans consumption and household staples	Food insufficiency
Famine and famine foods	Food consumption score
Food insufficiency and coping strategies	Household food security
Food consumption and diet diversity score	Diet diversity score
Household food consumption and food source (previous 7 days)	Diet diversity of child
Diet diversity of child	

3.0

AGRICULTURAL PRODUCTION AND MARKETS

3.1 Linkages between Nutrition and Agricultural Production

Agricultural production affects nutrition outcomes primarily by influencing caloric intakes and diet quality. Households that can afford to buy sufficient and diverse foods, or those that can produce enough food for their own consumption, have greater likelihood of ensuring acceptable household food and nutrient consumption. However, food markets and household gender dynamics can influence this expectation.
The goal of the survey was to use a case-control approach to investigate how increasing agricultural production can best ensure elimination of childhood malnutrition among households in Rwanda. This chapter presents results of the effects of agricultural production and markets on nutrition outcomes (stunting). The household and production characteristics are evaluated based on how they correlate with malnutrition among households. Household and production characteristics influence livelihood outcomes. Specific analyses of the interlinkages between nutrition and livelihoods are further presented in this chapter.

3.2 Linkages between Nutrition and Markets in Agricultural Production

Increased marketing and commercialization of semi-subsistence agriculture is an important element of livelihood efforts to improve nutrition outcomes among resource-poor households. Food markets influence nutrition outcomes in two main ways:

a. Food access – households are increasingly reliant on markets for food. Markets can play a pivotal role in ensuring food security and diet diversity at the household level.

b. Agricultural incomes – when directed toward food expenditure, income from the sale of agricultural produce can improve caloric intake and diet quality. When allocated to non-food expenditure that is related to healthcare, income improvements are also likely to be associated with reduced infection rates, hence reducing levels of malnutrition.

However, markets can also take away food and nutrients from the household and agricultural incomes may not always be allocated towards food access or healthcare. One of the aims of this survey was to generate data on how agricultural production and food markets impact maternal and child nutrition outcomes.

The total sample was 2788 with 1388 case households representing 49.8 percent and 1400 controls representing 50.2 percent. The case and control groups were matched in the ratio of 1:1 as also used by Maluccio and Flores (2005). The 1:1 ratio was applied in both provinces and districts and the control group resembled the case group for location, sex and age with the key difference between the groups being nutrition status.

3.3 Livelihoods and Incomes

The questionnaire on household livelihood activities investigated the following key questions on livelihood activities (Table 3.1): number of household livelihood activities, importance of livelihood activities (top three livelihoods), rank of agriculture as a livelihood activity, income contribution of the main livelihood activity, household participation in livelihood activities, and seasonality of livelihood activities. Five of the seven variables were significantly different between the case and control households, except for household participation in livelihood and seasonality of the livelihood activities.

Table 3.1: Comparison of Variables on Livelihood Activities between Case and Control Households

Variables	p-value
Number of livelihood activities	0.000
Agriculture vis a vis other livelihood activities	0.000
Rank of agriculture as a livelihood activity	0.000
Household member participation in livelihood activities	Not significant
Monthly incomes contribution of the main livelihood activity	0.000
Contribution of the main livelihood activity to household incomes	0.000
Seasonality of livelihood activities	Not significant

3.3.1 Number of Livelihood Activities

Q. How many livelihood activities does your household have?

The proportion of households that had only one livelihood activity was 61 percent (49% control households, 51% case households), while the proportion of households that had two livelihood activities was 32 percent (54% control households, 46% case households). Less than 3 percent of the households had more than three livelihood activities (1% control households, 2% case households). About 4 percent of the households either relied on social support or other form of livelihood activity (2% for both the control and case households) (Figure 3.1).

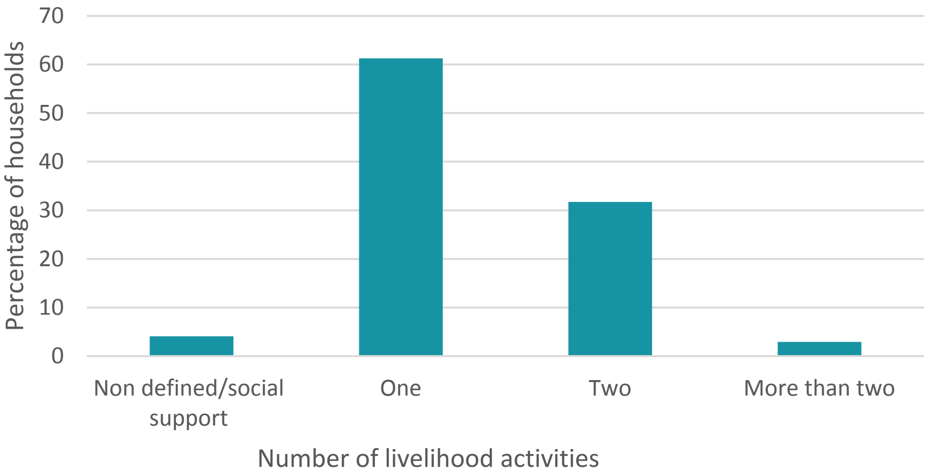

Figure 3.1: Distribution of Livelihood Activities among Surveyed Households

Is the number of household activities a risk factor for stunting? Compared to households that relied only on social support programmes, having at least one livelihood activity had a protective effect as children in households that had one livelihood activity were 14 percent less likely to be stunted. On the other hand, children in households that had two livelihood activities were 31 percent less likely to be stunted (Table 3.2).

Table 3.2: Number of Household Livelihood Activities

	Households with a stunted child				
Number of livelihood activities	**N**	**%**	**OR**	**[95% CI.**	**p.**
None/social support programs (113)	62	54.9	1		
One (1655)	849	51.3	0.86	0.59-1.27	0.463
Two (857)	392	45.7	0.69	0.47-1.02	0.068
More than two (80)	44	55	1	0.56-1.79	0.986
Total 2705)	**1347**	**49.8**			

3.3.2 Income and Risks for Stunting

Income from the Main Source of Livelihood

Income is linked to nutrition outcomes through two routes: (a) food expenditure, which affects food consumption, dietary intake and ultimately nutrition outcomes, and (b) non-food expenditure that is relevant to nutrition outcomes such as healthcare expenditure that influences health status and ultimately nutrition outcomes.

Monthly Cash Income in Rwandan Francs from Livelihood Activity

The mean monthly income for case households was FRw 25,911, while for control households this was FRw 36,975 (Table 3.3). The difference in the incomes between the two groups was statistically significant. Thus case households made significantly less income per month relative to control households. Results of effect of incomes on stunting indicate that an increase in monthly incomes (measured in Rwanda Francs) significantly reduced the odds of stunting by 10 percent (OR=0.9).

Table 3.3: Summary of Monthly Cash Income in Rwandan Francs from Livelihood Activity

Case or control	N	Mean	Standard Deviation	p
Control	1349	36,976	94,081	
Case	1328	25,912	73,494	0.000
Total	**2677**	**31,487**	**84,663**	

Income Share from the Main Livelihood Activity

The relative contribution of the main livelihood source to monthly income differed significantly (p = 0.012) between case households (87%) and control households (85%) (Table 3.4). Although quite close, additional results show that control households appeared to have more diversified sources of income than case households. For example, the proportion of income from second and third livelihood sources was relatively higher for control households than the income of the case households.

Table 3.4: Contribution of the Main Livelihood Activity to Monthly Income

Case or control	N.	Mean (%)	Std. Dev.	p
Control	1308	84.84	23.62	
Case	1288	86.96	22.37	0.012
Total	**2596**	**85.89**	**23.02**	

Based on the odds ratio, children in households that increase the proportion of incomes generated from the main livelihood activity by 1 percent have reduced odds of stunting by about 3.3 percent. More case households relied on agriculture as the main livelihood activity, thus deriving incomes mainly from agriculture. This reduces the available food for consumption if food is used for income purposes.

Table 3.5: Incomes from Main Livelihood Activity as a Factor for Stunting in Children under 24 Months

Case or control	OR	Std. Err.	z	p	95% CI.
Proportion of income from main livelihood activity	0.97	0.015	-2.23	0.026	.94-0.99

Income from Different Livelihood Sources

Households derived their incomes from different sources such as employment (28%), businesses (8%), livestock activities (4%) and transfers from relatives (2%). These are in addition to the principal agricultural production sources. The ranges of the incomes received are presented in Figure 3.2. It appears that most of the sampled households (26%) earn about FRw 20,000-50,000 per annum from non-agricultural sources.

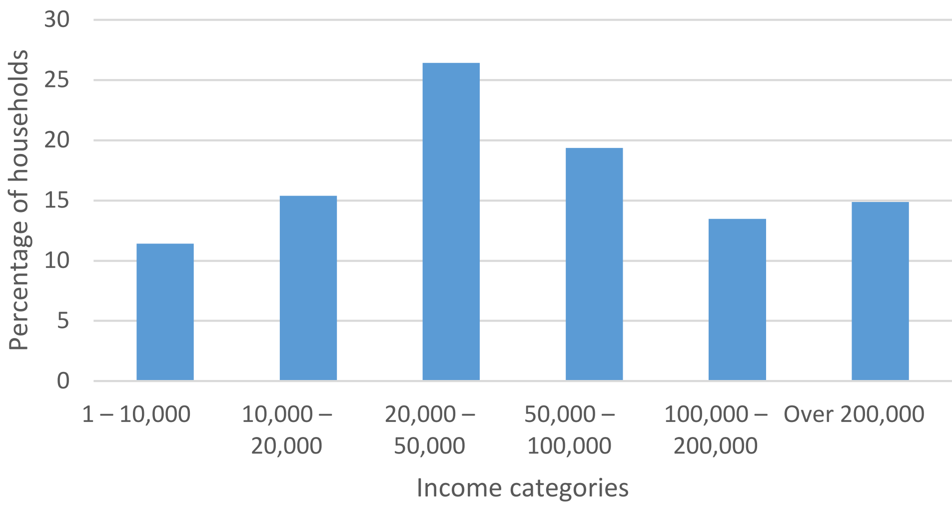

Figure 3.2: Distribution of Annual Incomes from Non-agricultural Sources among Households

Compared to households that earned less than 5000 Rwandan francs, children in households that derived at least 50,000 Rwandan francs (FRw) from non-agricultural livelihood activities were 35 percent less likely to be stunted (Table 3.6). Regardless of the livelihood activity, it would appear that this is a threshold for earnings from livelihood sources for good nutrition outcomes. Labour laws and social protection strategies need to be reviewed for their nutrition sensitivity with regard to the recommended or minimum incomes for vulnerable populations and enrolment into social protection programmes, respectively. Non-agricultural sources of income are a major supplementation of the farming incomes to a household and have a positive effect on the nutrition status.

Table 3.6: Threshold for Income from Non-agricultural Livelihoods as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Total monthly cash income from livelihood activity					
< FRw5,000 (n=555)	278	50.1	1		
FRw5,000-20,000 (n=825)	442	53.6	1.15	[0.93-1.43]	0.204
FRw20,000-50,000 (n=752)	392	52.1	1.08	[0.87-1.35]	0.466
≥ FRw50,000 (n=545)	216	39.6	0.65	[0.56-0.83]	0.001
Total (n=2,677)	1328	49.6			

3.3.3 Agriculture as a Main Livelihood Activity and Risk of Stunting

The results on livelihood activities that households are involved in are quite telling, especially with respect to agriculture. Paradoxically, children in households where agriculture is a main source of livelihood are 1.42 times more likely to be stunted (Table 3.7).

Table 3.7: Household Livelihood and Risk for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Main livelihood activity					
Other livelihood activities (n=831)	362	43.6	1		
Agriculture (n=1,846)	964	52.2	1.42	[1.20-1.67]	0.000
Total (n=2,677)	1326	49.5			

The observations in Table 3.7 are further reinforced by results in Table 3.8 showing that relative to main livelihood activities other than agriculture, children in households that rely on social support programmes are 1.62 times more likely to be stunted while those in households that have agriculture as their main household activity are 1.40 times more likely to have stunted growth.

Table 3.8: Rank of Agriculture as a Livelihood Activity and Risk for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	P
	N	%			
Livelihood activities					
Livelihood activities other than agriculture (n=707)	310	43.8	1		
Other livelihood activity (social support programmes) (n=111)	62	55.9	1.62	1.08-2.42	0.019
Agriculture as main livelihood activity (n=1,846)	964	52.2	1.4	1.18-1.67	0.000
Agriculture as second livelihood activity (n=124)	52	41.9	0.92	0 .63-1.36	0.692
Total (n=2,788)	**1388**	**49.8**			

It is probable that the data analysed reflect a disconnect between agriculture and nutrition outcomes, especially among farming households. While it would generally be expected that households relying on agriculture should also have better nutrition through consumption of own agricultural produce, the results suggest otherwise: households that have alternative livelihood sources appear to fare better than households that rely solely or largely on agriculture. There is therefore a need for more and better-designed research to clarify what agricultural programmes can do to achieve positive maternal and child nutrition outcomes. How could agriculture improve nutrition outcomes if it explicitly included health and nutrition goals? What kinds of policy and programming changes would be needed to leverage agriculture's contribution to nutrition? And what would be the key pathways in linking agriculture to nutrition in Rwanda?

3.3.4 Other Livelihood Activities and Risk for Stunting

The livelihood activities that households were involved in are represented in Table 3.9. Slightly more than 52 percent of the households were involved in agricultural production as their main livelihood activity (49.7% were control households, 50.3% were case households). Another 16 percent were involved in agricultural work on other farms for wage income (41.3% were control households, 58.7% were case households). Thus more case households were involved in work on other people's farms than control households. Other livelihood activities included unskilled non-agricultural labour (6%) of which 53.3 percent were control households and 46.7 percent were case households; informal or petty trade (5%) of which 53.4 percent were control households and 46.6 percent were case households; and salaried jobs or pension (4%) of which 69.3 percent were control households and 30.7 percent were case households. Control households thus participated more in salaried jobs and informal trade than case households.

For each of the livelihood sources, their odds on stunting were calculated relative to agricultural production on own farm (Table 3.9). Compared with agricultural production, children in household whose livelihood involved participation in agriculture by doing work on other people's farms were 1.4 times more likely to be stunted. However, households raising livestock were about 86 percent less likely to have stunted children. On the other hand, children in households whose main livelihood activity is in the transport business were 59 percent less likely to be stunted. Similarly, children in households that rely on salaried/pension livelihood activities were 56 percent less likely to be stunted. Other livelihood sources did not show significant associations as risk factors for stunting in the children.

Table 3.9: Livelihood Activities and Odds of Stunting in Children Under 24 Months

	Household with a stunted child		OR	95%CI	p
Activities	**n**	**%**			
Agricultural production on own farm (1,372)	690	50.3	1	.	.
Agricultural work on others' farms for wage income (433)	254	58.7	1.4	1.13-1.75	0.002
Livestock raising (26)	12	12.5	0.14	0.02-1.12	0.033
Unskilled daily labour (non-agricultural) (167)	78	46.7	0.87	0.63-1.20	0.382
Skilled labour (62)	29	46.7	0.87	0.52-1.45	0.588
Purchase / sale of agricultural products (16)	7	43.7	0.99	0.29-3.43	0.985
Informal sale / petty trade (131)	61	46.6	0.86	0.60-1.12	0.415
Handicrafts / artisanal work (24)	12	50	0.99	0.44-2.22	0.977
Transport (including motor cycle) (44)	15	34.1	0.51	0.27-0.96	0.034
Salaried, pension (101)	31	30.7	0.44	0.28-0.68	0.000
Own business / self-employed (41)	19	46.3	0.85	0.46-1.59	0.618
Other (184)	82	44.6	0.79	0.58-1.08	0.145
Total (2601)	**1290**	**49.6**	**2,601**		

3.3.5 Land Tenure Effect

The following land tenure issues were investigated. However, the results indicated that there was no significant difference between the case and control households with respect to land tenure (Table 3.10). Similarly, there was no significant effect on stunting in children arising from land tenure issues.

Table 3.10: Land Tenure Issues

Livelihood activities	Percentage of land	p-value
Total land size for household	-	Not significant
Proportion of land Inherited	47%	Not significant
Proportion of land purchased	25%	Not significant
Proportion of land rented-in	16%	Not significant
Proportion of land rented-out	8.50%	Not significant
Proportion of land under irrigation	6%	Not significant
Proportion of land received from government	2.60%	Not significant
Proportion of land held on behalf of relatives	4.80%	Not significant
Whether part of the land is under the consolidation program	6.40%	Not significant
Of those with land consolidation, how much of the land is under consolidation	45%	Not significant
Of those with land consolidation, proportion of land under crop intensification program	28%	Not significant

Overall, land distribution among the cases and control household is depicted in Figure 3.3. More than 65 percent of the households had less than 1 hectare of land, while 25 percent did not know the size of their land. Households with 1 hectare and below thus constituted more than 70 percent of the households included in the sample. However, there were no significant effects on stunting resulting from the differences in land sizes among the case and control households.

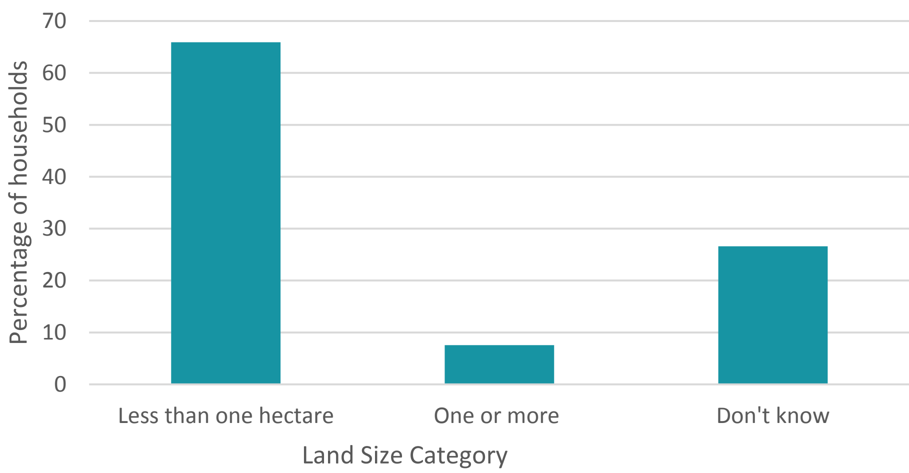

Figure 3.3: Land Availability to Households

3.4 Agricultural Production of Key Food Commodities

The majority of rural livelihoods are involved in agricultural production as a source of food and incomes in Rwanda. The production of food is affected by the nature of production and endowments at their disposal. Some of the food produced is sold to generate incomes to meet household needs. Thus an evaluation of food production characteristics would help identify underlying linkages with household nutrition status. A discussion on the agricultural production practices and their association with stunting are discussed in this section. The issues investigated in the survey are presented in Table 3.11. The tables also shows which of these issues were significantly different between case and control households. The significant variables are further discussed below.

Table 3.11: Agricultural Practices Assessed

Agricultural Production Characteristics	p-value
Sources of seeds and planting materials	0.000
Expenditure on seeds	Not significant
Use of fertiliser	0.000
Expenditure on fertiliser	0.051
Expenditure on manure	Not significant
Type of labour used	0.000
Expenditure on labour	0.020
Use of ditches on the farm	0.000
Labour providers in households	Not significant
Main crops cultivated	Not significant
Seasons for cultivating crops	Not significant
Percentage of land used for crop	Not significant

3.4.1 Ability to Acquire Seed

Overall, the mode of acquiring seeds or planting materials was significantly different between the control and case households. The survey results show that households acquired seeds/planting materials either through purchase (49%), or retained selected seeds from the previous harvest (34%), or acquired the seeds from fellow farmers (11%). Other ways of acquiring seeds mentioned by the households included gifts, government, and cooperatives.

Table 3.12 indicates that in comparison to those that had the ability to purchase their own planting materials or seeds, children in households that rely on sourcing seed as a gift or from NGOs were 1.92 times more likely to be stunted.

Table 3.12: Ability to Source for Planting Material as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Purchase (n=899)	437	48.6	1		
From other farmers (n=203)	103	50.7	1.09	[0.80-1.48]	0.584
From previous harvest (n=617)	303	49.1	1.02	[0.83-1.25]	0.849
From Government (n=34)	12	35.3	0.58	[0.28-1.18]	0.132
Cooperatives (n=17)	9	52.9	1.19	[0.45-3.11]	0.724
Gift, NGO or other (n=62)	40	64.5	1.92	[1.12-3.29]	0.017
Total (n=1,832)	**904**	**49.3**			

Results further show that about 56 percent of the farmers did not spend anything on seeds while 36 percent spent up to FRw 5,000; out of which about 49 percent were case households and 51 percent control households. About 8 percent of the households spent between FRw 5,000 and FRw 200,000, which were dominated by control households. Hardly 4 percent of both case and control households spent more than FRw 5,000 on seed purchases. Expenditure on seed was not significantly different between the case and control households.

3.4.2 Use of Fertiliser and Hired Labour

The use of mineral fertiliser was significantly different between case and control households. Of the households applying fertiliser (18%), 42.7 percent were case households while control households were 57.3 percent. The use of fertilisers among the sampled households was significantly different between cases and controls (p=0.006). Compared to households that used fertiliser, children in households that did not use fertiliser were 1.40 times more likely to be stunted (Table 3.13). Naturally, low fertiliser use is associated with low production, which may reduce availability of food to the family. Majority of the households (85%) did not use mineral fertilisers in crop production confirming previous findings in the region (Ouma et al 2012, Ochieng et al 2014).

Table 3.13: Application of Mineral Fertiliser as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		**OR**	**95% CI**	**p**
	N	**%**			
Do you apply mineral fertiliser?					
Yes (n=335)	143	42.7	1		
No (n=1,504)	767	51	1.4	[1.10-1.77]	0.006
Total (n=1,839)	**910**	**49.5**			

Expenditure on fertiliser by the households indicate that children in households that could afford fertiliser were less likely to be stunted (Table 3.14). For example, compared to households that did not spend money on fertiliser, children in households that spent at least Rwf 5000 on fertiliser were 29 percent less likely to be stunted.

Table 3.14: Expenditure on Fertiliser as a Risk Factor for Stunting in Children

Expenditure on fertiliser	**Households with a stunted child**		**OR**	**[95% CI.**	**p**
	N	**%**			
0 Rwf (1,484)	761	51.2	1	-	.
0 - 5,000 (182)	78	42.8	0.71	0.52-0.97	0.032
5,000-10,000 (65)	24	36.9	0.56	0.33-0.93	0.024
10,000-50,000 (65)	29	44.6	0.77	0.46-01.26	0.293
50,000- 200,000 (6)	2	33.3	0.48	0.087-2.60	0.380
Total (1737)	**894**				

The sampled households predominantly used family labour, especially the case households. The type of labour used was significantly different between the case and control households. Control households predominantly used both family and hired labour (57% of users); of which hired labour constituted 63 percent of the households while some households exchanged labour (53% of users). Expenditure on labour was significantly different between the controls and case households. About 86 percent of the households indicated that they did not spend on labour meaning that they heavily relied on family labour. Out of the households who spent between FRw 5,000-200,000 on labour, the control households represented 54-74 percent while case households that spent money on labour were as low as 26 percent. Children in households that relied on hired labour had significantly lower odds of stunting relative to those that relied solely on family labour (Table 3.15). The odds of stunting in children in households that relied on hired labour were 43% lower compared to those that relied solely on family labour.

Table 3.15: Type of Labour used as a Risk Factor for Stunting in Children

	Household with a stunted child		OR	95% CI	p
	N	%			
What type of labour did you use?					
Family labour (n=1,541)	787	51.1	1		
Hired labour (n=112)	42	37.5	0.57	[0.39-0.85]	0.006
Both hired and family (n=89)	39	43.8	0.75	[0.49-1.15]	0.185
Exchange labour (n=25)	11	44	0.75	[0.34-1.67]	0.484
Other (n=71)	30	42.3	0.7	[0.43-1.13]	0.148
Total (n=1,838)	**909**	**49.5**			

Results on the total monetary expenditure on all inputs by the households show mildly significant differences between the control and case households ($p>0.05$). However, expenditure on labour was quite different between the control and case households ($p=0.02$). Children in households that spent at least FRw 10,000 on labour were 45 percent less likely to be stunted compared to children in households that did not spend on labour (Table 3.16).

Table 3.16: Expenditure on Labour as a Risk Factor for Stunting in Children

Expenditure on labour	Households with a stunted child		OR	[95% CI.	p
	N	%			
0 Rwf (1,623)	823	50.7	1	.	.
0 - 5,000 (59)	24	40.7	0.67	0.39-1.13	0.13
5,000-10,000 (43)	21	48.8	0.93	0.51-1.70	0.809
10,000-50,000 (58)	21	36.2	0.55	0.32-0.95	0.03
50,000- 200,000 (15)	4	26.7	0.35	0.11-1.11	0.064
Over 200,0000 (1)	0	0	0	.	0.311
Total (1799)	**3**				

The seeds expenditure scenario is similar to fertiliser expenditure where 84 percent did not buy fertiliser and the 16 percent who did were mainly from control households.

One of the farm management practices that also had a significant association with malnutrition was the use of ditches to manage soil erosion by the households (Table 3.17). In comparison with utilization of hedges and terraces, more households used ditches which was significantly different between the control and case households (p=0.001).

The use of ditches as part of farming practices significantly reduced the odds of stunting for children in the households (odds ratio of 0.81) that used the ditches. This is probably due to enhanced productivity from the soil erosion control measures.

Table 3.17: Use of Ditches on Farms

Do you use ditches?	N	%	OR	[95% CI	p
Yes (779)	409	51.5	1		
No(1028)	487	49.5	0.81	[0.67 - 0.98]	0.031
Total	**1807**				

3.4.3 Other Agricultural Production Practices

Other crop production and management practices did not have significant effect on observed levels of stunting among children. However, some of them showed significant differences between the cases and controls. But these practices did not significantly affect stunting in children. The discussion below highlights the differences between the case and control households with respect to some of these agricultural practices that showed significant differences between the two groups.

Table 3.18: Other Agricultural Practices among the Case and Control Households

Other Agricultural Production Characteristics	p-value
Main crops used for Intercropping: maize and Irish potatoes	0.000
Use of terraces	Not significant
Use of hedges on the farms	Not significant
Mulching	Not significant
Labour provision for land preparation	0.000
Labour provision for planting	0.001
Labour provision for weeding	0.033
Labour provision for harvesting	0.002
Periods for different agricultural practices (only July and October	0.012
Investment in staking materials, chemicals and other inputs	Not significant
Source of funds for production activities	Not significant
Who initiates decisions on area of land to plant	Not significant
Who initiates decision on the variety to plant	0.009
Frequency of participation in evaluation of new varieties and technologies	Not significant
Main production issues and constraints	Not significant
Main market issues and constraints	Not significant

Intercropping: There were only two crops that showed significant differences between the case and control households when used as intercrops in the farming practices: maize and Irish potatoes. Control households used maize as a main intercrop (about 59%) while case households used Irish potato as a main intercrop (about 65%), although there were only a few that used Irish potatoes for intercropping. Other crops did not show significant differences between the case and control households (Table 3.19).

Table 3.19: If Intercropped, Which is the Main Intercrop Crop?

	Case		Control		Total
	%	95% CI	%	95% CI	%
Main intercrop crop is maize				p=0.028	
No (n=786)	50	[46.5,53.5]	50	[46.5,53.5]	**100**
Yes (n=201)	41.3	[34.7,48.2]	58.7	[51.8,65.3]	**100**
Main intercrop crop is Irish potato		p=0.039			
No (n=950)	47.6	[44.4,50.8]	52.4	[49.2,55.6]	**100**
Yes (n=37)	64.9	[48.4,78.4]	35.1	[21.6,51.6]	**100**

Household use of soil management techniques: Few farmers had terraces in their farms and about 52 percent of them were from control households. Similarly, hedges were rarely used by all the farmers but majority of those who had them were from control households (>51%) as well. Only less than 1 percent of the households used mulching and 54 percent of them were control households. Results further indicate that more than 90 percent of the households planted after rain started with 52 percent being control and 48 percent being case households.

Land preparation and planting: The results in Table 3.20 show a significant difference between the case and control households with regard to provision of labour for land preparation (p=0.000). Approximately 62 percent of the households reported that land preparation is mainly done jointly by the household head and spouse.

Table 3.20: Who in the Household Provides Labour for Land Preparation?

Who provides labour for land preparation p= 0.000					
	Case		**Control**		**Total**
	%	**95% CI**	**%**	**95% CI**	**%**
No one (n=64)	67.2	[54.9-77.5]	32.8	[22.5-45.1]	**100**
Head of household only (n=278)	47.8	[42.0-53.7]	52.2	[46.3-58.0]	**100**
Spouse of head of household only (n=530)	54.3	[50.1-58.5]	45.7	[41.5-49.9]	**100**
Household head and spouse jointly (n=2,026)	49.3	[47.1-51.4]	50.7	[48.6-52.9]	**100**
Men only (n=37)	62.2	[45.8-76.2]	37.8	[23.8-54.2]	**100**
Women only (n=75)	73.3	[62.2-82.1]	26.7	[17.9-37.8]	**100**
Adults only (n=68)	42.6	[31.5-54.6]	57.4	[45.4-68.5]	**100**
Children only (n=6)	33.3	[8.4-73.2]	66.7	[26.8-91.6]	**100**
Women and children (n=46)	50.0	[35.9-64.1]	50.0	[35.9-64.1]	**100**
Men and children (n=3)	66.7	[15.3-95.7]	33.3	[4.3-84.7]	**100**
Everybody (n=113)	56.6	[47.4-65.5]	43.4	[34.5-52.6]	**100**

On the other hand, about 45 percent of the sample, of which 53 percent were from the control category, indicated that planting is mainly done by the spouse and also many times done jointly by the household head and spouse (Table 3.21). There was a significant difference (p=0.001) between the case and control households in providing labour for planting.

Table 3.21: Who in the Household Provides Labour for Planting?

Who provides labour for planting	**p=0.001**				
	Case		**Control**		**Total**
	%	**95% CI**	**%**	**95% CI**	**%**
No one (n=61)	67.2	[54.6,77.8]	32.8	[22.2,45.4]	**100**
Head of household only (n=188)	42.6	[35.7-49.7]	57.4	[50.3-64.3]	**100**
Spouse of head of household only (n=1,463)	52.8	[50.2-55.3]	47.2	[44.7-49.8]	**100**
Household head and spouse jointly (n=1,224)	48.4	[45.7-51.3]	51.6	[48.7-54.3]	**100**
Men only (n=33)	66.7	[49.2-80.5]	33.3	[19.5-50.8]	**100**
Women only (n=92)	65.2	[55.0-74.2]	34.8	[25.8-45.0]	**100**
Adults only (n=54)	42.6	[30.2-56.0]	57.4	[44.0-69.8]	**100**
Children only (n=6)	33.3	[8.4-73.2]	66.7	[26.8-91.6]	**100**
Women and children (n=44)	52.3	[37.7-66.4]	47.7	[33.6-62.3]	**100**
Men and children (n=1)	0.0		100.0		**100**
Everybody (n=80)	55	[44.0-65.5]	45	[34.5-56.0]	**100**
Total (n=13,940)	**50.2**	**[49.4-51.0]**	**49.8**	**[49.0-50.6]**	**100**

Weeding: Provision of labour for weeding was significantly different between the case and the control households (p=0.0333). In Table 3.22 majority (48%) of those interviewed, who were dominated by the control households (52%), reported that weeding is mostly done by the spouse.

Table 3.22: Who in the Household Provides Labour for Weeding?

Who provides labour for weeding p=0.033					
	Case		**Control**		**Total**
	%	**95% CI**	**%**	**95% CI**	**%**
No one (n=190)	55.8	[48.7,62.7]	44.2	[37.3,51.3]	**100**
Head of household only (n=139)	41.0	[33.1-49.4]	59.0	[50.6-66.9]	**100**
Spouse of head of household only (1554(	51.8	[49.3-54.3]	48.2	[45.7-50.7]	**100**
Household head and spouse jointly (n=1,044)	49.5	[46.5-52.6]	50.5	[47.4-53.5]	**100**
Men only (n=35)	65.7	[48.8-79.4]	34.3	[20.6-51.2]	**100**
Women only (n=89)	61.8	[51.3-71.3]	38.2	[28.7-48.7]	**100**
Adults only (n=52)	44.2	[31.4-57.8]	55.8	[42.2-68.6]	**100**
Children only (n=7)	28.6	[7.2-67.4]	71.4	[32.6-92.8]	**100**
Women and children (n=46)	56.5	[42.0-70.0]	43.5	[30.0-58.0]	**100**
Men and children (n=1)	100.0		0.0		**100**
Everybody (n=89)	50.6	[40.3-60.8]	49.4	[39.2-59.7]	**100**
Total (n=1806)	**50.2**	**[49.4-51.0]**	**49.8**	**[49.0-50.6]**	**100**

Pesticide and fumigation: It is important to note that majority (90%) of those interviewed neither applied pesticides nor fumigants. The few (4%) who did reported that this activity was done jointly by the head of the household and the spouse. However, there is no significant difference in provision of labour for pesticide and fumigation application between the cases and controls (p=0.146).

Harvesting: From the results in Table 3.23, there is a significant difference (p=0.002) between the case and control households with regard to provision of labour for harvesting. About 52 percent of the respondents reported that harvesting is mostly done jointly by the household head and spouse (who are equally distributed in the case and control categories), followed by the spouse mostly in the control category at 53 percent.

Table 3.23: Who in the Household Provides Labour for Harvesting?

Who provides labour for harvesting p=0.002					
	Case		Control		Total
	%	95% CI	%	95% CI	%
No one (n=174)	52.3	[44.9-59.6]	47.7	[40.4-55.1]	**100**
Head of household only (n=146)	38.4	[30.8-46.5]	61.6	[53.5-69.2]	**100**
Spouse of head of household only (n=896)	53.2	[50.0-56.5]	46.8	[43.5-50.0]	**100**
Household head and spouse jointly (n=1,688)	49.9	[47.6-52.3]	50.1	[47.7-52.4]	**100**
Men only (n=29)	69.0	[50.3-83.0]	31.0	[17.0-49.7]	**100**
Women only (n=78)	69.2	[58.2-78.4]	30.8	[21.6-41.8]	**100**
Adults only (n=57)	45.6	[33.2-58.6]	54.4	[41.4-66.8]	**100**
Children only (n=9)	33.3	[11.1-66.7]	66.7	[33.3-88.9]	**100**
Women and children (n=53)	50.9	[37.7-64.0]	49.1	[36.0-62.3]	**100**
Men and children (n=6)	50.0	[16.8-83.2]	50.0	[16.8-83.2]	**100**
Everybody (n=110)	54.5	[45.2-63.6]	45.5	[36.4-54.8]	**100**
Total (n=13,940)	**50.2**	**[49.4-51.0]**	**49.8**	**[49.0-50.6]**	**100**

Post-harvest storage: The results show that 61 percent of the respondents reported that none of the household members provide labour for post-harvesting activities. In the case households, 18 percent reported that post-harvest storage is mainly done jointly by the household head and spouse, while about 16 percent reported that the activity is done by the women. There was a significant difference (p=0.050) between the control and the case households.

Periods for the Different Agricultural Practices

Period for land preparation: There is no specific month when land is prepared for planting, but rather depends on the specific household and the crop to be planted. However, the month when land preparation was carried out was insignificantly different between the control and case households. Notwithstanding, results show that much of the land preparation was done in January and February, and 51-52 percent of the respondents were in the control category. From the beginning to the end of the year, households prepared their land for planting with November-December being the months when this activity was rarely done since most households have already planted for the season.

Period for planting: Majority of the sampled farm households planted in February and March. However, depending on the crop type, planting spread throughout the year. Similar to land preparation, many households did not plant during November and December. Both the case and control households planted almost at the same time thus no significant differences were observed between them.

Period for weeding: The months for weeding crops were not significantly different between the control and case households ($p>0.005$). This is because farmers weed almost at the same time. In general, the results show that weeding was mainly done in March and April. However, in every month there were some households who still weeded their crops showing that weeding can be done any time.

Period for staking beans: The results show that few households carried out staking and for those that did it was done in the few months after planting mainly in March and April. Among the farmers who did staking after March and April, majority were from the control households. For example, in the control households, 64 percent did staking in May, June (69%), July (57%) and August (71%). This implies that many control households were able to plant beans off-season (June to August).

Period for pesticide application and fumigation: The months for application of pesticides and fumigants were not significantly different between the control and case households. Overall, the farmers hardly used pesticides and fumigants, which conforms to previous findings in Rwanda by Ochieng et al (2014) who found that 0.41 percent of the farmers applied crop chemicals in their farms. On monthly basis, less than one percent of the households indicated that they use pesticides and fumigants. However, out of the few who sprayed and fumigated in January, April and October, over 50 percent were control households while case households dominated in March, June, August and September. As observed, pesticide application and fumigation occur throughout the year because spraying is mainly done in the field while fumigation is undertaken in the stores.

Period for harvesting: Harvesting period was not significantly different between control and case households because farmers often do harvesting at the same time except in the months of July and October ($p=0.002$ and 0.012, respectively). However, overall results show that majority of the households harvest in June or July. Nevertheless, harvesting period may vary from one farmer to another depending on the month they planted their crops. For farmers who harvested in June, both the controls and cases are equally (50:50) distributed, while more case than control households harvested in July. Results further show that few farmers harvested crops in the rest of the months (including January, February, March, April, May, August, September, November and December (Table 3.24). More control (53-61%) households harvested crops in July, September and October than case households (38-46%), the difference being quite significant between them.

Table 3.24: Which Months are the Following Activities Done: Harvesting?

	Case		Control		Total
	%	95% CI	%	95% CI	%
Which months for Harvesting: July		**p=0.002**			
No (n=2,500)	52.9	[51.0-54.9]	47.1	[45.1-49.0]	100
Yes (n=825)	46.8	[43.4-50.2]	53.2	[49.8-56.6]	100
Which months for Harvesting: September		**p=0.076**			
No (n=3,176)	51.7	[50.0-53.5]	48.3	[46.5-50.0]	100
Yes (n=149)	44.3	[36.5-52.4]	55.7	[47.6-63.5]	100
Which months for Harvesting: October		**p=0.012**			
No (n=3,234)	51.8	[50.0-53.5]	48.2	[46.5-50.0]	100
Yes (n=91)	38.5	[29.1-48.8]	61.5	[51.2-70.9]	100

Period of selling: Just like other farm activities, the months of selling farm produce were not significantly different between case and control households. Although selling of the produce occurred throughout the year, relatively more households sold in June, July and August. Most households harvest in June-July and prices might not be conducive to cover the production costs during this period of high supply. It is noted that control households mainly sold their produce in August (55%), February (56%), March (54%) and December (54%) while case households dominated the rest of the months. This may imply that the case households dominantly sold immediately after harvest.

Period for post-harvest storage: The period for post-harvest storage was not significantly different between the cases and controls. Most of the households stored their produce around July, August and September, which is immediately after harvesting of crops that often begins in June. Notably, post-harvest storage was carried out throughout the year by some households who harvested at different times in the year. The few post-harvest activities in October, November and December were dominated by control households (>50%).

Other Production Factors

Investment in staking materials, pesticides, post-harvest storage and others: Expenditure on staking materials, pesticides, post-harvest storage and other expenses was not significantly different between the control and case households. From the results, 91 percent of the sampled households did not spend resources on staking materials and only nine percent did. Similarly, 94 percent of the households did not spend on pesticides while less than one percent spent up to FRw 200,000 reflecting the existence of low investments on agricultural inputs. Most households did not spend on post-harvest storage and other expenses either; an indication that most of the storage is done within the main dwelling units. Those who spent on post-harvest storage were the control households.

Source of money to cover the production costs: The money to cover production costs mainly came from sale of previous crops (26%), employment and trading activities (25%) and other sources (49%). The difference between controls and cases in the sources of funds to cover production costs were not significant.

Initiator of decisions on the area of land and variety to plant: Crop management decisions were not significantly different between the control and case households. Most of the decisions were dominantly made jointly by the household head and spouse followed by head of the household only. Specifically, 51 percent of the households indicated that the household head and spouse jointly decided on the area to plant (51% controls; 49% cases), and 61 percent of the households indicated that the household head and spouse jointly decided on the variety of crops to plant (50% controls; 50% cases).

Frequency of participation in evaluating new varieties and technologies: The frequency of household involvement in evaluating new varieties and technologies was not significantly different between the case and control households. About 33 percent of the households had never participated in technology evaluations. Majority of the households (60%) had participated up to 5 times with the rest having participated more than 5 times in the evaluation of varieties and technologies.

The main issue that needs most attention to improve crop production: The farmer's perception on the most important issue in crop production was significantly different between the case and control households ($p=0.06$). It is evident from the survey that soil fertility is the most important issue in crop production (32%) followed by better varieties (22%). Among the farmers who indicated that soil fertility is key, 52 percent were from case households. 56 percent of case households mentioned better varieties.

The main issue that needs most attention to improve agricultural markets: The main issue that needed urgent attention was not significantly different between control and case households. However, according to sampled households, better markets were cited by about 31 percent as the most important issue that needs quick attention followed by government policies (20%). Out of the 31 percent who mentioned better markets as a key area of attention, 52 percent were control households while government policy was mentioned by 52 percent of case households. Other issues mentioned by the households to be given attention include market information, credit to support production and road infrastructure to support movements. All these issues are important because production cannot remain strong and sustainable without complementary market access and resource endowment such as credit, infrastructure, market information and a conducive policy environment.

3.5 Harvesting, Storage and Marketing of Agricultural Products

A large number of variables were assessed for differences between case and control households. Some were not significant to differentiate between the two groups (Table 3.25).

Table 3.25: Crop Harvests and Marketing between Control and Case Households

Issues investigated	p-value
How much of the crop was harvested	0.000
Whether any of the harvest was sold	Not significant
Quantity sold, if sold	Not significant
Form in which product was sold	0.000
Whether sold individually or collectively	Not significant
Main purpose of selling	Not significant
Distance to nearest market	Not significant
Time to nearest market	Not significant
Mode of transport to market	0.000
Whether product was sold immediately after harvest or not	Not significant
Where product was sold from	Not significant
Whether any product was stored	Not significant
Length of household food storage	0.000
Who decides how much to sell	Not significant
Who decides how to use money from sales	Not significant
If did not sell, reason for not selling	Not significant

There is a significant difference with respect to selling of agricultural products between the case and control households (p=0.089). The majority of the respondents (62%) grow crops for subsistence use while only about 38 percent sold at least part of the produce. The results also indicate that, most of the households sold their produce to traders in the village markets (over 60%), and only 27 percent and 9 percent of the farmers sold their produce to cooperatives and processors, respectively. However, the effect of type of market outlet on stunting was not statistically significant.

Although the significance levels are on the borderline, children in households that produced at least 5 bags of produce were less likely to be stunted (by 45%) relative to children in households that produced less than one bag of produce (Table 3.26). The results strengthen the case for improving productivity of the farms to make food more available.

Table 3.26: Agricultural Productivity and Risk for Stunting

	Household with a stunted child		OR	95% CI	p
	N	%			
How much of the crops did you harvest?					
Less than a bag (100 kg) (n=935)	472	50.5	1.00		
One - five bags (n=390)	183	46.9	0.87	[0 .68-1.10]	0.238
Others (more than 5 bags) (n=46)	16	34.8	0.52	[0.28-0.97]	0.041

Additional results in Table 3.27 show that relative to children in households that sold their products in fresh form, children in households that sold their products in dry form had significantly higher odds for stunting in children less than 24 months. The plausible explanation for this is that in the event of food scarcities, those that sell dry (reserve) foods may be doing so under duress thus depleting their food reserves and increasing the odds of poor nutrition outcomes in the households.

Table 3.27: Agricultural Marketing and Risk for Stunting in Children under 24 Months

	Households with a stunted child		OR	95%CI	p
	N	%			
In what form did you mostly sell the product?					
Fresh (n=110)	40	36.4	1.00		
Dry (n=342)	173	50.6	1.79	[1.15-2.79]	0.010
Processed (n=6)	2	33.3	0.88	[0.15-4.99]	0.881
Other (n=4)	3	75.0	5.25	[0.53-52.17]	0.157

In addition to productivity, storage time at the home had a significant effect on the odds of stunting in children under 24 months. This was seen when comparing households that stored food for less than one month vis a vis households that stored for periods of more than one month.

The odds of stunting in children significantly decreased by 56 percent when produce was stored for periods longer than one month compared to households that stored for less than one month (Table 3.28). Overall, among the households that reported having stored at least some food, much fewer households indicated that they stored food for longer periods than 3 months.

Table 3.28: Length of Food Storage and Risk for Stunting in Children

	Household with a stunted child		OR	95% CI	p
	N	%			
How long did your household store products?					
One month or less (n=43)	27	62.8	1.00		
More than a month to three months (n=300)	128	42.7	0.44	[0.23-0.85]	0.015
More than three months to six months (n=72)	32	44.4	0.47	[0.22-1.03]	0.059
More than 6 months (n=9)	3	33.3	0.30	[0.06-1.35]	0.116
Other (n=3)	2	66.7	1.19	[0.10-14.14]	0.893

Mode of Transport

The main mode of transport used by both case and control households was on foot, about 50 percent for both case and controls. Of those who used bicycles, 44 percent were case households while 56 percent were control households. Similarly for other motorised transport, relatively fewer case households used them: motor cycle 21 percent, vehicle 41 percent for case while controls were 79 percent for motorcycle and 59 percent for vehicle.

Results of the odds ratios show that only the use of motorcycle was significantly different between the case and control households. Children in households that used motorcycle transport were 74 percent less likely to be stunted compared to children in households that went on foot to markets. Access to markets is made easier with motorcycle transport relative to other means of transport thus impacting on stunting in children.

Table 3.29: Means of Transport as a Risk Factor for Stunting in Children under 24 Months

What means of transport do you use to get to nearest market					
	Households with a stunted child		OR	95%CI	p
	N	%			
On foot (n=2,216)	1115	50.3	1.00		
Bicycle (n=124)	55	44.4	0.79	[0.55-1.13]	0.197
Motor cycle/tricycle (n=24)	5	20.8	0.26	[0.10-0.70]	0.008
Vehicle (n=73)	30	41.1	0.69	[0.43-1.11]	0.123
Public transport (n=6)	2	33.3	0.49	[0.09-2.70]	0.416
Other (n=344)	181	52.6	1.10	[0.87-1.38]	0.427

3.6 Market Information

Market information can play an important role in optimizing returns from production activities through accessing better prices and/or larger volumes being taken to better markets. In the NMG Survey, the use of various sources of market information was significantly different between the case and control households. Two questions were asked with respect to market information; the first on the most important sources of market information (P=0.042), and the other on satisfaction with market information sources (P=0.004).

The prevalence of the different sources of market information among households shows radio, community meetings and the market place as major sources of market information among the surveyed households (Figure 3.4). In terms of the importance households attached to the different sources of information, direct information from the market place came out as the most important (42%), followed by community meetings (22%), radio (10%), and cooperatives although cooperatives were restricted to about 5 percent of the households. Control households systematically used more of newspapers (54%), farmer cooperatives (55%), radio (57%), and TV (69%). On the other hand, case households used more community meetings (52%), the market place (51%) and other sources of information (52%). Thus case households significantly used more of the informal information sources while control households relied more on the formal information sources.


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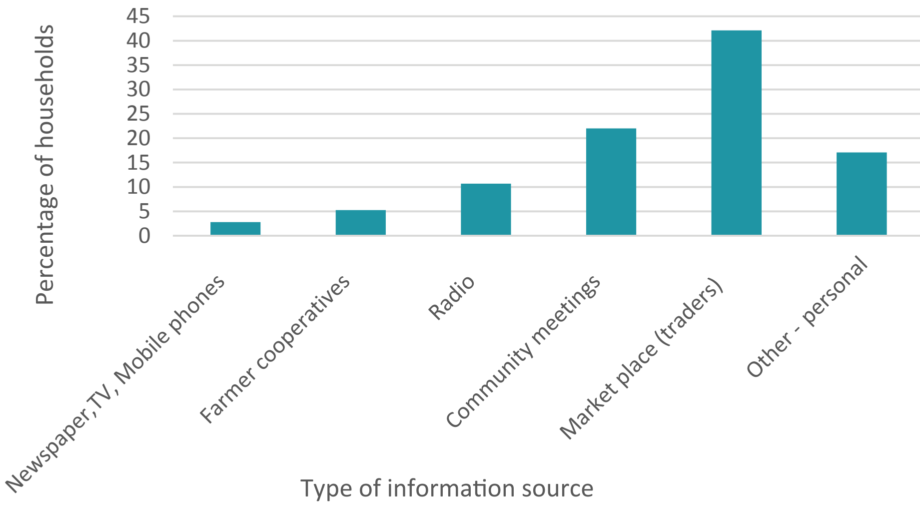

Figure 3.4: Most Important Source of Market Information for Households in the Past 12 Months

Children in households using most of the market information sources such as cooperative sources, radio, television and mobile phones showed decreased odds of stunting among households compared to those using newspapers, but the effect is not statistically significant. On the other hand, children in households that predominantly used information directly from the markets showed potential to increase the odds of stunting compared to those that relied on newspapers, but this was not significant in effect. The dominant information included information sourced directly from the market as well as meetings and gatherings. Sourcing this kind of information requires the household to travel to the sources or rely on others to provide it. Reliability of this dominant source is low and the cost of acquiring the information can be quite high.

Satisfaction with the different sources of information also varied, although this was not a significant factor for stunting (Figure 3.5). About 23 percent were very satisfied while 35 percent of the households were moderately satisfied with the information, with the rest being mostly indifferent or not satisfied at all. Relatively more control households were satisfied with the market information sources than case households. Of the households that were very much satisfied with market information, 48 percent were case households and 52 percent were control households. Moderately satisfied case households were 47 percent compared to control households with 53 percent. On the other hand, among those that were indifferent, case households accounted for 54 percent and control for 46 percent. However, a much less figure of 45 percent was observed for case households that were not satisfied at all with the information while for control households the proportion was 55 percent.

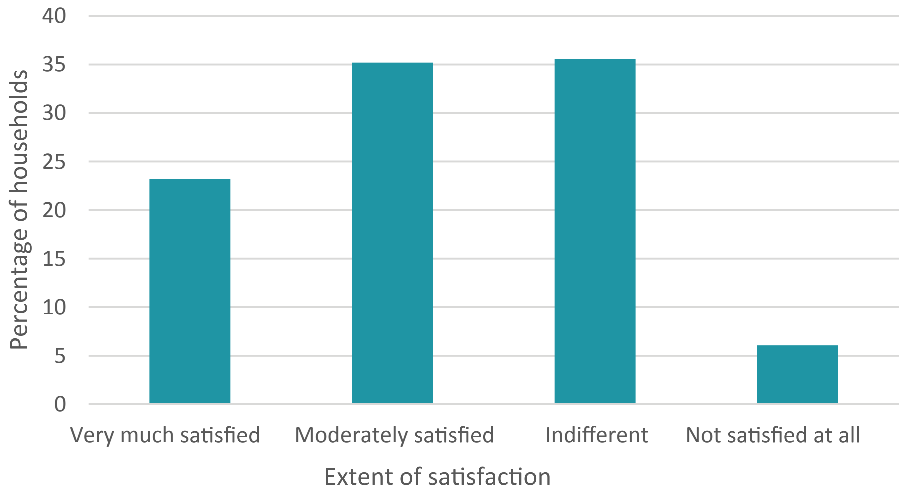

Figure 3.5: Level of Satisfaction with Sources of Market Information

Results of the odds ratios indicate that children in households that were satisfied with market information were significantly correlated with low levels of stunting. Children in households that were indifferent to the market information sources (neither satisfied nor dissatisfied) were 1.29 more likely to be stunted relative to those in households that were satisfied with the market information. The households that were indifferent to market information sources may not be actively searching for markets for their produce or do not intend to sell part of their produce hence were more likely to retain food for their families contributing to the reduced odds of stunting (Table 3.30).

Table 3.30: Satisfaction with Market Information as a Risk Factor for Stunting in Children under 24 Months

	Household with stunted child		OR	95% Conf. Interval	p
Extent of satisfaction	**N**	**%**			
Very much (629)	302	48.0	1.00	. .	.
Moderate (934)	438	46.9	0.96	0.78-1.17	0.664
Indifferent (978)	532	54.4	1.29	1.06-0.58	0.012
Not satisfied (164)	75	45.7	0.91	0.65-1.29	0.603
Total (2705)	**1347**	**49.8**			

3.6.1 Livestock Production and Marketing and Stunting in Children

The effect of livestock production activities on stunting in children was analysed and showed that most of the livestock activities were not significantly different between case and control households (Table 3.31). Other than frequency of sales of the livestock products, the effect of the individual livestock related variables were not significantly different between the cases and controls. A reason could be the low scale of livestock production activities across both case and control households. Overall, the proportion of households that were engaged in livestock-related activities was less than 2 percent of the entire sample. This was not enough to bring out the full effect of livestock rearing on stunting in children.

Table 3.31: Livestock Production and Marketing as Risk Factors for Stunting in Children

	p
Whether keeping large, small livestock or poultry affected stunting	Not significant
Number of livestock types	Not significant
Importance of main livestock activities	Not significant
Whether any livestock were sold	Not significant
Whom the livestock were sold to	Not significant
If sold, where they were sold	Not significant
How often the livestock products were sold	0.000
Percentage of livestock product sold	Not significant

Relatively few households sold any livestock products. When livestock products are sold less regularly by households (as opposed to daily sales), the odds of stunting in children within these households significantly reduced by 88 percent, especially if sales only took place seasonally (Table 3.32). This implies that children in households that were able to retain livestock food products within the household stood a better chance at improving their nutrition compared to children in households that sold the products on daily basis.

Table 3.32: Frequency of Livestock Sales as a Risk Factor for Stunting in Children under 24 Months

Frequency of livestock product sales	Households with a stunted child		OR	[95%CI	p
	N	%			
Daily (22)	13	59	1.00	. .	
Weekly (6)	1	17	0.14	0.01-1.70	0.070
Monthly (6)	4	67	1.38	0.20-9.61	0.741
Seasonally (7)	1	14	0.12	0.01-1.43	0.042
Twice a year (3)	1	33	0.35	0.03-4.83	0.409
Yearly (20)	10	50	0.69	0.20-2.39	0.559
Other (19)	7	37	0.40	0.11-1.50	0.160
Total (85)	**37**				

3.7. Membership in Cooperatives

To assess whether there was a difference in the social capital of both case and control households, 3 questions on cooperatives were asked (Table 3.33).

Table 3.33: Cooperative Membership Issues

Variable	Significance
Membership in cooperatives	0.000
Membership in a SACCO (savings cooperatives)	Not significant
Reason for non-participation in cooperatives	0.000

The effect of social capital in many African communities is to reduce transaction costs and costs of accessing certain services for those participating in group activities. In agriculture, services that may be received through collective action may include credit and extension and marketing services. The expectation here would be that households that are able to access input and marketing services for their agricultural production through cooperative efforts would be in a better position to improve household nutrition status. The data in Table 3.34 confirm this hypothesis. More than 40 percent of the households (47% of these were case households and 53% control households) belonged to a cooperative organization and the odds of stunting in children where the household members did not belong to cooperatives was 1.2 times higher compared to children where household members belonged to a cooperative or group.

Further analyses of the data also showed that one of the reasons cited for non-membership in cooperatives was high membership fees although the amount was not stated. This reason was quite significant in explaining the observed stunting levels in children in case households. Children in households that indicated membership fees as a reason for not joining cooperatives were 1.69 times more likely to be stunted compared to children in households that indicated proximity as a reason for not joining a cooperative. Extreme poverty levels may contribute to non-participation in collective economic efforts, thus further marginalizing vulnerable households from mainstream economic activities. Agricultural policies and programmes need to be reviewed for their nutrition sensitivity with regard to this issue.

Table 3.34: Household Membership in a Cooperative as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	P
	N	%			
Household membership in farmer cooperative/group					
Yes (n=1,117)	526	47.1	1.00		
No (n=1,670)	862	51.6	1.20	[1.03-1.40]	0.019
Total (n=2,787)	**1388**	**49.8**			
Reason for non-participation in membership of any cooperative					
There is none near me (n=115)	47	40.9	1.00		
The membership fee is high (n=1,018)	545	53.5	1.67	[1.13-2.47]	0.011
Not interested in cooperatives (n=194)	87	44.8	1.18	[0.74-1.88]	0.496
Other (n=189)	103	54.5	1.73	[1.08-2.78]	0.022
Total (n=1,516)	**782**	**51.6**			

3.8. Household Food and Non-food Expenditure

3.8.1 Expenditure on Food Items

Expenditure on food items over the 30 days prior to the survey were analysed and revealed that there were significant differences between case and control households in some of the food item expenditures (Table 3.35). There were significant differences in expenditures on cereals, bread, banana, meat/poultry, eggs, milk, fresh fruit and sugar/sweets. In all households, case households spent progressively lower than control households. Between 41-48 percent of the households reported spending money on different food items. Those who reported spending money on the food items in control households ranged between 51-59 percent. Overall, more than half of the interviewed households spent some money on food items for the family over the previous 30 days. Among those who spent relatively less on food were the case households.

Table 3.35: Household Food Expenditure

Expenditure item	Significance
Expenditure on cereals	0.000
Bread	0.000
Banana	0.000
Meat/poultry	0.000
Eggs	0.000
Milk	0.000
Fresh fruit	0.000
Sugar /sweets	0.000
Roots and tubers, oils and fats, pulses, vegetables, groundnuts, drinking water, meals outside home, other foods	Not significant
Most important uses of incomes	Not significant

The data on household expenditure on specific food items show a close association between incidence of expenditure on food items and odds of stunting in children under 24 months (Table 3.36). Overall the odds for stunting in children are significantly higher in households that had limited food expenditure in the past 30 days. Compared to children in households that spent money on different food items, the odds of stunting in children was 1.2 times higher in households that did not spend money on cereals over the 30 day period. Similarly, for bread, the odds of stunting in children increased by 1.4 times in households did not spend on bread. The odds of stunting in children increased by 1.18 times when the household did not spend on bananas and by 1.40 when the households did not spend on eggs over the period. The odds of stunting in children was 1.59 times higher when a household did not spend on meat/poultry or fish. Similarly, the odds of stunting in children was likely to increase by 1.36 for eggs, 1.25 for dairy, and 1.43 for fresh fruits and sugars and sweets when a household did not spend money on these items. From the data, lack of household expenditure on foods such as meats, milk, eggs, and fresh fruits was significantly associated with stunting in children under 24 months. This may be linked to reduced diets in terms of quality/diversity and quantity, which would explain stunting in children under 24 months. The data thus infer that social protection programmes and nutrition interventions that provide food or access to food should prioritise provision of animal protein and fruits for vulnerable households.

Table 3.36: Household Food Expenditure as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Did you spend money on cereals in the last 30 days?					
Yes (n=1,907)	927	48.6	1.00		
No (n=857)	454	53	1.19	[1.01-1.40]	0.034
Did you spend money on bread in the last 30 days?					
Yes (n=1,034)	462	44.7	1.00		
No (n=1,666)	885	53.1	1.40	[1.20-1.64]	0.000
Did you spend money on bananas in the last 30 days?					
Yes (n=1,272)	606	47.6	1.00		
No (n=1,427)	738	51.7	1.18	[1.01-1.37]	0.035
Did you spend money on meat/poultry/fish in the last 30 days?					
Yes (n=789)	329	41.7	1.00		
No (n=1,927)	1026	53.2	1.59	[1.35-1.88]	0.000
Did you spend money on eggs in the last 30 days?					
Yes (n=296)	127	42.9	1.00		
No (n=2,419)	1224	50.6	1.36	[1.07-1.74]	0.013
Did you spend money on milk and other dairy in the last 30 days?					
Yes (n=660)	301	45.6	1.00		
No (n=2,056)	1051	51.1	1.25	[1.05-1.49]	0.014
Did you spend money on fresh fruits in the last 30 days?					
Yes (n=802)	348	43.4	1.00		
No (n=1,889)	989	52.4	1.43	[1.21-1.69]	0.000
Did you spend money on sugar and sweets products in the last 30 days?					
Yes (n=1,373)	623	45.4	1.00		
No (n=1,349)	732	54.3	1.43	[1.23-1.66]	0.000

3.8.2 Expenditure on Non-food Items

Expenditure of money on non-food items is summarised in Table 3.37. Evaluation of expenditure indicates that expenditure on transport, lighting and energy, and communications was significantly different between the case and control households. The significant expenditure items are further discussed below.

Table 3.37: Expenditure on Non-food Items

Expenditure item	Significance
Alcohol and tobacco	Not significant
Soap and personal hygiene	Not significant
Transport	0.003
Lighting and energy	0.011
Waste disposal	Not significant
Rent	Not significant
Milling	Not significant
Communications	0.000
Others	Not significant

Expenditure on transport: Overall, 52 percent of the households spent money on transport and out of this number about 43 percent were case households. Control households that spent on transport were relatively more at 56 percent. The data (Table 3.38) further indicates that compared to children in households that spent money on transport, children in households that did not spend money on transport were 1.24 times more likely to have stunted growth.

Table 3.38: Expenditure on Transport as a Risk Factor for Stunting in Children under 24 Months

	Households with a stunted child				
Expenditure on transport	**N**	**%**	**OR**	**[95% CI**	**p**
Yes (1380)	649	47	1.00	.	.
No (1245)	653	52	1.24	1.07-1.45	0.006
Don't know (12)	4	50	0.56	0.17-1.88	0.344
Total 2637	**1306**				

Expenditure on lighting and energy: Only about 4 percent of the households spent on lighting and energy. There was a significant difference between case and control households with respect to expenditure on energy and lighting. Of the households spending on lighting and energy, about 47 percent were case households while 53 percent were control households. Although the case and control households spent differently on lighting and energy, this was not statistically significant to influence stunting in children from households that did not spend any money (Table 3.39).

Table 3.39: Expenditure on Lighting and Energy as a Risk Factor for Stunting in Children under 24 Months

	Households with a stunted child				
Expenditure on lighting and energy	**N**	**%**	**OR**	**95% CI.**	**p**
Yes (105)	46	44	1.00	.	
No (2530)	1260	50	1.27	0.86-1.89	0.23
Total (2635)	**1306**				

Communications: About 49 percent of the households reported spending money on communications over the 30 day period before the survey (Table 3.40). Of these, 45 percent were case households while the proportion of control households that spent on communications was 55 percent. The two groups were thus significantly different in the way they spent on communications. Children in households that did not spend money on communications over the last 30 days were 1.47 times more likely to be stunted compared to children in households that spent money on communications. Non-expenditure on communications could be an indication of poverty levels which is then reflected in inability to provide for the nutrition needs of a child.

Table 3.40: Expenditure on Communications as a Risk Factor for Stunting in Children under 24 Months

Expenditure on communications	**Households with a stunted child**		**OR**	**95% CI**	**p**
	N	**%**			
Yes (1298)	583	45	1.00	. .	-
No (1263)	688	54	1.47	1.25-1.72	0.000
Don't know (78)	37	46	1.11	0.70-1.75	0.664
Total (2639)	**1308**				

Amounts spent on non-food items: The proportion of households that spent money on non-food items over the previous 30 days was about 16 percent (Table 3.41). About 53 percent of those that spent on non-food items were control households. The amounts spent on non-food items were also different between the cases and controls (p=0.005). While control households spent a mean of FRw 4,000 on non-food items, case households spent only FRw 2,700. However, the results were not statistically significant to influence the odds of stunting in children.

Table 3.41: Expenditure of Money on Non-food Items in the Past 30 days for Domestic Consumption

	N	%	OR		p
Yes (439)	208	47.3	1.00		
No (2202)	1101	50.0	1.11	0.90-1.36	0.31
Don't know (64)	38	59.3	1.62	0.95-2.77	0.07
Total		**2,705**			

Income sources

A number of sources of incomes for households were evaluated for effect on stunting in children under 24 months. Significant differences between case and control households based on the income sources are summarised in Table 3.42. Only incomes from other businesses differed significantly between case and control households. Income from employment and transfers from relatives differed significantly between the two groups in terms of the amounts generated. The uses of the incomes was however not significantly different between the case and control households.

Table 3.42: Income Sources for Households

Income source	Income source type	Amount of income	Major uses of incomes
Employment	Not significant	0.001	Not significant
Other business	0.001	Not significant	Not significant
Transfers from relatives	Not significant	0.000	Not significant
Livestock and livestock sales	Not significant	Not significant	Not significant
Other sources	Not significant	0.000	Not significant

Results on the odds of the income sources reveal that children from households that generate employment incomes ranging between FRw 100,000-200,000 were 46 percent less likely to be stunted compared to children in households that generated incomes of less than FRw 10,000 (Table 3.43).

Children in households with incomes from transfers from relatives, if received in the range of FRw 20,000-50,000 were 90 percent less likely to be stunted relative to children in households that received less than FRw 10,000 in transfers. This income may be playing a highly complementary role to the regular incomes hence quite effective in being channeled to nutrition needs of children. The recipients of transfers were however quite few in the sampled households.

Supplementary incomes from other sources showed significant effect on stunting in children from households receiving these incomes. Children in households receiving other incomes in the range of FRw 100,000 to 200,000 were 90 percent less likely to be stunted compared to children in households that received less than FRw 10,000. However, households receiving such high levels of income were quite few. The data also shows that fewer case households were represented in the higher income brackets relative to control households.

Table 3.43: Household Income Sources as a Risk Factor for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Estimated amount of income in Rwandan francs from employment/paid labour					
1 - 10,000 (n=75)	40	53.3	1.00		
10,000 - 20,000 (n=120)	68	56.7	1.14	[0.64-2.04]	0.649
20,000 - 50,000 (n=206)	97	47.1	0.78	[0.46-1.32]	0.355
50,000 - 100,000 (n=151)	70	46.4	0.76	[0.43-1.32]	0.324
100,000 - 200,000 (n=105)	40	38.1	0.54	[0.30-0.98]	0.043
Over 200,000 (n=116)	49	42.2	0.64	[0.36-1.15]	0.134
Estimated amount of income in Rwandan francs from other business					
1 - 10,000 (n=22)	10	45.5	1.00		
10,000 - 20,000 (n=32)	7	21.9	0.34	[0.10-1.10]	0.071
20,000 - 50,000 (n=48)	25	52.1	1.30	[0.47-3.59]	0.607
50,000 - 100,000 (n=33)	15	45.5	1.00	[0.34-2.95]	1.000
100,000 - 200,000 (n=23)	7	30.4	0.53	[0.15-1.78]	0.301
Over 200,000 (n=57)	21	36.8	0.70	[0.26-1.90]	0.483

	Household with a stunted child		OR	95% CI	p
	N	%			
Estimated amount of income in Rwandan francs from transfers from relatives					
1 - 10,000 (n=13)	10	76.9	1.00		
10,000 - 20,000 (n=17)	10	58.8	0.43	[0.09-2.15]	0.303
20,000 - 50,000 (n=12)	2	16.7	0.06	[0.01-0.44]	0.006
50,000 - 100,000 (n=2)	1	50	0.30	[0.01-6.38]	0.440
100,000 - 200,000 (n=2)	1	50	0.30	[0.01-6.38]	0.440
Over 200,000 (n=4)	2	50	0.30	[0 .03-3.13]	0.315
Estimated amount of income in Rwandan francs from other sources					
1 - 10,000 (n=25)	18	72	1.00		
10,000 - 20,000 (n=40)	19	47.5	0.35	[0.12-1.03]	0.056
20,000 - 50,000 (n=64)	33	51.6	0.41	[0.15-1.13]	0.084
50,000 - 100,000 (n=27)	13	48.1	0.36	[0.11-1.15]	0.084
100,000 - 200,000 (n=7)	1	14.3	0.06	[0.01-0.64]	0.019
Over 200,000 (n=8)	3	37.5	0.23	[0.04-1.25]	0.089

3.9 Role of Social and Assistance Programmes

A number of social assistance programmes among the control and case households were assessed. These are summarised in Table 3.44. Most of the assistance programmes did not show any statistically significant difference between the case and control households. The beneficiaries of the programmes were also too few to establish clear associations with stunting in children. Only about 7 percent of the case and control households participated in any Vision 2020 Umurenge Program (VUP), 48 percent of whom were control households and 52 percent case households. The type of VUP programme that most of the households participated in was public works (91%), distributed in the same ratio of 48 and 52 percent for control and case households, respectively. However, there was no statistical difference between case and control households, and consequently, no significant effect on stunting in children.

Table 3.44: Types of Social Assistance to Households

Type of support	Significance
Proportion of households that at least received social assistance	Modest (0.058)
Monetary support	Not significant
Housing support	Not significant
Food	Not significant
Transportation	Not significant
Educational support	Not significant
Childcare support	Not significant
Other support services	Not significant
Participation in VUP programmes	Not significant
Type of VUP programme	Not significant
When household needed support for:	Not significant
Educational issues	Not significant
Domestic or child	Not significant
Advocacy against mistreatment	Not significant
Transportation	Not significant
Childcare	Not significant
Emotional or behavioural issues	Not significant

A few of the sampled households (5%) indicated that they received some form of assistance for their livelihoods. For those households receiving assistance (Figure 3.6), 29 percent received assistance from other family members, 25 percent from NGOs and others from neighbours (19%).

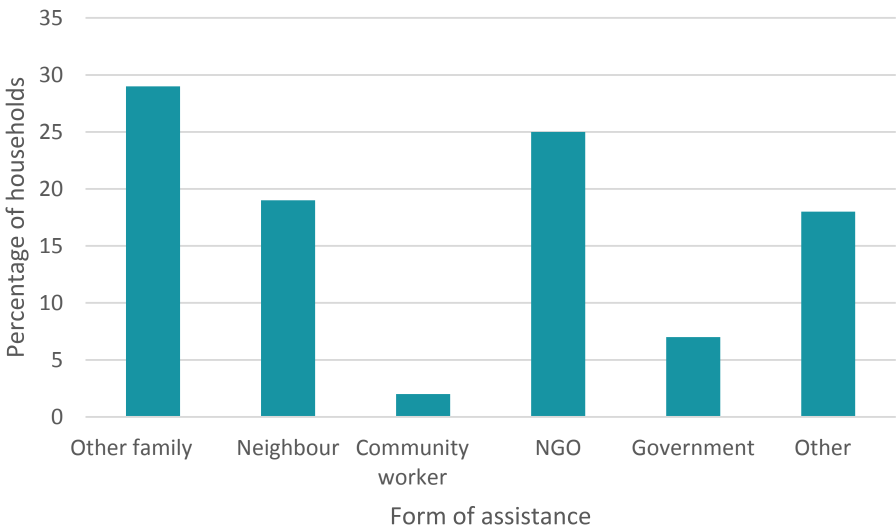

Figure 3.6: Assistance Programmes to Households

The results on assistance programmes indicate that receiving some form of assistance did not have a significant effect on stunting in children in households receiving the support. Households that received assistance were too few to bring out reliable statistical information. Households that had at least one member of the family working and remitting cash to the household were less than 5 percent.

3.10 Summary of Risk Factors

Below is a summary of significant risk factors identified from an assessment of the individual questions in the production and markets component of the survey. The data suggest that underlying causes of stunting in Rwanda are diverse. Chapter 5 of this report synthesises the listed determinants of stunting in children under 24 months in Rwanda and presents the drivers of stunting in this population.

Table 3.45: List of Determinants for Stunting

Factor category	List of determinants for stunting
Incomes and livelihood factors	Rank of agriculture as a livelihood activity
	Type of livelihood activity
	Number of livelihood activities
	Income contributions of the livelihood activities
	Sources of incomes for the households
Agricultural production characteristics	
	Seed quality and sources
	Fertiliser use and expenditure
	Soil erosion control via ditches
	Household labour use and expenditure
	Frequency of sale of livestock products
Market related factors	Quantity of produce harvested
	Livestock sales
	Form in which produce is sold
	Type of market information sources
	Importance attached to information sources
	Mode of transport
Food security factors	Length of storage of product
	Incidence of food expenditure on cereals, bread, bananas, meats, eggs, milk and dairy, fresh fruits, and sugars and sweets
	Incidence of expenditure in non-food items: transport and communications
Social capital factors in production	Membership in cooperatives
	Extent of non-participation in cooperatives

4.0

GENDER AND EMPOWERMENT

4.1 Introduction

The gender objective of the NMG Survey was to generate and disseminate knowledge on how women empowerment influences maternal and child nutrition outcomes. Empowerment of women in the agricultural sector is essential for nutrition. Enhancing the extent or level of women's engagement in decisions about food production, purchases and sales; access to and decision-making influence over productive resources; control over use of income for health and childcare practices; and efficient time use, can positively influence maternal and child nutrition outcomes.

The NMG Survey applied a Women's Empowerment in Agriculture Index (WEAI) tool that is adapted to the Rwanda country situation to capture information relevant to gender. The original WEAI tool was launched by the International Food and Policy Research Institute, Oxford Poverty and Human Development Initiative, and the United States Agency for International Development's Feed the Future in February 2012. The tool is a composite empowerment index that uses two sub-indices – the five domains of empowerment (5DE) and the Gender Parity Index (GPI). The 5DE include (1) decisions about agricultural production, (2) access to and decision-making power over productive resources, (3) control over use of income, (4) leadership in the community, and (5) time use. The GPI measures the proportion of women who are as empowered as men within their households. In this analysis, empowerment scores were used to measure the empowerment of men and women among case and control households, and odds ratios used to measure the association between the gender disempowerment and stunting in children under 24 months of age. The WEAI tool was adapted to include a sixth domain of 'health' with one indicator on women's vulnerability, that is, women's decision-making in reproductive activities (Table 4.1).

Table 4.1: The Six Domains of Empowerment (6DE) in the Adapted NMG WEAI tool for Rwanda

Domain	Indicator	Definition
1. Production	Input into productive decisions	Sole or joint decision-making over food and cash crop farming, livestock, and fisheries as well as autonomy in agricultural production
	Autonomy in production	
2. Resources	Ownership of assets	Ownership, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, consumer durables, and credit
	Purchase, sale or transfer of assets	
	Access to and decision on credit	
3. Income	Control over use of income	Sole or joint control over income and expenditures
4. Leadership	Group member	Membership in economic or social groups and comfort in speaking in public
	Speaking in public	
	Ownership of identity card	
5. Time	Workload	Allocation of time to productive and domestic tasks and satisfaction with the available time for leisure activities
	Leisure	
6. Health	Autonomy in making appropriate reproductive health decisions	Capacity to make informed and appropriate reproductive health decisions

Focusing on elements that show significant differences between men and women and between case and control households, the chapter begins by discussing the six domains and at the end of the chapter discusses the odds of some of these domains on stunting.

4.2 Empowerment and Nutrition Outcomes

The six domains that were used to generate the empowerment scores for individuals and households surveyed are discussed below.

4.2.1 Gender and Decision-making in Agricultural Production

This empowerment dimension concerns input into productive decisions – decisions about agricultural production – and refers to sole or joint decision-making about food and cash crop farming, and livestock and fisheries. The survey questions that contribute to the empowerment analysis in this domain include:

Q1. How much input did you have in making decisions about: food crop farming, cash crop farming, livestock raising, fish culture?
Q2. If they did participate in said activity, who in the household normally makes decisions regarding that activity?
Q3. If they participated in the activity, how much input did they have in making decisions about the activity?
Q4. To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to: food crop farming, cash crop farming, livestock raising, fish culture?

Individuals can have no input in decision-making, have input in few or some of the decisions, have input in most or all decisions. On the other hand, for those who participate in decision-making, individuals may feel that they can participate in decision-making to a small, medium, or high extent. Individuals are adequate on input in production decisions if they participate in at least two types of decisions in which they have some input, make the decision, or feel they could make the decision to a medium extent if they wanted to. A household's structure and decision-making influences how it feeds a child as determined by the level of empowerment of the woman who bears the greater responsibility for caring for children. Results on the contribution of gender on children's nutrition status are discussed in this section.

Results

Some of the major issues evaluated to assess the extent of decision-making between men and women and between case and control households are shown in Table 4.2. A large number of the variables were not significantly different between case and control households, though many were significantly different between men and women. Variables with significant effect on stunting in children were further analysed for the odds ratios.

Table 4.2: Variables Evaluated in the Production Domain

Extent of decision-making	Significance with respect to gender differences	Significance with respect to stunting in children
Types of crops grown by households	Not significant	Not significant
Type of crops to plant	0.000	Not significant
Use seeds	0.000	Not significant
Use of fertiliser	0.000	Not significant
Use of agricultural technologies	0.000	Not significant
Crop harvesting	0.000	0.040
Use of labour	0.000	Not significant
Labour from other family members	0.000	Not significant
Sale of produce	0.000	Not significant
Type of livestock to be kept	0.000	0.000
Livestock to consume	0.000	Not significant
Sale of livestock and products, prices, share of incomes from sales	0.000	0.090
Wages, salaries and employment	0.000	Not significant
Health issues	0.000	Not significant
Daily tasks	0.000	Not significant

Importance of Crops Grown by Households

Figure 4.1 shows a range of crops grown by households including cash crops, cereals, pulses, fruits and vegetables among others. Overall, the top 3 crops in each household constituted almost 90 percent of the crops grown by the household. The top three crops were mainly beans (climbing and bush beans), maize and sweet potato in that order. The rest of the crops, even though quite large in number, contributed marginal proportions. Among the major crops the bean was the only contributor to protein requirements while other crops were mainly cereals or starch. Climbing beans did not show significant differences between cases and controls and between men and women. However, there were differences between men and women for maize, with more men preferring maize than females. Sweet potatoes were evenly distributed across gender, and between cases and controls. The survey results also show that crops such as wheat, coffee, soya, sugarcane, cabbage, other vegetables and banana fruit (for dessert) were ranked as the least cultivated crops. Other crops such as cassava, cooking banana, sorghum and Irish potato accounted for only 1 and 2.7 percent of the crops grown. Beans, maize and sweet potatoes are not only staple crops but could also be important as nutritional foods; especially beans that contribute to household protein sources.

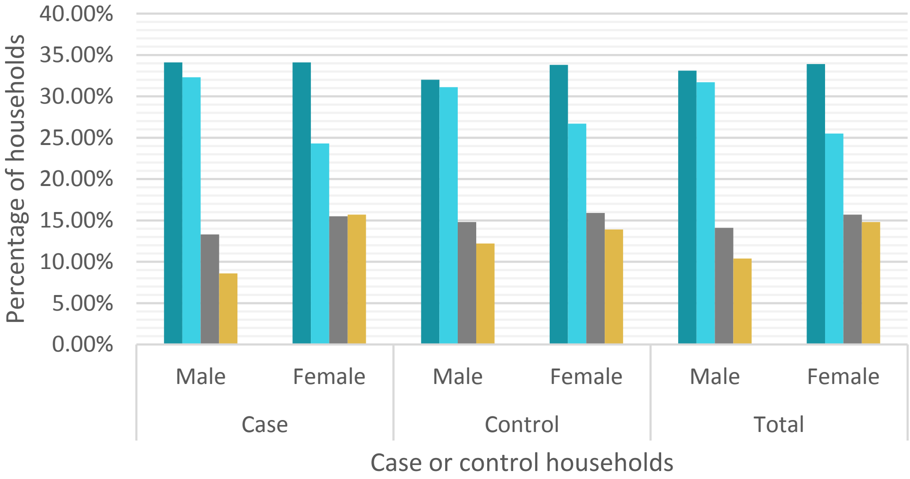

Figure 4.1: Main Crops Grown by the Households

Participation in Cropping Decisions

Results revealed significant gender differences within and between case and control households on the level of contribution women and men make in terms of the type of crops to plant (Figure 4.2). More females than males in the control group made substantial contribution to decisions on which crops to grow (at least 75% of females compared with 65% of the males).

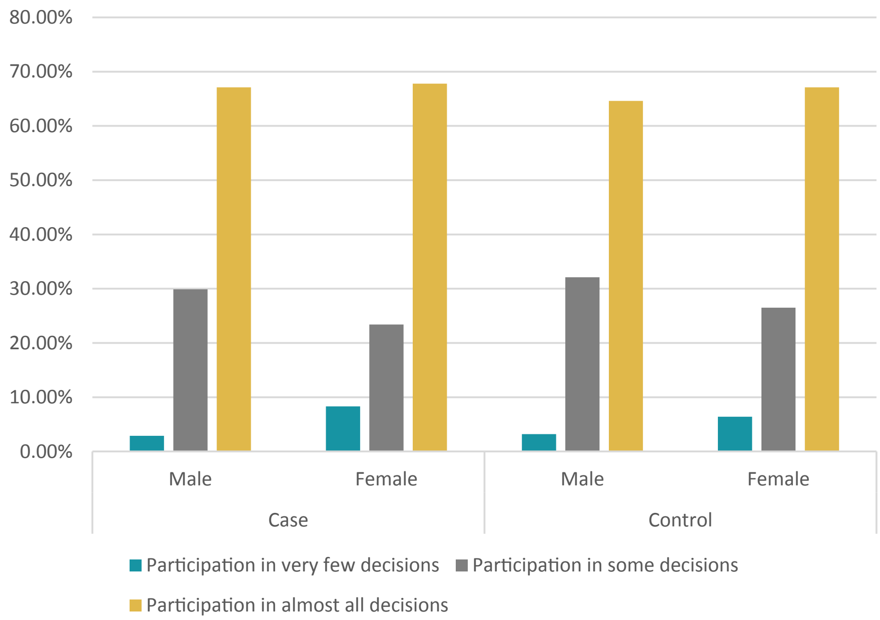

Figure 4.2: Participation in Decision-making on which Crop to Plant

Decisions into the Use of Basic Agricultural Inputs

Seeds

In both case and control households, women participated more in decision-making on which seeds to use. Results showed that more than 65 percent of women participated in most decisions while 61 percent of men were involved in making almost all the decisions. These differences were significant across case and control households (Figure 4.3).

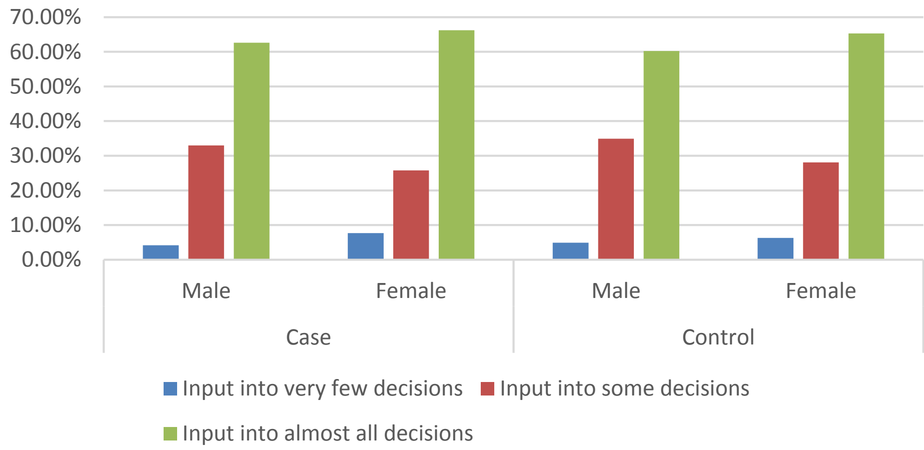

Figure 4.3: Participation in Decisions about Seeds to Plant

With respect to who contributed to the decisions in the household, it was evident that the majority of production decisions were made by either the household head alone, spouse alone or jointly between the household head and spouse. Results showed that on average 86.3 percent of males reported that decisions regarding which seeds to use were jointly made by both the household head and the spouse compared with 69.7 percent of the females (Table 4.3). This response was significantly different between the men and women (p=0.002).

Table 4.3: Decision-making on which Seeds to Plant

Decision maker	Case			Control			Overall		
	Sex of the respondent			Sex of the respondent			Sex of the respondent		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Household head	8.00%	18.50%	13.70%	6.30%	14.90%	10.90%	7.20%	16.70%	**12.30%**
Spouse	5.40%	10.30%	8.10%	6.50%	11.00%	8.90%	6.00%	10.60%	**8.50%**
Household head and spouse jointly	85.80%	67.20%	75.70%	86.80%	71.50%	78.50%	86.30%	69.40%	**77.10%**
Other household decision combination	0.70%	3.90%	2.50%	0.30%	2.70%	1.70%	0.60%	3.50%	**2.20%**
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
P-value			0.411			0.009			**0.002**

Fertiliser

Decisions on fertiliser use were evenly distributed between men and women with around 65 percent of the men and women indicating that they made substantial contributions to these decisions. A large number of those who did not make substantial decisions on fertiliser use were females at 7 percent versus males at 3 percent.

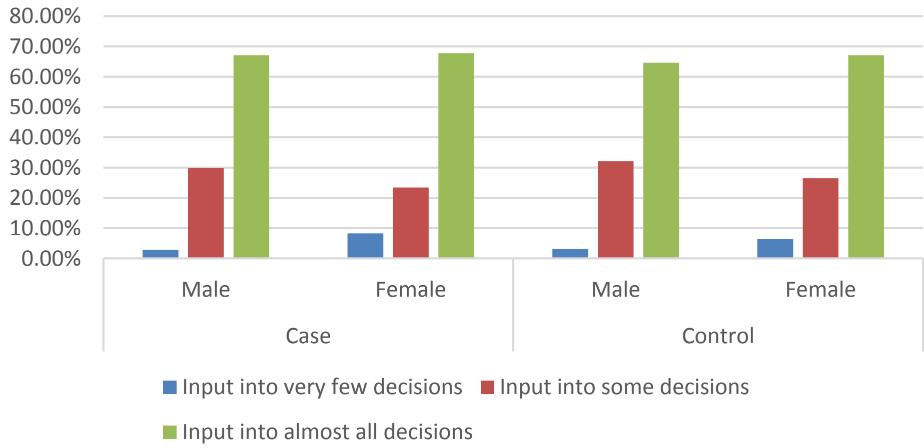

Figure 4.4: Participation in Decisions about Whether to Apply Fertiliser

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Labour

Females reported higher participation levels (65%) in labour-use decisions than males at less than 60 percent across case and control households. Gender differences about labour were significant in both control and case households.

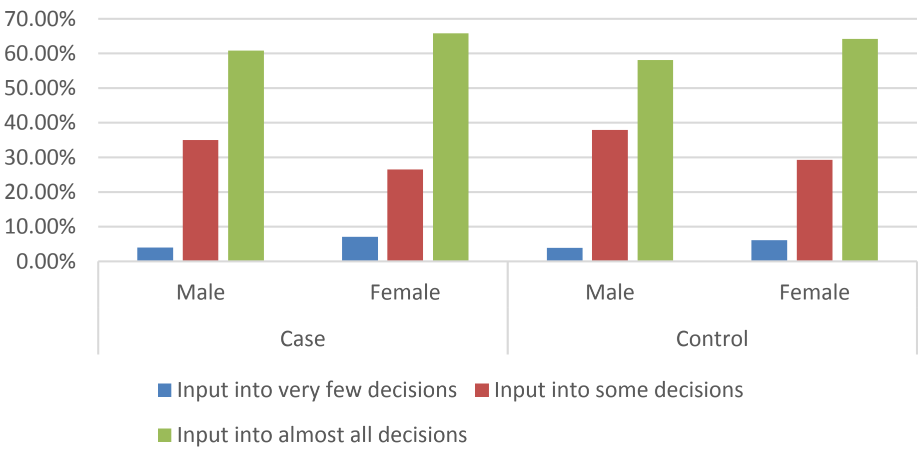


Figure 4.5: Participation in Labour Use in the Households

Use of Agricultural Technologies

Results in Figure 4.6 on decisions on the use of technologies show that an overly high number of males had very limited participation in these decisions. For instance, for the case households only 18 percent of males compared with about 28 percent for females made substantial decisions on technology use. The gender differences are significant and the trend by which females are more involved is seen in both the case and control households. It is a bit surprising that few males participate in decisions/ issues of new technologies because they are the ones more likely to attend meetings or sessions where new technologies are promoted. This result highlights the significant role women play in agricultural technology adoption.

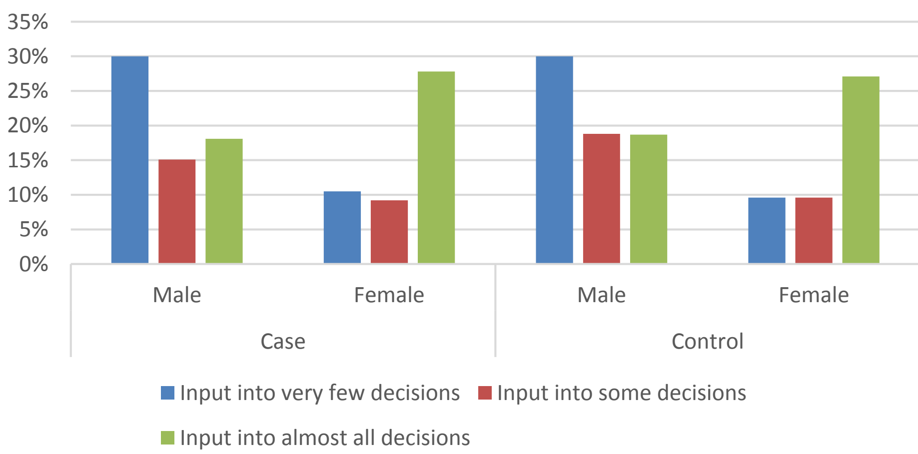


Figure 4.6: Decisions on Using Technologies

Decisions on Input Purchases

An assessment of inputs in general reveal differences in household decision-making on which inputs to buy for agricultural production (Table 4.4). A majority of these decisions are made jointly by the household head and spouse. On average 77.1 percent of males and 65.7 percent of females reported that decisions regarding particular input purchases for agricultural production are made jointly by both the household head and the spouse. This response was significantly different in terms of gender ($p<0.007$). Only a small proportion of respondents reported production decisions being made individually by either the household head or spouse. Within the household, participation in input decisions, either jointly by the spouses or the entire household significantly decreased the odds of stunting in children.

Table 4.4: Decision on Inputs to Buy for Agricultural Production

Decision maker	Case			Control			Overall		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Household head	15.80%	19.40%	**17.80%**	12.70%	14.60%	**13.70%**	14.20%	16.90%	**15.70%**
Spouse	7.50%	14.40%	**11.20%**	8.30%	15.10%	**12.00%**	7.90%	14.70%	**11.60%**
Household head and spouse jointly	76.00%	63.70%	**69.30%**	78.20%	67.70%	**72.50%**	77.10%	65.70%	**70.90%**
Other household decision combination	0.20%	2.40%	**1.60%**	0.10%	2.60%	**1.90%**	0.30%	2.70%	**1.80%**
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
P-value			0.338			0.007			0.004

Decisions about Crop Harvesting

With respect to decisions about harvesting, females appear to be more concerned with this activity than males across the case and control households (Figure 4.7). The participation in decision-making was statistically significant for decisions relating to the harvesting of crops. In this case, children in households where women have low participation in product harvesting decisions are significantly more likely to have increased odds of stunting compared to households where females participate in the decisions made. The odds of stunting decrease by 60-80 percent for children in households where women at least have some input into decisions made on crop harvesting (Table 4.5). Decisions on harvesting appear to have a strong bearing on what kind of feeding a child will have and consequently on the nutrition outcomes.

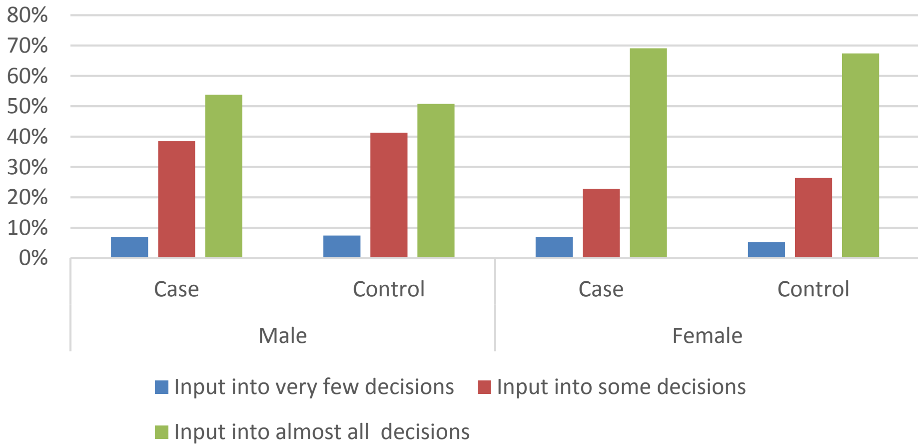


Figure 4.7: Decisions about Harvesting by Gender

Table 4.5: Decisions on Crop Harvesting as a Factor for Stunting in Children under 24 Months

Crop harvesting decisions	Households with a stunted child		OR	95% CI.	p
	N	%			
No input (23)	17	74	1	.	
Input into very few decisions (47)	17	36	0.2	0.06- 0.66	0.003
Input into some decisions (331)	17	53	0.4	0.15-1.045	0.054
Input into almost all decisions (497)	250	40	0.36	0.14-0.93	0.027
Input into all decisions (155)	75	48	0.33	0.12-0.90	0.023
Total 1053)	**535**				

4.2.2 Gender and Decision-making on Livestock Production Activities

Table 4.6: Livestock Issues

Livestock issue	Significance
Major livestock kept	0.090
Decisions on which livestock to keep	0.000
Decisions on labour in livestock rearing	0.001
Use of technology in livestock rearing	0.001
Decisions on which livestock products to consume	0.060

Major Livestock in Households

The highest valued livestock is the dairy cow across all households with at least 40 percent of those owning livestock having a dairy cow. Slightly more males owned more dairy cows than females across all households. This was followed by goats at 25 percent of the households. Pigs came third while chickens were the fourth most important livestock. Other major livestock were oxen, rabbits and sheep. Overall, the proportion of households keeping livestock was less than 30 percent.

Some of the livestock kept were significantly associated with stunting among children. Keeping large livestock other than dairy or oxen significantly increased the odds of having children who are not stunted in the households. However, the effects took an opposite effect if rabbits were the main livestock kept by families such that the odds of having children who are stunted significantly increased.

Decisions on Which Livestock to Keep

A majority of the respondents felt they could make independent decisions on livestock rearing but only to a medium extent (Figure 4.8). The proportion of males was significantly higher (60%) than the proportion of females (53%) at p=0.096. In a few instances, this decision was made independently by either the household head or the spouse. There is however no significant difference between the men and women for the case and control categories.

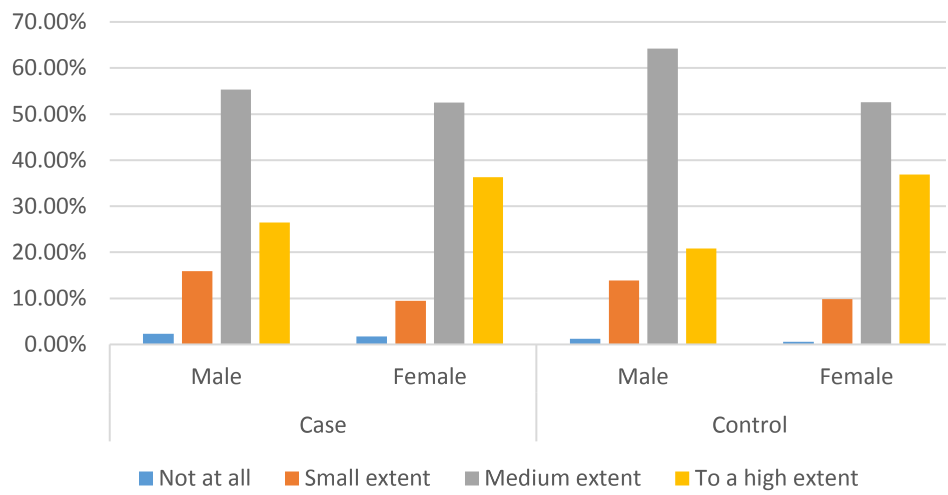


Figure 4.8: Decisions on which Livestock to Rear

There was a significant relationship between participation in decisions on which livestock to keep and stunting levels. Children in households that had men and women contributing to the decisions on which livestock to rear significantly reduced the odds for stunting compared to those that did not have any input. Other livestock decisions did not bring out significant associations with child nutrition status.

Table 4.7: Livestock Rearing as a Factor for Stunting in Children under 24 Months

Decisions on which livestock to rear	Households with a stunted child		OR	95% CI	p
	N	%			
No input (63)	40	63	1.00	.	
Input into very few decisions (55)	24	44	0.45	0.21-0.95	0.032
Input into some decisions (414)	211	51	0.59	0.34-1.04	0.064
Input into almost all decisions (596)	287	48	0.53	0.31-0.92	0.021
Input into all decisions (281)	140	50	0.57	0.32-1.01	0.05
Total (1409)	**702**	**39**	**0.37**	**0.13-1.02**	**0.045**

Decisions on Labour in Livestock Rearing

Results revealed significant differences between females and males in decision-making on labour used in livestock. In case households, less women reported participation in almost all the decisions while the opposite is observed in control households. In the overall sample, men were more involved in such decisions (Figure 4.9).

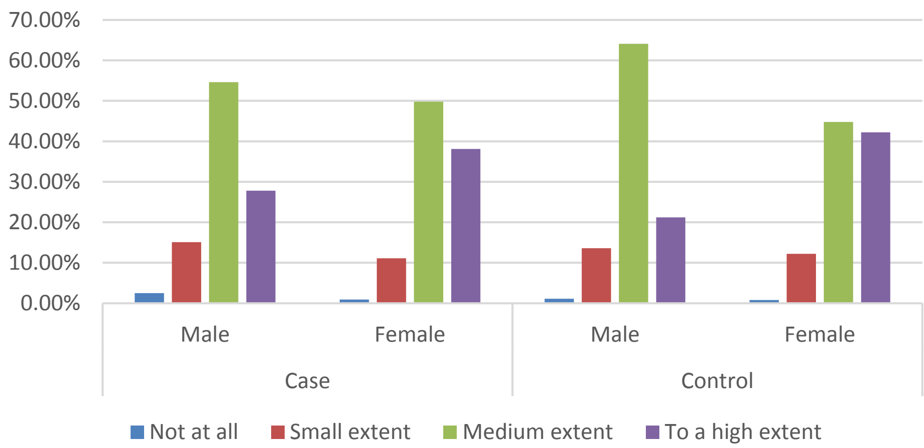


Figure 4.9: Decisions on Labour in Livestock Rearing

Decisions on Using Technology in Livestock Rearing

Results in Figure 4.10 show significant differences between case and controls especially among the males in terms of decision-making on whether to use technology in livestock rearing. Males in case and control households contributed less in all decisions taken on technology use compared to females.

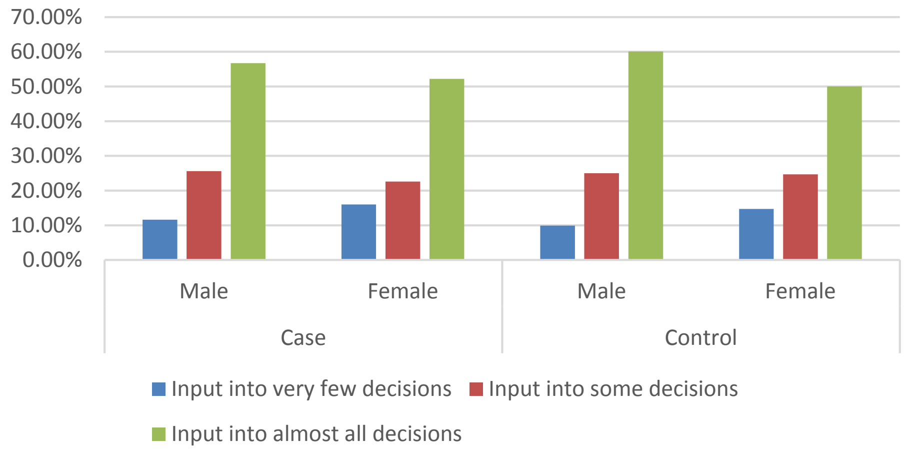


Figure 4.10: Decisions about Using Technology in Livestock Rearing

Decisions on Livestock Products

The livestock products that were reported as the most important by the households were first milk (38%), then manure (32%) and eggs (20%). Meat was reported as important by only 7 percent of the respondents. Females participated more in decisions on milk and egg products while males participated more in the meat and manure business decisions. Less than 10 percent of the participating households reported having livestock products. Decisions on consumption of livestock products were made more by females than by males, although the participation of males was quite significant as well (Table 4.8). The results indicate that children in households that did not make any decisions on which livestock product to consume were likely to face high odds of stunting. However, the effect was not statistically significant (p=0.06).

Table 4.8: Decision-making About which Product to Consume by Gender

Did you have input on decisions about which products to consume?	Male		Female		Total		N
	Case	Control	Case	Control	Case	Control	
No input	13.40%	11.30%	3.60%	12.10%	**8.50%**	**11.70%**	49
Input into very few decisions	2.70%	5.70%	1.80%	0.90%	**2.20%**	**3.50%**	14
Input into some decisions	17.00%	24.80%	9.80%	19.00%	**13.40%**	**22.20%**	87
Input into most decisions	33.00%	29.80%	43.80%	37.10%	**38.40%**	**33.10%**	171
Input into all decisions	16.10%	17.70%	24.10%	17.20%	**20.10%**	**17.50%**	90
Decision not made/not applicable	17.90%	9.90%	16.10%	13.80%	**17.00%**	**11.70%**	68
Don't know	0.00%	0.70%	0.90%	0.00%	**0.40%**	**0.40%**	2
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	481

4.2.3 Gender and Decision-making in Agricultural Commercialization and Use of Income

The following product commercialization variables were analysed for significance on gender and effect on stunting in children.

Table 4.9: Crop and Animals Sales

Decision making on:	Significance
When to take crops to the market	0.058
Decisions on sale of live animals	0.000
Use of income	0.001

Commercialization of Agricultural Commodities and Products

A majority of men in both the case and control groups (60% and 61% respectively) felt they could make their own personal decisions regarding who takes the produce to the market. However, a slightly lower proportion of females (52% in both categories) felt they could make such decisions personally but only to a medium extent. More women than men in both the case and control (36% and 37%) groups felt they could make commercialization decisions individually.

Similarly 64 percent of males in the control category felt they could personally make decisions on when crops should be taken to the market (Figure 4.11). A slightly lower proportion of females (45%) in the same category shared the same opinion. In the case category, 55 percent of males and 50 percent of females felt that decisions on when crops should be taken to the market could be made independently. This proportion was significantly different at (p=0.058).

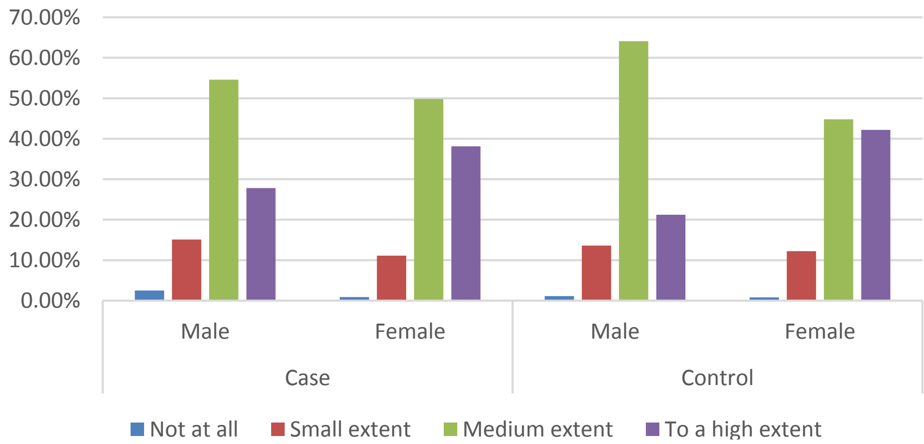


Figure 4.11: When Crops are Taken to the Market

With respect to the sale of livestock products, more men than women appear to have more input under case households than control households but this is not significantly different. Of the households that had livestock products, at least 23 percent sold the products, although there were no statistically different observations between men and women or control and case households. Nonetheless, significant differences were evident when it came to the decision to sell animals where men were more involved in almost all the decisions taken (Figure 4.12) in both case and control groups.

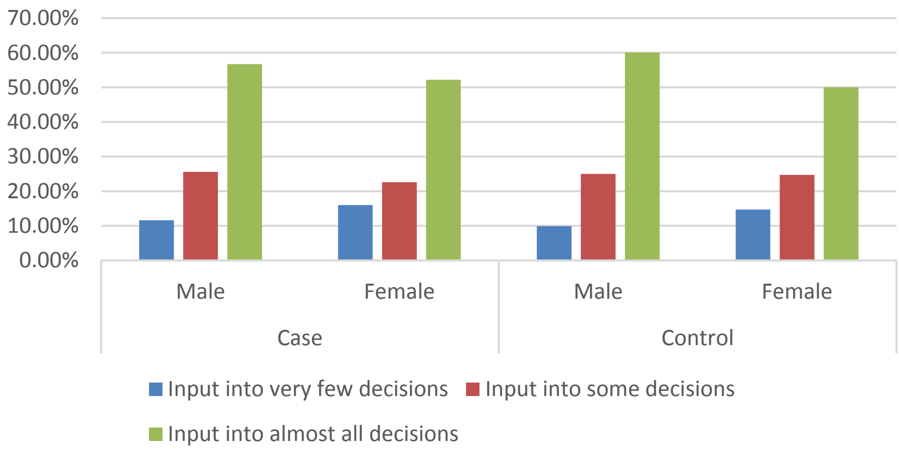


Figure 4.12: Decisions about Selling Animals

A significant association between decisions on sale of animals and stunting in children was established in the survey. Compared to households where mothers had no input in decision making, children in households in which mothers at least participated in decisions on sale of livelihoods animals were 41-55 percent less likely to be stunted. This is important since some of the animals sold constitute part of the food for the households or generate income that can be used to source for additional food, or health care.

Table 4.10: Sale of Live Animals as a Factor for Stunting in Children

Decision on sale of live animals	Households with a stunted child		OR	95% CI	p
	N	%			
No input (63)	40	63	1.00	. .	
Input into few decisions (55)	24	44	0.45	0.22-0.95	0.032
Input into some decisions (414)	211	51	0.59	0.35-1.04	0.064
Input into almost all decisions (596)	287	48	0.53	0.31-0.92	0.021
Input into all decisions (281)	140	50	0.57	0.32-1.01	0.049
Total (1412)	**704**				

Use of Income

Decisions on the use of income from harvested crops were significantly different between men and women and between cases and controls. Relatively more males than females made income decisions, for example, around 69 percent of the males made substantial decisions on incomes from crop commercialization while only 54 percent of the females were able to do so in case households. In control households, 62 percent of the males made substantive decisions while 48 percent of the females did so. This points to an imbalance in the decision-making on incomes between men and women and between case and control households.

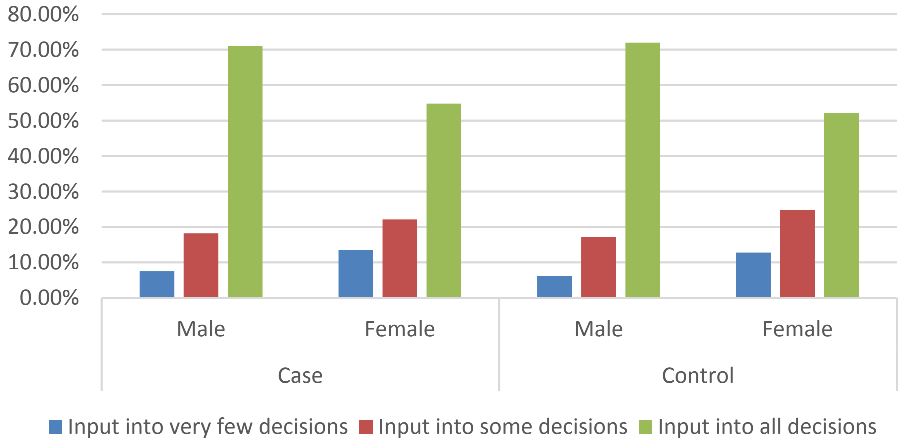


Figure 4.13: Participation in Decisions to Use Agricultural Income

With regard to income from livestock, differences between men and women were also significant within and across case and control groups. In both groups, findings show that women were less involved in decision-making on how to use income from livestock commercialization (Figure 4.14). However, whereas there are some gender differences and across cases and controls, no significant association with stunting on children was established.

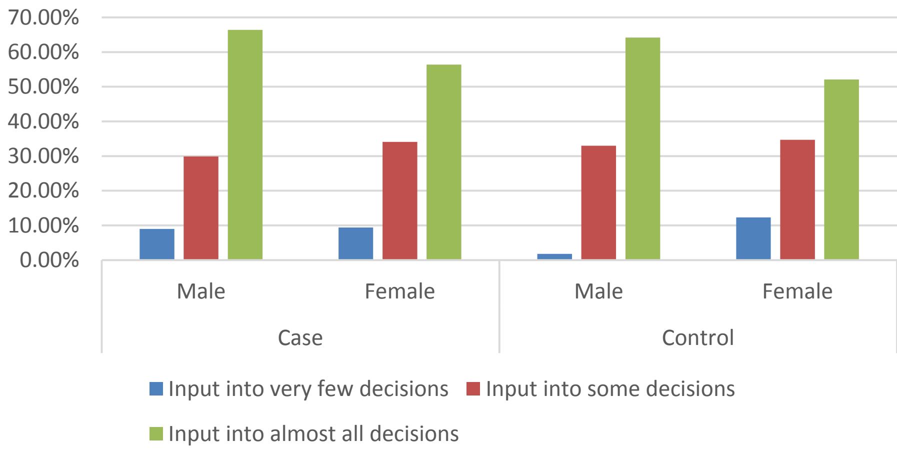


Figure 4.14: Decisions on Income from Livestock

4.2.4 Gender and Decisions on Non-farm Economic Activities

Table 4.11: Non-farm Economic Issues Evaluated

Issue	Significance
Decisions about working outside the house	0.001
Decisions about labour from household members	0.001
Decisions on wage and salaried employment	Not significant
Decisions on serious health problems	0.062
Decisions on expressing religious faith	0.067
Decisions on tasks for a particular day	0.006

Decisions on non-farm economic activities were not significantly different between men and women as well as between cases and controls. Some of the major or significant non-farm economic activities the households participated in included skilled labour, transportation and salaried work. The activities had significant influence on stunting in children as they generate incomes that the households can use to feed children.

Purchase decisions differed significantly between men and women. Males had more say in the purchase decisions under case households as well as in control households relative to females. On the sale of goods, females also made significantly fewer decisions than males, a situation that was also observed in decisions to work outside the house (Figure 4.15). Sale of household goods also contributed to household incomes. About 18 percent of the households sold some household goods to meet their needs. The odds of having a stunted child significantly increased among those that sold the goods compared to those that did not sell any goods.

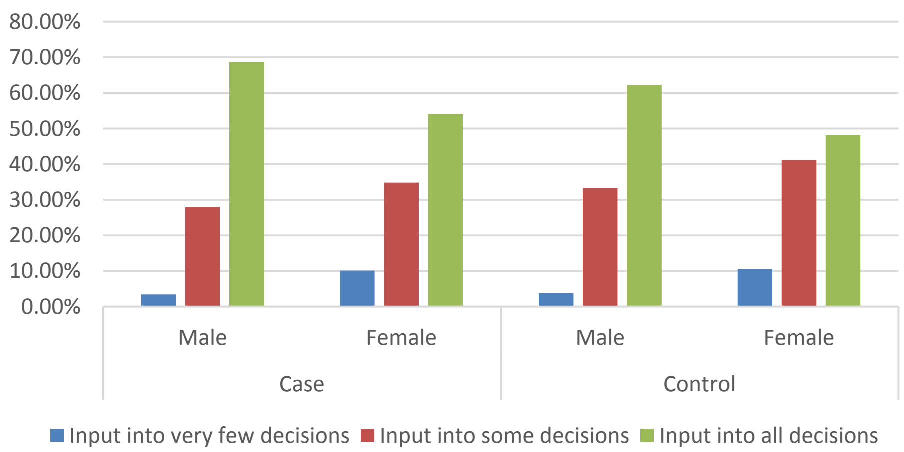


Figure 4.15: Decisions about Working Outside the House

4.2.5 Decisions about Labour from the Household

As reported in Figure 4.16, significant differences in decisions about family labour were noticed in both case and control households. Men participated more in almost all the decisions taken about household labour than women. Moreover, the number of women who reported having very little input in decision-making on labour was higher in both control and case households.

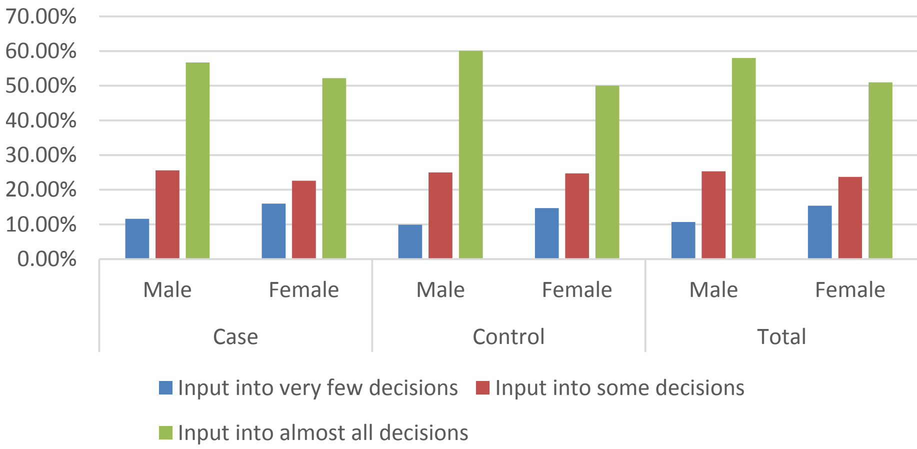


Figure 4.16: Decisions about Labour from Other Family Members

4.2.6 Decision on Own Wage or Salaried Employment

From the results in Table 4.12, an equal proportion of men and women (62%) reported that the decision of individual wage or salary employment was made jointly by the head of the household and the spouse. In the case category, 63.3 percent of males and 60.3 percent of women were of the same opinion. In the control category majority of women (64.3% compared with 61.1% of men) were of the same view. In addition, 33 percent of males and 30 percent of females reported that such decisions were made only by the household head. This scenario was similar in the case and control categories where a larger proportion of males compared with females were of the opinion that these decisions were made by the household head. Nonetheless, only in the control category were gender differences about decision-making on own wage or salaried employment modestly significant ($p=0.092$).

Table 4.12: Decision-making on Own Wage or Salary Employment

Decision maker	Case			Control			Overall		
	Sex of the respondent			Sex of the respondent			Sex of the respondent		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Household head	32.20%	29.30%	**30.70%**	33.70%	26.70%	**30.20%**	33.00%	27.90%	**30.50%**
Household head and spouse jointly	63.30%	60.30%	**61.70%**	61.10%	64.30%	**62.60%**	62.10%	62.30%	**62.20%**
Household head and other household member	0.20%	0.00%	**0.10%**	0.20%	0.80%	**0.50%**	0.20%	0.40%	**0.30%**
P-value			**0.945**			**0.092**			**0.425**

Results further indicate that participation in decisions on labour from other family members significantly influenced the odds of having stunted children. Children in households in which mothers contributed to at least some decisions were 27 percent less likely to be stunted relative to children in households where mothers did not contribute to decisions at all (Table 4.13).

Table 4.13: Decisions on Labour from Family as a Factor in Stunting in Children under 24 Months

	Households with a stunted child				
Decisions on labour from family members	**N**	**%**	**OR**	**95%CI**	**p**
No input (205)	111	54	1.00	.	.
Input into few decisions (137)	66	48	0.78	0.51-1.22	0.280
Input into some decisions (626)	296	47	0.76	0.55-1.04	0.088
Input into most decisions (848)	393	46	0.73	0.54-0.99	0.045
Input into all decisions (561)	290	52	0.91	0.66-1.25	0.548
Total (2378)	**1156**	**46**	**0.72**	**0.49-1.07**	**0.103**

4.2.7 Other Decisions Related to Production

Results on decision-making in the case of a serious health problem, expression of personal faith and ability to make decisions with respect to daily activities also significantly influenced stunting in children. In the case of a serious health problem within the household, 62 percent of males and 47 percent of females reported that the decision on how to address this situation was made jointly by the household head and the spouse (Figure 4.17). In both the case and control categories, a larger proportion of males compared to women reported that these decisions were made jointly by the household head and spouse. In a few instances, such decisions were made independently by either the household head or spouse. The difference in gender was significant in the control group (p=0.052) and overall (p=0.062). In addition, majority of men in both the case (52%) and control (54%) households compared with women felt they could make independent decisions on what to do in the event of a serious health problem only to a medium extent. On the other hand, a higher number of women in the case (48%) and control (46%) households felt they could make such decisions individually to a high extent. However, decisions on serious health problems did not significantly affect stunting in children under 24 months.

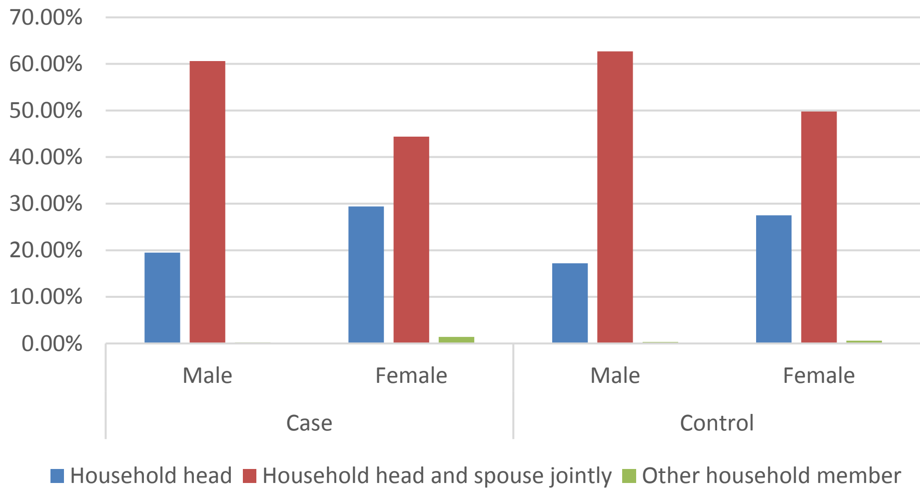


Figure 4.17: Decision-making in the Case of a Serious Health Problem

Regarding faith, it is interesting to note that an equal proportion of males (73%) in both the case and control categories compared with only 12 percent of females reported that the decision for one to express his/her religious faith is made by the spouse (Figure 4.18); and yet the majority of females in both the case and control categories were of the opinion that such decisions are made by the household head. The difference in gender was significant in all the categories at p=0.049 for the case households, p=0.067 for the control and p=0.087 for overall significance. Moreover, findings indicate that majority of men felt they could make personal decisions on whether and how to express religious faith to a medium extent. Decisions on expressing faith did not significantly affect stunting in children.

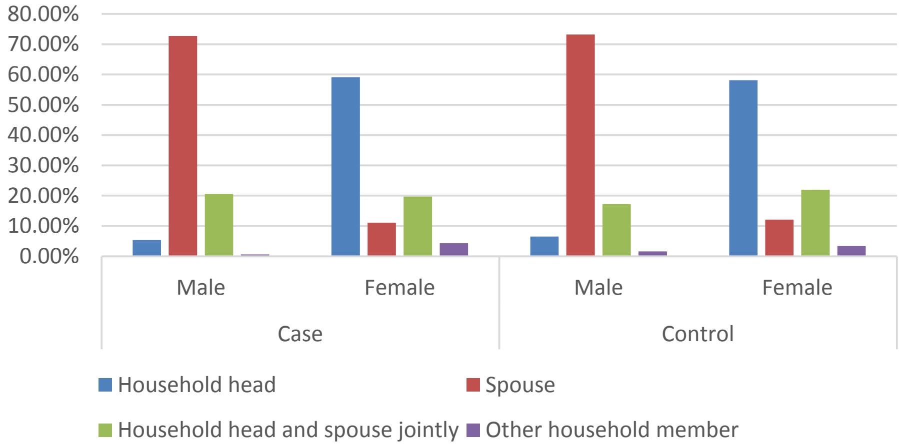


Figure 4.18: Decision on Expressing Religious Faith

Decisions regarding the daily household activities were made either jointly or independently by the household head and spouse as shown in Figure 4.19. In the case category, more males (48%) compared with females (45%) reported that decisions on particular tasks of the day were made jointly by the household head and spouse. In addition, 46 percent of males and 16 percent of females reported that the household head made such decisions. In the control category, there is a significant difference in gender (p=0.022), where 53 percent of males reported joint decision-making between the household head and spouse compared with 50 percent of females. Overall, there is a significant difference (p=0.006) in the proportion of men (51%) and women (48%) who reported that these decisions were made jointly.

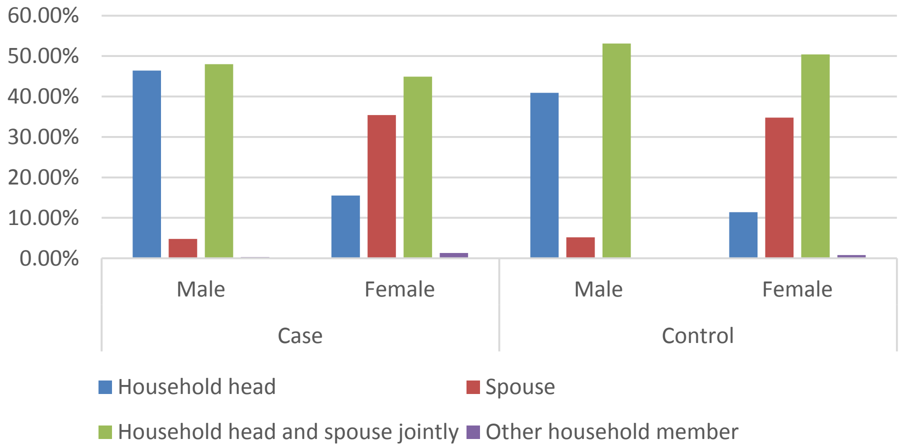


Figure 4.19: Decisions on Tasks for a Particular Day

4.2.8 Disempowerment in the Production Domain

Responses to the various empowerment questions were further classified into whether one was either empowered or disempowered. Disempowerment was defined as a respondent not having any input into the decisions made by the household. Based on this measure the results on some of the key areas of empowerment are reflected in Table 4.14. Only significant variables are shown.

Disempowered women have limited roles or limited participation in decision-making over the production of food and cash crops, livestock and fisheries farming as well as little autonomy in agricultural production in general. Among farming households, children in homes where mothers were disempowered in decision-making on agricultural production were 1.41 times more likely to be stunted compared with children in households where mothers were empowered. Children in households where women were disempowered in decision-making on what inputs to buy for agricultural production were 1.43 times more likely to be stunted. In addition, children in households where women were disempowered in decision-making on what types of crops to grow were 1.32 times more likely to have stunted growth. In addition, children in households where women were disempowered in decision-making on what kind of tasks they do on a particular day were 1.44 times more likely to have stunted growth (Table 4.14).

Table 4.14: Women Disempowerment in Production and Risk for Stunting in Children Under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Who normally makes decisions on agricultural production?					
Empowered (n=1,639)	786	48	1.00		
Disempowered (n=384)	217	56.5	1.41	[1.13-1.76]	0.003
Who normally makes decisions on what inputs to buy for agricultural production?					
Empowered (n=1,608)	764	47.5	1.00		
Disempowered (n=371)	209	56.3	1.43	[1.14-1.79]	0.002
Who normally makes decisions on what types of crops to grow?					
Empowered (n=1,630)	784	48.1	1.00		
Disempowered (n=376)	207	55.1	1.32	[1.06-1.66]	0.015
Who normally makes decisions on when a crop is harvested?					
Empowered (n=1,713)	834	48.7	1.00		
Disempowered (n=281)	154	54.8	1.28	[0.99-1.65]	0.058
Who normally makes decisions on what kind of tasks you will do on a particular day?					
Empowered (n=2,161)	51.9	48.1	1.00		
Disempowered (n=414)	42.8	57.2	1.44	[1.17-1.78]	0.001

4.3 Resources

This empowerment dimension concerns ownership of and access to productive resources such as land, livestock, agricultural equipment, consumer durables, and credit. The survey questions that contribute to the empowerment analysis in this domain include:

a. Ownership of Assets

Q1. Does anyone in your household currently have any asset item?
Q2. Do you own any of the assets?

Asset items evaluated included agricultural land, large livestock, small livestock, chicks etc; fish pond/equipment; farm equipment (non-mechanised); Farm equipment (mechanised); non-farm business equipment; house; large durables; small durables; mobile phone; non-agricultural land (if any); and means of transport.

For ownership, individuals can have sole, joint or no ownership of an item. Individuals are considered adequate on ownership if they own at least one asset, providing it is not only chickens, ducks, turkeys, pigeons, non-mechanised farm equipment, or small consumer durables. Individuals who live in households that do not own any type of asset are considered inadequate on ownership.

The survey focused on variables that showed significant differences between men and women and on stunting in children with respect to the resources (Table 4.15).

Table 4.15: Key Variables for Assessing Resource Acquisition and Use by Households

Resource type	Significance with respect to ownership	Significance with respect to usage	Significance with respect to sale of asset
Agricultural land	Not significant	0.08	0.050
Equipment: non-mechanised	0.089	Not significant	0.034
Farm equipment: mechanised	0.09	Not significant	Not significant
Mobile phone	Not significant	Not significant	Not significant
Large livestock	Not significant	Not significant	Not significant
Small livestock	Not significant	Not significant	Not significant
Large consumer durables	Not significant	Not significant	0.034
Small consumer durables	Not significant	Not significant	Not significant
Bees	Not significant	Not significant	0.078

4.3.1 Ownership and Use of Productive Assets

Overall, a number of assets were significantly associated with the level of stunting in children. These kind of assets included non-farm equipment, large durable assets, small consumer durable assets, mobile phones and means of transport. Ownership of each of these assets significantly reduced the odds of having a stunted child in the households by between 27-32 percent if either owned by the heads of household jointly or by all household members jointly. This is in comparison to single ownership by the head of the household. Results from the study indicate that ownership of assets significantly differs between men and women for large consumable assets, small durable assets and mobile phones among the case and control groups (Table 4.16). Among the control group, all forms of assets indicated higher male ownership except for small durables that had higher ownership by females. Between the cases and controls, there is a significant difference across all asset types. More control households reported a higher proportion of asset ownership compared to cases ($p<0.03$). With respect to who owns most of the key assets, significant observations were made on ownership of agricultural land, non-mechanised farm equipment, mechanised farm equipment and non-farm business equipment. Children in households where land is jointly owned by both spouses or by the entire household jointly were likely to have reduced stunting compared to households where land was owned by only the head of the household. These results are replicated for the rest of the assets with the most significant ownership being joint ownership by both spouses (Table 4.16).

Table 4.16: Ownership of Most of the Assets

		Case			Control				Overall sig
		Male	Female	Sig	Male	Female	Sig	Total	
Farm equipment (non-mechanised) Hoe, shovel, rake, spade, wheel barrow	Household head	3.30%	14.40%		3.10%	8.90%		**141**	
	Spouse	1.80%	6.00%		1.30%	6.40%		**74**	
	Household head and spouse jointly	86.70%	70.40%	0.980 1.000	87.70%	76.70%	0.041	**1420**	0.089
	Other household member	0.50%	0.40%		0.50%	0.60%		**9**	
	Household jointly	7.70%	8.80%		7.40%	7.50%		**141**	
Farm equipment (mechanised)	Household head	23.10%	38.50%		14.30%	6.30%		**11**	
	Spouse	7.70%	7.70%		7.10%	0.00%		**3**	
	Household head and spouse jointly	61.50%	53.80%	0.521	64.30%	87.50%	0.080	**38**	0.090
	Household jointly	7.70%	0.00%		14.30%	6.30%		**4**	
Mobile phone	Household head	58.40%	44.70%		63.20%	37.30%		**1181**	
	Spouse	2.70%	15.90%		1.40%	14.90%		**202**	
	Household head and spouse jointly	37.90%	37.30%		34.60%	45.90%		**906**	
	Other household member	0.40%	1.50%	0.117	0.00%	1.10%	0.077	**17**	0.421
	Other household decision combination	0.60%	0.60%	0.000%	0.80%	0.80%		**15**	

Results on usage of assets pertained significantly to land, large livestock, non-mechanised farm equipment, mechanised farm equipment, houses and other structures. Use of land and non-mechanised equipment by spouse or jointly by the household significantly decreased the odds of having a stunted child (p=0.00) (Table 4.17). For large livestock, joint use of the livestock significantly increased the odds of having a stunted child; a fact that could point to inequitable sharing of the benefits of the livestock. Results on other items show that when other household members used the assets it only served to increase the chances of having a stunted child.

Table 4.17: Usage of the Items Most of the Time

		Male			Female				
		Case	Control	Sig	Case	Control	Sig	Total	Overall Sig
Agricultural land (pieces/ plots in acres)	Household head	3.60%	3.40%		10.60%	7.20%		**142**	
	Spouse	6.80%	8.40%		11.10%	13.70%		**226**	
	Household head and spouse jointly	84.30%	84.00%	0.832	65.80%	65.70%	0.084	**1633**	0.08
	Other household member	0.80%	0.60%		2.40%	1.00%		**27**	
	Household jointly	3.80%	3.40%		9.40%	11.90%		**165**	
	Household head and other household member	0.60%	0.20%		0.30%	0.80%		**11**	
Large livestock (oxen, cow)	Household head	5.30%	13.30%		9.40%	13.00%		**54**	
	Spouse	3.10%	4.40%	0.100	7.70%	6.50%	0.266	**28**	0.222
	Household head and spouse jointly	80.20%	77.00%		71.80%	59.40%		**375**	
	Other household member	2.30%	1.50%		1.70%	0.70%		**8**	
	Household jointly	8.40%	3.00%		9.40%	18.10%		**51**	
	Household head and other outside people	0.80%	0.70%		0.00%	2.10%		**5**	
Farm equipment (mechanised)	Household head	9.10%	7.70%		30.80%	0.00%		**6**	
	Spouse	0.00%	7.70%	0.574	7.70%	6.70%	0.082	**3**	0.138
	Household head and spouse jointly	90.90%	69.20%		61.50%	80.00%		**39**	
	Other household member	0.00%	15.40%		0.00%	13.30%		**4**	

Sale of household assets (Table 4.18) by both spouses (land) significantly enhanced the odds of having a non-stunted child. Sale of non-mechanised assets either by a spouse or jointly significantly increases the odds of having non-stunted children in the household. This most likely relates to what use the income from the assets is put to. The results are mixed regarding giving away of the assets: giving away large livestock increases the odds of having a stunted child in the household. This may due to the productive capacity in large livestock such as milk cow, which denies the household the benefits of the livestock.

Table 4.18: Decision on Whether to Sell Item Most of the Time

		Male			Female				
		Case	Control	Sig	Case	Control	Sig	Total	Overall Sig
Agricultural land (pieces/ plots in acres)	Household head	7.90%	7.60%		22.70%	15.10%		**254**	
	Spouse	4.90%	2.30%		4.40%	6.30%		**85**	
	Household head and spouse jointly	86.10%	89.00%	0.314	67.70%	74.60%	0.051	**1502**	0.143
	Other household member	0.60%	0.60%		2.90%	1.50%		**27**	
	Household jointly	0.40%	0.20%		1.50%	1.90%		**19**	
	Household head and other combinations of household members	0.00%	0.20%		0.80%	0.60%		**8**	
Bees	Household head				100.00%	0.00%		**2**	
	Household head and spouse jointly	100.00%	100.00%		0.00%	100.00%	0.083	**12**	0.078
Farm equipment (non-mechanised) Hoe, shovel, rake, spade, wheel barrow	Household head	8.20%	6.50%		16.90%	10.80%		**160**	
	Spouse	3.80%	3.30%	0.746	7.70%	9.70%	0.025	**93**	0.034
	Household head and spouse jointly	87.20%	89.70%		71.20%	78.20%		**1225**	
	Other household member				1.10%	0.50%		**6**	
	Household jointly	0.80%	0.50%		2.40%	0.80%		**17**	
	Household head and other household member				0.80%	0.00%		**3**	
Farm equipment (mechanised)	Household head	9.10%	9.10%		28.60%	0.00%		**6**	
	Spouse			0.591	7.10%	0.00%	0.086	**1**	0.193
	Household head and spouse jointly	90.90%	90.90%		64.30%	100.00%		**40**	
Large consumer durables (fridge, TV, sofa)	Household head	3.40%	4.80%		19.00%	6.60%		**27**	
	Spouse	0.00%	1.90%	0.224	3.20%	4.10%	0.034	**9**	0.244
	Household head and spouse jointly	96.60%	88.60%		68.30%	84.30%		**295**	
	Household jointly	0.00%	4.80%		9.50%	5.00%		**17**	

Other issues evaluated related to who would keep assets in case of termination of marriages or partnerships. Analysis of decisions on who would keep most of the assets on the break-up of a marriage or union revealed that the most beneficial effect would be when the assets, especially the large consumer durables, were kept by other family members. These decisions however did not significantly affect the odds of stunting in children.

4.3.2 Disempowerment in the Resources Domain

Disempowered women lack a role or participation in ownership, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, consumer durables, and credit. Relative to households where women were empowered, children in households where mothers are disempowered in decision-making on whether to sell or give away agricultural land are 1.66 times or 1.45 times more likely to be stunted, respectively. Children in households where mothers are disempowered in decision-making on whether to sell or give away farm equipment (non-mechanised) are 1.75 times or 1.50 times more likely to be stunted, respectively. Also, children in households where mothers are disempowered in decision-making on whether to sell or give away mobile phones are 1.35 times or 1.47 times more likely to have stunted growth, respectively (Table 4.19). On the other hand, children in households where women are disempowered in decision-making on whether to purchase new agricultural land or new mobile phones are 1.36 times more likely to be stunted.

Table 4.19: Women Disempowerment in Purchase, Sale or Transfer of Assets and Risk for Stunting in Children Under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Who would you say can decide whether to sell agricultural land most of the time?					
Empowered (n=760)	358	47.1	1.00		
Disempowered (n=216)	129	59.7	1.66	[1.22-2.26]	0.001
Total (n=976)	**487**	**49.9**			
Who would you say can decide whether to sell farm equipment (non-mechanised) most of the time?					
Empowered (n=663)	314	47.4	1.00		
Disempowered (n=116)	71	61.2	1.75	[1.17-2.62]	0.006
Total (n=779)	**385**	**49.4**			
Who would you say can decide whether to sell a house (and other structures) most of the time?					
Empowered (n=846)	397	46.9	1.00		
Disempowered (n=169)	93	55	1.38	[0.99-.93]	0.055
Total (n=1,015)	**490**	**48.3**			
Who would you say can decide whether to sell a mobile phone most of the time?					
Empowered (n=650)	282	43.4	1.00		
Disempowered (n=461)	234	50.8	1.35	[1.06-1.71]	0.015
Total (n=1,111)	**516**	**46.4**			
Who would you say can decide whether to give away agricultural land most of the time?					
Empowered (n=668)	323	48.4	1.00		
Disempowered (n=203)	117	57.6	1.45	[1.06-1.99]	0.021
Total (n=871)	**440**	**50.5**			
Who would you say can decide whether to give away farm equipment (non-mechanised) most of the time?					
Empowered (n=592)	289	48.8	1.00		
Disempowered (n=119)	70	58.8	1.5	[1.00-2.23]	0.047
Total (n=711)	**359**	**50.5**			
Who would you say can decide whether to give away a mobile phone most of the time?					
Empowered (n=608)	259	42.6	1.00		
Disempowered (n=408)	213	52.2	1.47	[1.14-1.89]	0.003
Total (n=1,016)	**427**	**46.5**			
Who contributes most to decisions regarding a new purchase of agricultural land?					
Empowered (n=806)	380	47.1	1.00	1.027	
Disempowered (n=261)	143	54.8	1.36	1.798	0.032
Total (n=1,067)	**523**	**49**			
Who contributes most to decisions regarding a new purchase of a mobile phone?					
Empowered (n=699)	302	43.2	1.00		
Disempowered (n=486)	247	50.8	1.36	1.076816 1.714052	0.010
Total (n=1,185)	**549**	**46.3**			

4.3.3 Access to and Decisions on Credit

The following questions were considered in the assessment of credit decisions by households.

Q1. Has anyone in your household taken any loans or borrowed any cash/in-kind from a credit source in the past 12 months?
Q2. Who made the decision to borrow and what to do with the money/ item borrowed from the credit source?

The sources considered were non-governmental organizations (NGO); informal lenders; formal lenders (bank); friends or relatives; savings/ credit group. For access to and decision-making on credit, individuals can have sole, joint or no input in decision-making. Individuals are considered adequate on access to and decisions on credit if they make at least one decision relative to credit from at least one source of credit. Individuals who live in households that do not use any source of credit are considered inadequate on access to credit. The evaluated variables are indicated in Table 4.20.

Table 4.20: Key Credit Variables Considered

Credit source	Significance with respect to input into decision	Significance with respect to who took the loan	Significance with respect to use of credit
Non-governmental organization (NGO)	Not significant	0.03	Not significant
Informal lender	Not significant	Not significant	Not significant
Formal lender (bank);	Not significant	Not significant	Not significant
Friends or Relatives	Not significant	Not significant	Not significant
Savings/Credit group	Not significant	0.000	0.011
Mutual savings groups	Not significant	0.081	0.070
Others	Not significant	Not significant	0.002

4.3.4. Results on Decisions on Credit

Though mortgaging was not the most common source of financing, results show that decisions among households that mortgaged or rented out assets were significant for the well-being of children. For example, joint decisions by spouses on mortgaging or renting out land significantly reduced the odds of having a stunted child. This also applied to non-mechanised farm assets and large household assets. With respect to small livestock, most decisions were made by the spouses and this had a negative effect of increasing the odds of having a stunted child in the household.

Main Source of Loans or Credit

The main sources of credit for households included formal lending where relatively more males took loans as compared with females, and informal lending where relatively more females than men took loans (Figure 4.20). For the rest of the credit sources, there was no significant difference between men and women. Overall, there were significant differences between cases and controls for formal lending from which control households used more credit from formal lenders, while informal lenders like mutual saving groups, and saving and credit groups loaned more in case groups. Two sources of borrowing, NGOs and savings and credit sources, showed significant differences in the decisions made on borrowing by men and women.

In NGO credit, no significant differences between men and women were observed in the case group, while significant differences were observed among men and women in the control groups. Overall the differences between men and women in both controls and cases was mild (about p=0.06). However, in the case of savings and credit groups, there were significant differences between men and women in both the cases and controls (p=0.03). Also significantly more men than women made decisions to borrow from savings and credit groups among the cases.

In the control group, there were major differences between the men and women in who makes the decisions. In this case, higher proportions of females than men reported that it was heads of households who made borrowing decisions from the savings and credit source. In general, there was higher involvement in the borrowing decisions by control household heads.

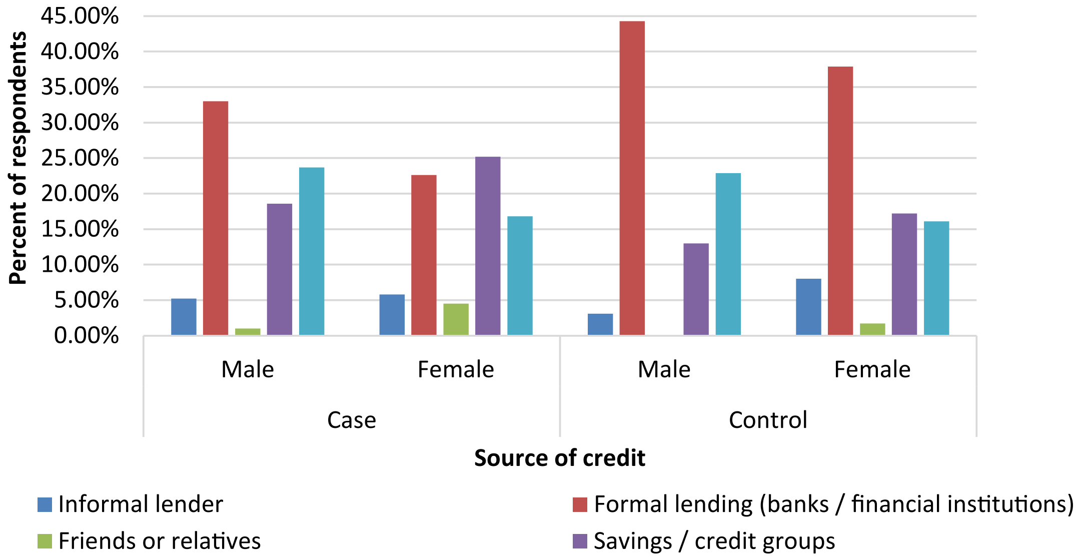


Figure 4.20: Sources of Loans or Credit

Access to Loans or Credit

There was a significant difference between case and control households on decisions to take loans or credit. Less than 10 percent of the case households took credit, but among the control households more than 10 percent had taken credit in the previous 12 months. More women in control households took loans or credit than males (Figure 4.21). A few of the households did not know whether some household members had taken any credit.

The results show that households that did not take a loan were also at significantly higher odds of having a stunted child compared to those that did take a loan (p=0.03). The availability of a loan could contribute to the consumption behaviour (food and non-food expenditure decisions) of the household and in particular on how a child is fed thus impacting on the nutrition outcomes of the child.

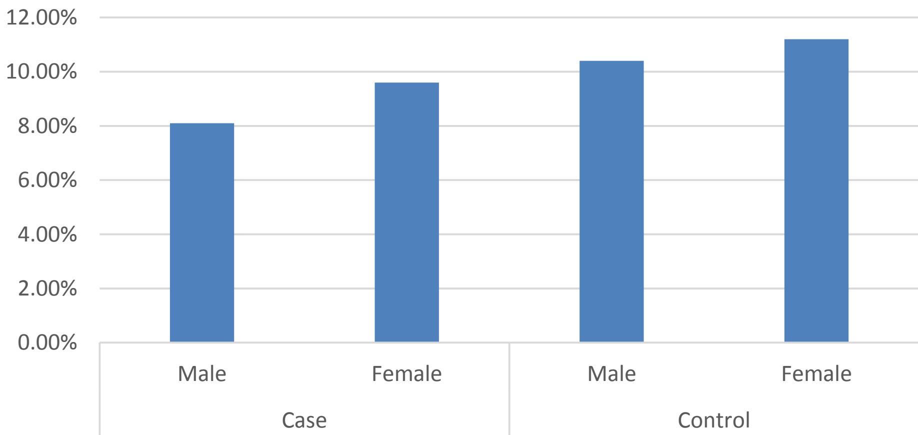


Figure 4.21: Percentage of Respondents who Took a Loan or Credit

Several sources of credit were significant in influencing the nutrition status of the child. These included formal financial institutions, friends and relatives, savings and credit groups, mutual savings groups and other sources. All these had varying effects on child nutrition status. For example, households that did not borrow from formal financial institutions or savings and credit groups had significantly higher odds of having a stunted child compared to those that borrowed from the formal sources. However, those that did not borrow from friends and relatives, and other sources, decreased the odds of having a stunted child. Thus these sources of credit had opposite effects, which could be an indicator of whether the sources are productive or only used to prop up personal consumption. Further analyses indicated that a significant number of the borrowers invested in business and this significantly decreased the odds of having stunted children in households that used formal sources of credit.

Regarding the person who took a loan or credit in the household, only the results on the person who took a loan from a savings and credit group showed a difference between men and women (Table 4.21). In both case and control groups, more men indicated that the head of the household took the loans. In the case of Rwanda where males head many households, these results indicate that men are likely to take loans from savings and credit groups. The trend was the same in the control group for lending from NGOs – significant differences were observed between men and women from NGO credit source with more males (over 71%) indicating that heads of households were the ones who took the loans (p=0.039), while 43 percent of the females indicated the spouse to be the one who took the loan. Overall, the respondents from the control group significantly used more formal credit and savings than case households.

Table 4.21: Who Took the Loan in the Household?

		Case			Control				
		Male	Female	Sig	Male	Female	Sig	Total	Sig
Non-governmental organization (NGO)	Household head	33.30%	75.00%		71.40%	42.90%		16	
	Spouse	50.00%	25.00%	0.226	0.00%	57.10%	0.039	9	0.127
	Household head and spouse jointly	16.70%	0.00%		28.60%	0.00%		3	
Formal lender (bank/financial institution)	Household head	45.50%	48.60%		34.50%	46.30%		83	
	Spouse	6.10%	11.40%	0.622	13.80%	20.90%	0.099	28	0.126
	Household head and spouse jointly	48.50%	40.00%		51.70%	32.80%		82	
Savings/credit group	Household head	68.40%	30.80%	0.007	66.70%	32.30%	0.003	47	
	Spouse	15.80%	61.50%		5.60%	54.80%		45	0.001
	Household head and spouse jointly	15.80%	7.70%	0%	27.80%	12.90%		15	
Mutual saving groups	Household head	41.70%	15.40%		25.80%	32.10%		31	
	Spouse	33.30%	57.70%	0.081	41.90%	53.60%	0.269	51	0.096
	Household head and spouse jointly	25.00%	26.90%		32.30%	14.30%		27	
Other	Household head	33.30%	100.00%		77.80%	71.40%		14	
	Spouse			0.248	0.00%	28.60%	0.126	2	0.057
	Household head and spouse jointly	66.70%	0.00%		22.20%	0.00%		4	

Decisions on How to Use the Money Borrowed

There was a significant difference (p=0.01) between the case and control groups on decisions about what to do with money borrowed from savings and credit sources. In both situations, males played a bigger role relative to women. Between the controls and cases, control households had higher numbers of heads of households making decisions on what to do with the credit from savings and credit groups than the case households (Table 4.22). Among the case households the differences in decision-making were mildly significant (p=0.07), while no significant differences were observed in the control households. On the question about what was the intended use for the loan or credit, there was no significant difference between men and women in usage of loans.

Table 4.22: Who Makes Decisions on What to do With the Funds Borrowed?

		Case			Control				
		Male	Female	p	Male	Female	p	m	p
Savings/ credit group	Household head	21.10%	12.80%	0.069	33.30%	23.30%	0.174	22	0.011
	Spouse	0.00%	23.10%		0.00%	16.70%		14	
	Household head and spouse jointly	78.90%	64.10%		66.70%	60.00%		70	
Mutual saving groups	Household head	13.00%	15.40%		10.00%	25.00%		17	
	Spouse				10.00%	7.10%		5	0.070
	Household head and spouse jointly	87.00%	84.60%		80.00%	67.90%		85	
Other sources	Household head	0.00%	100.00%	0.083	50.00%	33.30%	0.031	7	0.002
	Spouse				0.00%	50.00%		3	
	Household head and spouse jointly	100.00%	0.00%		50.00%	16.70%		7	

4.3.5 Extension Services

In the 12 months preceding the survey, only 3 percent of the households reported meeting some extension service workers. Overall, more males (3.3%) appear to have received extension services compared with females (2.1%). While there was no significant difference between men and women meeting extension workers under the case group, there was a significant difference in the control group with more males than females accessing extension services (Figure 4.22).

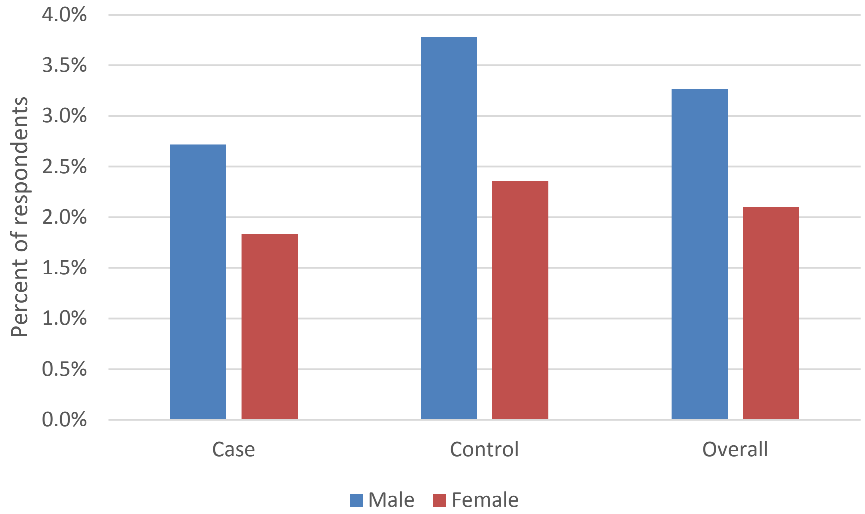


Figure 4.22: Meeting with an Agricultural Extension Worker or Livestock/Fisheries Worker

With respect to the time of visit by extension workers, timing was not significantly different among the case households (Figure 4.23). However, in the control groups, there were significant indications that the timing of extension visits was important to both the men and women. In general, more males (76%) than females (52%) indicated that timing was appropriate. In both cases, access to extension services by households did not significantly influence stunting in children.

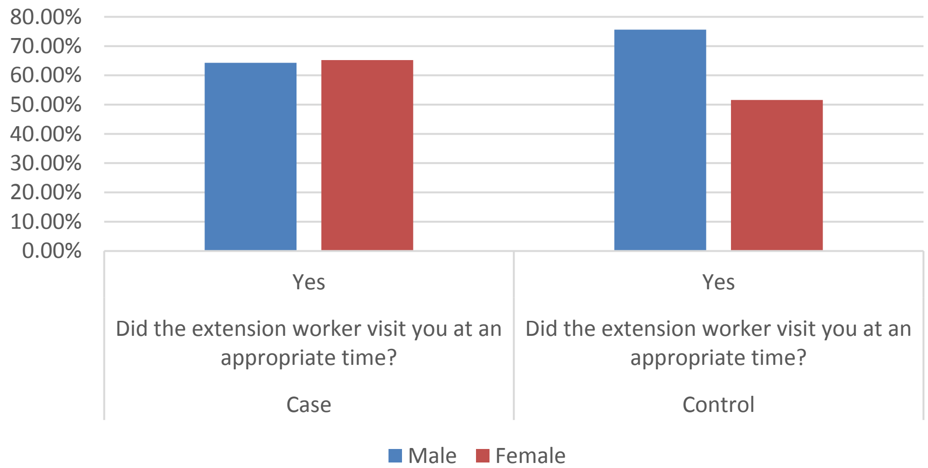


Figure 4.23: Appropriateness of Extension Worker's Visit Time

4.4 Income

This empowerment dimension concerns sole or joint control over the use of income and expenditures. The survey questions that contribute to the empowerment analysis in this domain include:

Q1. How much input did you have in decisions on the use of income generated from: food crop, cash crop, livestock, non-farm activities, wages and salary, and fish culture?
Q2. To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to: non-farm economic activities? Your own wage or salary employment? Major and minor household expenditures?

For income, individuals can have no input in decision-making, have input in few or some of decisions, have input in most or all decisions. Individuals are considered adequate on input in decisions about the use of income if they participate in that activity and have at least some input into decisions related to that activity.

On the other hand, regarding the extent to which the individual feels they can participate in decisions (that is, not at all, to a small extent, to a medium extent, or to a high extent), individuals are considered adequate if they make the decisions themselves or if they feel that they could participate in the decision-making at least to a medium extent providing it is not only regarding minor household expenditures. Some of the income and expenditure issues investigated are shown in Table 4.23.

Table 4.23: Income and Expenditure Issues Evaluated

Income issue	Significance with respect to males and females
Incomes earned	0.000
Minor expenditures	0.000
Major expenditures causes	0.000
Reasons for non-expenditure	Not significant

4.4.1 Household Incomes

Decisions on household incomes by gender are presented in Table 4.24 and the results indicate that the incomes earned were significantly different between men and women among the cases and controls ($p=0.000$). Out of the males interviewed in case households, 75 percent earned more money compared to their female counterparts, while 8 percent of the females earned more than the males. Similarly in the control households, 78 percent of the males earned more money than their wives, while only 8 percent of females earned more than their husbands. Over 24 percent of females in the case group did not earn any money as compared with only 3 percent of men; while 22 percent of the females in the control group did not earn any money. Some of the households did not know the amount of money their partners earned with majority being females (1%) in the cases and 2 percent in the controls.

The results on the effect of income expenditures reveal that when both partners do not earn any regular incomes, the odds of stunting in children in these households significantly increases by 1.47 times. Other combinations of earnings among the spouses or partners did not influence the levels of stunting in a significant manner.

Table 4.24: Income Decision Comparisons between Females and Males

	Case		Controls	
In comparison to your partner do you?	Sex of the respondent		Sex of the respondent	
	Male	Female	Male	Female
Earn more money than him / her	75.40%	7.90%	77.70%	8.40%
Earn less money than him / her	2.90%	53.10%	2.70%	56.10%
Earn about the same money as him / her	12.90%	6.20%	11.80%	6.80%
Partner does not earn money	2.40%	1.70%	2.10%	1.50%
I do not earn money	3.10%	24.40%	3.10%	22.00%
Partner and I do not earn money	3.10%	5.30%	2.20%	3.80%
Do not know how much partner earns	0.10%	1.30%	0.40%	1.50%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**
P –value		0.000		0.000

4.4.2 Decisions on Minor Expenditures

From the results in Table 4.25, more males (64%) than females (55%) in the overall sample reported that decisions regarding minor household expenditures are mostly made jointly between the household head and the spouse. About 53 percent and 57 percent of females in the case and control categories respectively were of the same opinion. Moreover, from all the groups the number of females who reported that such decisions are taken by the household head was greater than that of men. The gender differences in the control group and in the overall sample were statistically significant. Decisions on minor expenditures did not significantly impact on stunting in the children.

Table 4.25: Who Normally Makes Decisions on Minor Household Expenditures?

Decision maker	Case			Control			Overall		
	Sex of the respondent			Sex of the respondent			Sex of the respondent		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Household head	18.80%	25.60%	**22.50%**	17.40%	22.60%	**20.20%**	18.10%	24.10%	**21.30%**
Spouse	15.70%	16.80%	**16.30%**	16.50%	16.40%	**16.50%**	16.10%	16.60%	**16.40%**
Household head and spouse jointly	63.90%	53.30%	**58.10%**	64.20%	57.20%	**60.40%**	64.10%	55.30%	**59.30%**
Other household member	0.50%	1.50%	**1.00%**	0.50%	1.20%	**0.90%**	0.50%	1.40%	**1.00%**
P-value			**0.217**			**0.000**			**0.000**

4.4.3 Major Causes of Expenditure

Expenditure on various needs among men and women in both control and case groups were significantly different (p=0.000). Males spent more on clothes/shoes for the household members (43.9% in cases and 44.2% in controls) with the children's clothes taking the biggest share (17% in cases and 18% in controls). On the other hand, although females also spent much on the clothes of the household members (36.6%), they also spent more on services, charitable donations and consumables. Generally in the households, other important expenditure items were medicine or health costs (11% for both men and women). Some of the incomes were spent on buying farming assets (7% by males and 5% by females in cases, and 7% by males and 6% females in controls). Less than 1 percent in the case and 1 percent in the control groups bought assets for business, implying that majority of the households depended on farming.

On information on the disaster that challenged households' expenditure (Figure 4.24), significant differences between men and women (p=0.000) were observed. It is interesting to note that about 62 percent and 69 percent of the males in the case and control households, respectively, reported that they were affected by drought; while only 5 percent of the females reported this incidence in the control group. Notwithstanding, 33 percent and 40 percent of women from the case and control groups respectively had a poor harvest or reported a poor harvest as a challenge to food expenditure; while only 15 percent and around 5 percent of men from the case and control groups respectively were affected. As expected, more females were unemployed (26% in both cases and controls) compared with males (10% in cases and 18% controls).

The results indicate that besides food, households appeared to spend earnings on buying assets for business which significantly reduced the odds of having a stunted child; or purchased medicines for health needs, or on other non-specified needs. In instances where the households did not spend earnings on anything else after food, various reasons were provided for the non-expenditure. Among them negative shocks such as illness, bad harvests, unemployment or drought, though none of these was significant enough to influence stunting levels.

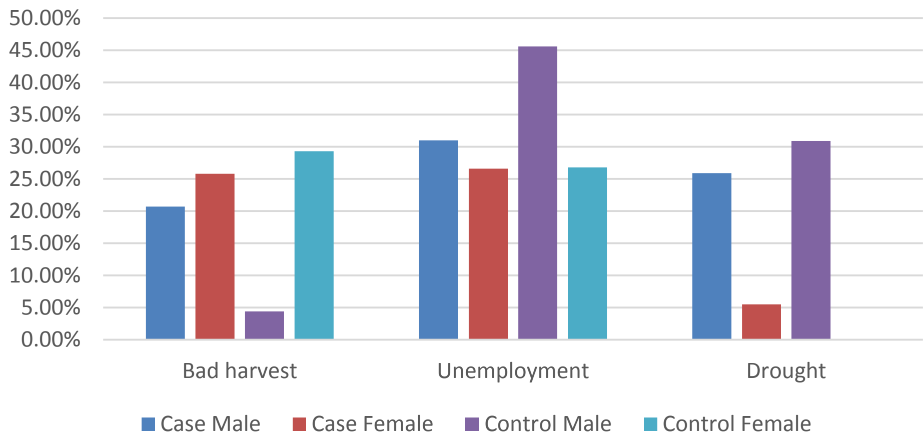


Figure 4.24: Reasons for not Spending Money on Only Food in the Last 12 Months by Gender

4.5 Leadership

This empowerment dimension concerns leadership in the community, and is measured by membership in formal or informal economic or social groups. The survey questions that contribute to the empowerment analysis in this domain include:

Q1. Are you a member of any: agricultural/livestock/fisheries producer/market group; water; forest users; credit or microfinance group; mutual help or insurance group (including burial societies); trade and business association; civic/charitable group; local government; religious group; other women's group; other group. Leadership issues also involved the extent of decision making in these groups and participation in community programmes including universal suffrage issues.

Individuals were considered inadequate for leadership if they were not part of at least one group. Some of the leadership issues analysed are shown in Table 4.26.

Table 4.26: Summary of Leadership Issues Investigated

Leadership issue	Significance with respect to males and females or case and controls
Ability to cause change	0.000
Contribution to community infrastructure	0.001
Influence on proper wages in public works	0.001
Protesting misbehaviour of authorities	0.001
Intervening in family disputes	0.030
Possession of national ID cards	Not significant
Who keeps ID card	Not significant
Possession of a voter' card	0.000
Who keeps voter's card	0.001
Who chooses candidate to vote for	0.001
Participation in elections	0.001
Assistance to others in need	0.000
Assistance to other families with labour	0.032
Position on influence ladder	0.000
Group membership	0.000
Leadership position in groups	0.030
Decision making in groups	0.000
Frequency of group meetings	0.000
Number of meetings	0.005

Results on Leadership Dimension

Ability to generate change in the community

As a starting point, both men and women were asked whether they felt they could generally cause change in the community (Table 4.27). The results showed that relative to households that were not able to cause any change, households that were able to contribute to changes in the community had reduced odds of having a stunted child. Thus results indicate strongly that child nutrition gets better with more leadership empowerment. Children in households that find it easy to generate change within the community have significantly lower odds of stunting (26% lower) compared to children in households that are not able to generate any change in the community.

Table 4.27: Ability to Cause Change in the Community

	Households with a stunted child				
Ability to generate change in community	**N**	**%**	**OR**	**95%CI**	**p**
No, not at all (1656)	862	52	1.00	.	.
Yes, but with great difficult (962)	479	50	0.91	0.78-1.07	0.265
Yes, but with little difficulty (1013)	502	50	0.9	0.77-1.05	0.211
Yes, fairly easily (813)	362	44	0.74	0.624-0.87	0.000
Yes, very easily (293)	133	45	0.76	0.59-0.98	0.036
Total (4737)	**2338**				

4.5.1 Influence on Community Infrastructure

One of the important aspects of leadership involves contribution to decisions on infrastructure. It was observed that about 35 percent of women and 19 percent of men in the case category were not comfortable at all in contributing to infrastructural decisions. These percentages were slightly lower in the control group at 32 percent for women and 14 percent for men. Only about 19 percent of the female respondents from both the case and control groups reported to be fairly comfortable with contributing to infrastructural decisions. These disparities between women and men were observed to be statistically significant (Figure 4.25).

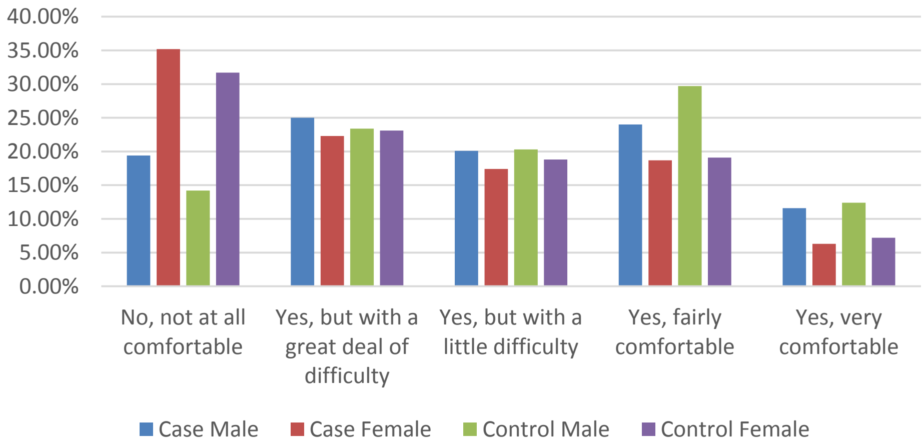


Figure 4.25: Contribution in Decisions on Infrastructure

Based on the analysis of the odds ratios, children in households that feel comfortable to contribute to community issues and infrastructural decisions have decreased odds of stunting of between 15-26% (Table 4.28). With respect to men and women, the relationship is strongest with male respondents compared to female respondents, thus males are more likely to easily make these decisions while most females would find some difficulties.

Table 4.28: Contribution to Community Infrastructure Decisions as a Factor for Stunting in Children under 24 Months

Decisions on community infrastructure	Households with a stunted child		Odds Ratio	95% CI	p
	N	%			
No, not at all (1656)	661	54	1.00	. .	.
Yes, but with great difficult (962)	549	49.5	0.85	0.72-1.00	0.052
Yes, but with little difficult (1013)	435	48	0.81	0.68-0.96	0.014
Yes, fairly easily (813)	492	46	0.74	0.63-0.88	0.000
Yes, very easily (293)	201	47	0.76	0.61-0.95	0.014
Total (4737)	**2338**				

4.5.2 Contribution to Community Infrastructure

Figure 4.26 presents the findings on the contribution of respondents towards building or maintaining schools (other activities such as wells/ irrigation facilities, and roads followed similar results and patterns) in their community. In both the case and control groups, the percentages of contributing men are significantly higher than those of women. Respondents from the control group participate more than those from the case group.

Findings on the contribution of respondents in building or maintaining local schools or mosques/churches show some significant differences between men and women from both the case and control groups. Contribution was highest in the control category where 72 percent and 59 percent of men and women contributed, respectively.

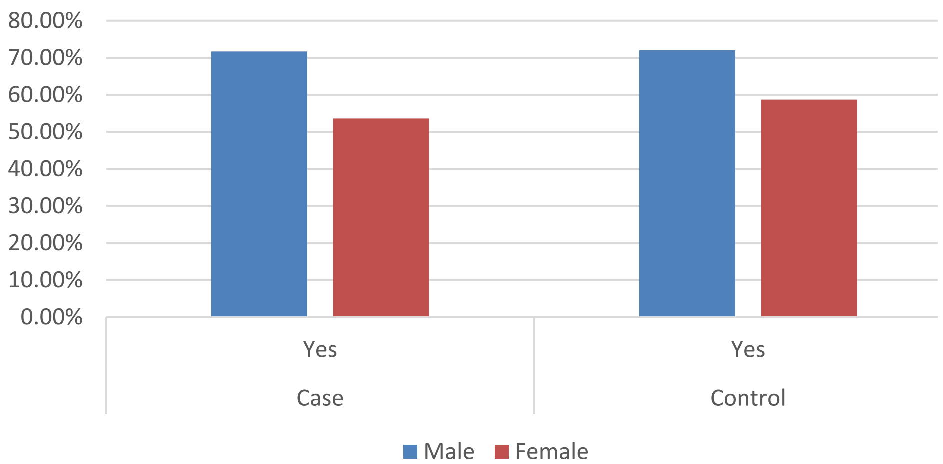


Figure 4.26: Contribution to Building or Maintaining Local Schools/ Mosques/Churches

Overall, the survey results show significant increase in the odds of stunting in children arising from non-participation by the households in community infrastructure, facilities (e.g. schools, churches) and processes (fund raising and donations), whether by exerting efforts or making monetary contributions (Table 4.29). The odds of stunting by nonparticipating households increased by 1.14 times relative to the children in households that participated in these community activities. Similarly, children in households that did not extended assistance to family members, relatives and friends through donation of funds or other support in kind were likely to have increased odds of stunting by more than 1.3 times.

Table 4.29: Contribution to Social Infrastructure as a Factor for Stunting in Children

Contribution to maintaining social infrastructure	Households with a stunted child		OR	95%CI	p
	N	%			
Yes	1440	48	1.00		.
No	898	51	1.14	1.02-1.29	0.027

4.5.3 Influence for Proper Payment or Wage in Public Works

Findings portray significant differences between men and women in how comfortable they feel in openly supporting proper payment of wages and helping to decide on infrastructure (Table 4.30). Regardless of the whether they belong to the case or control group, a relatively larger proportion of women reported being not comfortable voicing their opinions on proper payment of wages in public work or other similar programmes. Higher levels of participation in these issues decreased the odds of stunting in children.

Table 4.30: Contribution to Ensure Proper Payment of Wages for Public Work or other Similar Programmes

		Male	Female	Total
Case*	No, not at all comfortable	19.80%	36.30%	**678**
	Yes, but with a great deal of difficulty	20.10%	20.80%	**479**
	Yes, but with a little difficulty	21.90%	19.10%	**476**
	Yes, fairly comfortable	25.60%	18.20%	**502**
	Yes, very comfortable	12.50%	5.60%	**202**
Control*	No, not at all comfortable	14.70%	31.10%	**567**
	Yes, but with a great deal of difficulty	17.80%	21.50%	**475**
	Yes, but with a little difficulty	23.60%	20.70%	**528**
	Yes, fairly comfortable	30.40%	20.90%	**603**
	Yes, very comfortable	13.60%	5.90%	**225**

**Significant at 1% level*

4.5.4 Contribution in Protesting against Misbehaviour of Authorities

Compared with men, women were uncomfortable in protest against the misbehaviour of authorities and this was also significant in both the case and control groups (Table 4.31). Almost half of the females in the case group were uncomfortable to protest.

Table 4.31: To Protest the Misbehaviour of Authorities or Elected Officials

		Male	Female	Total
Case*	No, not at all comfortable	30.40%	47.20%	**930**
	Yes, but with a great deal of difficulty	17.80%	16.00%	**392**
	Yes, but with a little difficulty	19.10%	15.80%	**403**
	Yes, fairly comfortable	22.60%	17.40%	**460**
	Yes, very comfortable	10.10%	3.70%	**152**
Control*	No, not at all comfortable	27.10%	40.30%	**823**
	Yes, but with a great deal of difficulty	15.80%	17.00%	**394**
	Yes, but with a little difficulty	19.30%	17.10%	**434**
	Yes, fairly comfortable	25.60%	20.80%	**550**
	Yes, very comfortable	12.30%	4.90%	**197**

**Significant at 1% level*

There was a strong association between protest against behaviour of authorities and stunting in children in the households. Children in households where men and women were able to speak out against unfair wages or misbehaviour of authorities were less likely to be stunted (Table 4.32). The odds of stunting decreased by as much as 32 percent, relative to children in households that were not able to protest at all.

Table 4.32: Ability to Protest Against Misbehaviour of Authorities as a Factor for Stunting in Children under 24 Months

Protest behavior of authorities	Households with a stunted child		OR	p	95% CI
	N	%			
No, not at all (1753)	930	53	1.00	.	. .
Yes, but with great difficult (788)	393	50	0.88	0.74-1.04	0.140
Yes, but with little difficult (837)	403	48	0.82	0.69-0.97	0.020
Yes, fairly easily (1010)	460	45	0.74	0.63-0.86	0.000
Yes, very easily (349)	152	43	0.68	0.54-0.86	0.000
Total (4737)	**2338**				

4.5.5 Intervention in Case of Family Disputes

Results in Table 4.33 show significant differences between men and women with regard to their feelings about intervening in family disputes. In both the case and control categories, women dominated the number of respondents who were uncomfortable at all to intervene. Actually about 31 percent women in the case group and 27 percent in the control group were not comfortable; and about 20 percent in both groups were comfortable but with a great deal of difficulty.

Table 4.33: Extent of Intervention in Case of a Family Dispute

		Male	Female	Total
	No, not at all comfortable	13.70%	30.50%	539
	Yes, but with a great deal of difficulty	14.60%	20.40%	417
Case*	Yes, but with a little difficulty	18.00%	18.60%	428
	Yes, fairly comfortable	34.50%	22.60%	650
	Yes, very comfortable	19.30%	8.00%	303
	No, not at all comfortable	11.30%	27.20%	481
	Yes, but with a great deal of difficulty	13.40%	19.60%	402
Control*	Yes, but with a little difficulty	19.30%	19.60%	466
	Yes, fairly comfortable	35.40%	24.40%	704
	Yes, very comfortable	20.60%	9.30%	345

**Significant at 1% level*

The survey results show that children in households that intervened in cases of family disputes had reduced odds of stunting by children overall by as much as 22 percent, relative to children of households that were not able to intervene in disputes (Table 4.34).

Table 4.34: Ability to Intervene in Disputes as a Factor for Stunting in Children under 24 Months

Ability to intervene in family disputes	Households with a stunted child		OR	95%CI	p
	N	%			
No, not at all (1022)	540	53	1.00		.
Yes, but with great difficult (919)	417	51	0.93	0.77-1.11	0.412
Yes, but with little difficult (894)	428	48	0.82	0.68-0.98	0.030
Yes, fairly easily (1354)	650	48	0.82	0.70- 0.97	0.019
Yes, very easily (648)	303	47	0.78	0.64- 0.95	0.016
Total (4737)	**2338**				

4.5.6 Possession of National Identification Cards

The majority of the respondents had national identity cards (Table 4.35). There was no significant difference between men and women in the case category on possession of the cards. However, a significant difference was found among respondents from the control group where 97 percent of men and 93 percent of women reported having a national identity card. Most of the respondents from both categories kept their own national identity cards and there was no statistically significant difference between the men and women or between case and control groups with respect to possession of an identity card or where it is kept.

Table 4.35: Possession of Identity Card

Do you have an identity card?		Male	Female	Total
Case*	Yes	95.00%	92.80%	2192
	No	5.00%	7.20%	145
Control*	Yes	97.10%	93.40%	2280
	No	2.90%	6.60%	118

**Significant at 1% level*

4.5.7 Participation in Elections

Table 4.36 and Table 4.37 show the results concerning possession of a voter's card. The majority of respondents (men and women) from the case and control categories had voters' cards. However, the percentage of women (83%) having cards was found to be less than that of men (90%)

in the case group and in the control group (84% females and 94% males). These differences were found to be significant at 1 percent level in each category and between categories.

Table 4.36: Possession of an Elector's/Voter's Card

Do you have an electors/voters card?	Case		Control		
	Male	Female	Male	Female	Total
Yes	89.80%	83.10%	93.70%	84.20%	4134
No	10.20%	16.90%	6.30%	15.80%	601
Significance		0.000		0.000	0.000

Moreover, the results show that the majority of respondents kept their voter's card while very few reported their spouses kept it (Table 4.37). Women from the case category and men from the control one dominate the latter group. These results also revealed a higher number of women from both cases and controls who do not even remember where their voter's cards were kept. The differences between men and women in cases are significant at 1 percent. The differences are also significant when controls and cases are compared.

Table 4.37: Person who Keeps the Elector's/Voter's Card

	Case*		Control**		Total*
	Male	Female	Male	Female	Total
Yourself	97.60%	94.80%	97.30%	96.00%	**4116**
Spouse	1.40%	1.80%	1.40%	0.90%	**57**
Other relative	0.10%	0.90%	0.10%	0.60%	**19**
Somebody else	0.20%	0.40%	0.20%	0.30%	**11**
Does not remember	0.70%	2.20%	1.10%	2.20%	**69**

**Significant at 1% level, ** Significant at 5%*

On the question of whether the respondents ever participated in local or national elections, about 86 percent of females from case and control categories confirmed participation in elections (Table 4.38). Men from the cases and controls were found to have participated more at 91 percent and 93 percent respectively. Thus, the figures revealed a significant difference between men and women in terms of participation in local or national elections.

Table 4.38: Participation in a Local or National Election

		Male	Female	Total
Case*	Yes	91.30%	85.70%	**2060**
	No	8.70%	14.30%	**277**
Control*	Yes	93.20%	85.90%	**2139**
	No	6.80%	14.10%	**259**

**Significant at 1% level*

Table 4.39 reports the results on votes and participation of respondents in elections. The findings on voting show that the last time they voted, the majority of respondents in the total sample chose a candidate to vote for by themselves. However, a few respondents did not decide on who to vote for. These were mostly women in the case category where the husbands chose for them. The differences among men and women's choices of the voted candidates were found to be statistically significant for both case and control groups.

Table 4.39: Who Decides on the Candidate to Vote for

	Case**		Control*		
	Male	Female	Male	Female	Total*
Yourself	98.50%	96.60%	99.30%	96.70%	**4114**
Spouse	0.50%	1.20%	0.30%	0.70%	**29**
Other relative	0.00%	0.10%	0.00%	0.20%	**3**
Somebody else	0.70%	1.90%	0.40%	2.00%	**55**
Does not remember	0.20%	0.30%	0.00%	0.40%	**9**

**Significant at 1% level, ** Significant at 10% level*

Voter's card and stunting in children

One hallmark of empowerment is possession of a voter's card, an aspect that showed a statistically significant difference between the men and women as well as between households with and without a stunted child. The odds of having a stunted child significantly increased 1.25 times when household heads did not have a voter's card (Table 4.40).

Table 4.40: Possession of a Voter's Card as Factor for Stunting in Children under 24 Months

	Household with stunted child				
Possession of voter's card	**N**	**%**	**OR**	**95% CI**	**p**
Yes (4136)	2012	48	1.00	.	.
No (601)	326	54	1.25	1.05-1.49	0.01

4.5.8 Assistance to Others in Need

Assistance to those in need was captured in terms of sickness, labour demands, and childcare support. Support during sickness was observed to be significantly different between men and women in the case group in which about 26 percent of the males provided support during sickness, while about 22 percent of the females did the same.

Men and women significantly differed in extending help to other family members in health-related needs particularly among the case households. While about 21 percent of the males extended assistance, only 14 percent of the females did so. There was no significant difference among the control households. Overall, more control than case households appear to have extended assistance to the other family members in health-related needs.

Assistance to other families with agricultural labour requirements was not significantly different among case households. However among the control households, more females than males assisted other households requiring labour (p=0.032). This is also reflected in the overall differences between the cases and control households (Figure 4.27).

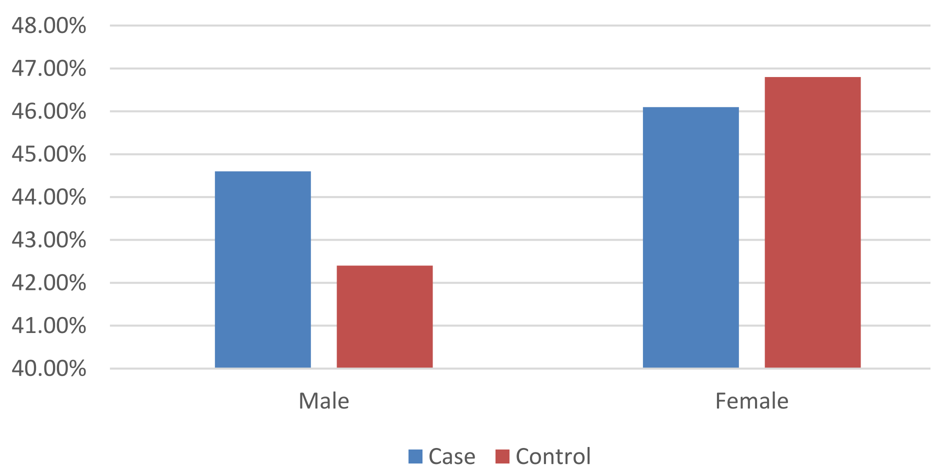


Figure 4.27: Assistance to Other Families with Agricultural Labour

Similar results were observed for support for non-health related needs as well as childcare. In both case and control groups, men were more likely to extend financial help for non-health related needs in case households than females. However, in comparing between cases and controls, more males (22%) than females (18%) in the control group were more likely to provide support for non-health needs. In all cases, assistance to others did not significantly influence stunting in children under 24 months.

4.5.9 Position on the Influence Ladder

An influence ladder was used to establish where men and women are positioned in terms of decision-making influence using a 9-scale ladder ranging from no influence to full influence. About 77.9 percent of the males in the case group had influence levels of only up to level 5 on the influence ladder (low influence), while about 85.5 percent of the females felt that they had influenced decisions of up to level 5 in the same group. The differences in positioning on the influence ladder were significantly different between men and women for the cases (p=0.00).

For the control households, fewer males (70.9%) felt they had influence levels of up to 5 on the ladder, while more females (80.6%) as well also indicated they had influence of up to 5. There was also a significant difference between the men and women on the level of influence they wielded (p=0.00). The variations in influence are larger especially for both lower levels of influence and higher levels of influence. (Figure 4.28).

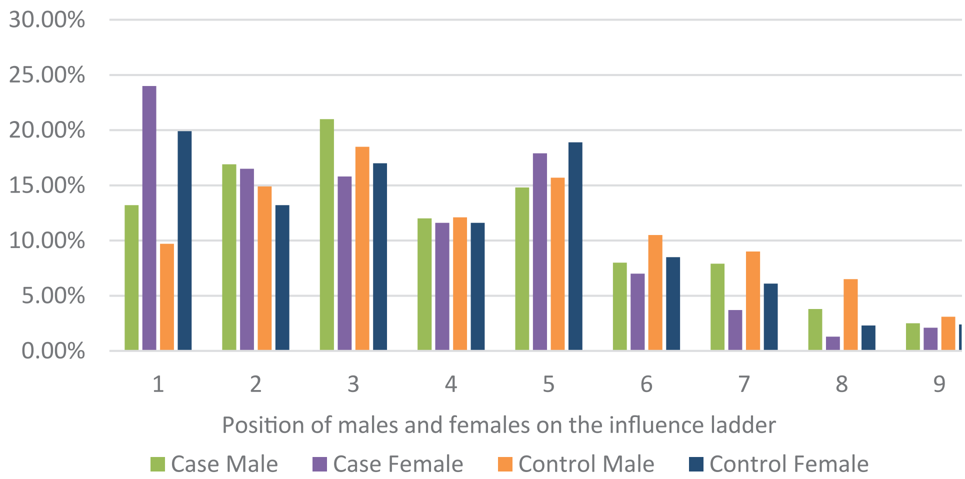


Figure 4.28: On which Step are you in the Influence Ladder?

Further results on positioning on the influence ladder indicate that a higher positioning on the influence ladder was significantly associated with odds of stunting in children. Table 4.41 shows that the odds of stunting in children decrease by upto 56 percent as the households move up the influence ladder.

Table 4.41: Position on Influence Ladder and Effect on Stunting

Position on the influence ladder	OR	95% CI	p
1	1.00		
2	1.02	0.79-1.32	0.859
3	0.77	0.60-0.98	0.034
4	0.83	0.63-1.10	0.193
5	0.77	0.61-0.98	0.031
6	0.69	0.50-0.95	0.023
7	0.56	0.38-0.83	0.003
8	0.44	0.24-0.82	0.007
9	0.69	0.40-1.16	0.158

4.5.10 Group Membership

Results on active membership in groups (Table 4.42) show that women respondents are not practically involved. In both the case and control groups, men's participation was significantly higher than that of women in agricultural producer groups, credit or micro-finance groups, trade and business associations, local government, and religious groups. Women only dominated in other women groups although their participation was still low at 1.5 percent and 1.4 percent from the case and control groups, respectively. In the groups for water users and merry-go-round, significant differences between male and female respondents were found among the control group.

Table 4.42: Active Membership in Groups

		Case			Control				
		Male	Female	SIGN	Male	Female	SIGN	Total	SIGN
Agricultural producer group	Yes	6.10%	3.90%	0.01*	7.50%	4.00%	0.00*	**247**	0.00*
	No	93.90%	96.10%		92.50%	96.00%		**4488**	
Water users group	Yes	0.30%	0.10%	0.21	0.80%	0.30%	0.08***	**17**	0.03**
	No	99.70%	99.90%		99.20%	99.70%		**4718**	
Credit or micro-finance group	Yes	7.70%	1.90%	0.00*	8.10%	3.70%	0.00*	**241**	0.00*
	No	92.30%	98.10%		91.90%	96.30%		**4494**	
Merry-go-round	Yes	20.70%	18.40%	0.17	23.90%	20.90%	0.08***	**988**	0.03**
	No	79.30%	81.60%		76.10%	79.10%		**3747**	
Mutual help group	Yes	5.00%	2.70%	0.00*	5.50%	4.70%	0.37	**208**	0.01*
	No	95.00%	97.30%		94.50%	95.30%		**4527**	
Trade and business association	Yes	0.80%	0.10%	0.01*	1.60%	0.50%	0.01*	**33**	0.00**
	No	99.20%	99.90%		98.40%	99.50%		**4702**	
Local government	Yes	1.40%	0.40%	0.01*	0.90%	0.40%	0.09*	**34**	0.00**
	No	98.60%	99.60%		99.10%	99.60%		**4701**	
Religious group	Yes	5.80%	2.40%	0.00*	5.90%	3.00%	0.00*	**194**	0.00**
	No	94.20%	97.60%		94.10%	97.00%		**4541**	
Other women group	Yes	0.40%	1.50%	0.01*	0.50%	1.40%	0.02*	**46**	0.00**
	No	99.60%	98.50%		99.50%	98.60%		**4689**	

** Significant at 1%, ** Significant at 5%, ***Significant at 10%,*

Although there is varying membership of groups by men and women, overall there is a significant association between group membership and child nutrition status. The results show that households that were neither a member nor a leader in a group increased the odds of having a stunted child significantly (odds ratio of 3.1, p=0.03). In many of the cases, women's participation appeared lower.

Generally as shown in Table 4.43, the majority of respondents had never occupied a leadership position in the different groups considered. Females in both the case and control categories who had never held such positions ranged from 85 percent to 100 percent. A significant difference at 10 percent was found in the combined sample for the forest users, credit or micro-finance, and local government groups. The difference in religious groups was found significant at 5 percent with higher participation of women (14.3%) than men (3.9%) in the control group.

Table 4.43: Leadership Position in this Group

		Case			Control				
		Male	Female	SIGN	Male	Female	SIGN	Total	SIGN
Forest users groups	Yes	20.00%	0.00%	0.41	66.70%	0.00%	0.05**	**3**	0.07***
	No	80.00%	100.00%		33.30%	100.00%		**12**	
Credit or micro-finance groups	Yes	12.70%	5.00%	0.34	14.30%	4.90%	0.13	**20**	0.08***
	No	87.30%	95.00%		85.70%	95.10%		**167**	
Merry go round	Yes	9.90%	2.40%	0.00*	4.30%	7.70%	0.14	**50**	0.28
	No	90.10%	97.60%		95.70%	92.30%		**783**	
Local government	Yes	75.00%	0.00%	0.17				**3**	0.06***
	No	25.00%	100.00%		100.00%	100.00%		**6**	
Religious groups	Yes	2.30%	8.00%	0.26	3.90%	14.30%	0.08***	**10**	0.04**
	No	97.70%	92.00%		96.10%	85.70%		**145**	
Others	Yes	6.50%	3.10%	0.54	14.30%	0.00%	0.04**	**7**	0.05**
	No	93.50%	96.90%		85.70%	100.00%		**112**	

** Significant at 1%, ** Significant at 5%, ***Significant at 10%*

Results show significant differences between men and women from both the case and control groups in their participation in decision-making in their groups (Table 4.44). A majority of women reported participating in some decisions in the merry-go-round (44.5%) and business and trade groups (100%), while they had little input in the mutual help groups (41.7%). On the other hand, majority of males participated in making decisions compared to females. This is especially reflected in the merry-go-round and mutual help groups where 51.4 percent and 57.4 percent of males from the case group at least participated in decision-making. Although the difference in decision-making between control and case groups was found significant, the findings show that the low level of participation of females followed similar trends in both groups.

Table 4.44: Amount of Input into Making Decisions in the Groups

		Case			Control				
		Male	Female	SIGN	Male	Female	SIGN	Total	SIGN
Merry-go-round	No input	0.90%	9.00%	0.00*	4.20%	12.00%	0.00**	69	0.00*
	Input into very few decisions	22.70%	24.10%		19.60%	23.30%		225	
	Input into some decisions	51.40%	44.50%		50.80%	39.20%		463	
	Input into most decisions	16.20%	17.60%		19.20%	20.80%		187	
	Input into all decisions	8.80%	4.90%		6.20%	4.60%		60	
Mutual help group	No input	9.30%	41.70%	0.01*	6.60%	39.10%	0.00**	49	0.00*
	Input into very few decisions	25.90%	13.90%		34.40%	20.30%		53	
	Input into some decisions	57.40%	36.10%		57.40%	31.30%		99	
	Input into most decisions	1.90%	2.80%		1.60%	6.30%		7	
	Input into all decisions	5.60%	5.60%		0.00%	3.10%		7	
Trade and business association	No input	12.50%	0.00%	0.91	0.00%	50.00%	0.01*	5	0.02**
	Input into very few decisions	12.50%	0.00%		17.60%	0.00%		4	
	Input into some decisions	62.50%	100.00%		41.20%	50.00%		17	
	Input into most decisions	12.50%	0.00%		29.40%	0.00%		6	
	Input into all decisions				11.80%	0.00%		2	

** Significant at 1%, ** Significant at 5%, ***Significant at 10%,*

In Table 4.45, the results show the number of meetings organised by groups. Significant differences were observed among male and female respondents. In both the case and control groups, the women groups (groups in which women predominantly belong) were scheduled to meet weekly, which may be a possible limitation to them given their other duties. Male-dominated groups tended to meet once a month. There was also a significant difference between the respondents from the case and control categories in terms of number of meetings per group type.

Table 4.45: Frequency of the Group Meetings

		Case			Control				
		Male	Female	SIGN	Male	Female	SIGN	Total	SIGN
	More than once a week	0.50%	0.80%		0.00%	2.10%		9	
	Once a week	31.20%	53.50%		38.10%	47.90%		433	
Merry-go-round	Once every two weeks	7.90%	8.20%	0.00*	14.20%	8.50%	0.00*	98	0.00*
	Once a month	56.30%	31.80%		42.70%	34.20%		407	
	Less than once a month	0.90%	2.00%		1.20%	3.20%		19	
	Other	3.30%	3.70%		3.80%	4.20%		38	
	More than once a week	0.00%	5.60%		3.30%	1.60%		5	
	Once a week	13.00%	8.30%		13.10%	9.50%		24	
	Once every two weeks	9.30%	5.60%		6.60%	6.30%		15	
	Once a month	68.50%	33.30%		63.90%	34.90%		110	
	Less than once a month	1.90%	2.80%		1.60%	6.30%		7	
Mutual help group	Other	7.40%	44.40%	0.00*	11.50%	41.30%	0.00*	53	0.00*
	Once a week	16.70%	52.40%		16.70%	28.60%		19	
	Once every two weeks	50.00%	4.80%		16.70%	23.80%		10	
	Once a month	16.70%	23.80%		33.30%	47.60%		18	
	Less than once a month	16.70%	4.80%		16.70%	0.00%		3	
	Other	0.00%	4.80%					1	

** Significant at 1%, ** Significant at 5%, ***Significant at 10%*

Table 4.46 shows the findings on the attendance of respondents in the latest five meetings. The results indicate a significant difference in the number of attendances between male and female respondents from the control groups of both forest users and the credit or micro-finance groups. In both groups, more men than women attended the meetings. In the forest users group, only men (100%) attended all the five meetings, while 56.2 percent of the men attended the five credit or microfinance group meetings. When comparing the respondents from the case and control groups, a significant difference in meeting attendance was observed at 1 percent, 5 percent and 10 percent significance levels in both forest users and credit or micro-credit groups.

Results point to the significant effect of frequency of attending group meetings. Compared to those that did not attend any meeting, attending at least two meetings had significant influence on the odds of stunting in children. It appears that children in households that attended meetings once every two weeks significantly decreased the odds of being stunted relative to children in households that attended based on other frequencies. Other frequencies of meeting attendance did not have significant effect on stunting. Results further show that it was the males who mostly attended meetings and that their effect on child stunting was significant (p=0.005) while female attendance was not significant in effect (due to very low incidences of attendance). In other groups, there was no difference between the men and women in terms of attendance of meetings.

Table 4.46: Out of the Past 5 Meetings, How Many Did You Attend?

		Case			Control			Overall	
		Male	Female	SIGN	Male	Female	SIGN	Total	SIGN
Forest users groups	0			0.71	0.00%	100.00%	0.05**	1	0.00*
	2	50.00%	33.30%					2	
	5	50.00%	66.70%		100.00%	0.00%		6	
Credit or micro-finance groups	0	6.20%	7.40%	0.29	5.60%	5.90%	0.06***	15	0.00*
	1	1.20%	11.10%		1.10%	5.90%		8	
	2	8.60%	7.40%		4.50%	17.60%		22	
	3	14.80%	18.50%		23.60%	21.60%		49	
	4	6.20%	3.70%		9.00%	3.90%		16	
	5	63.00%	51.90%		56.20%	45.10%		138	

** Significant at 1%, ** Significant at 5%, ***Significant at 10%*

4.5.11 Disempowerment in the Leadership Domain

In the leadership domain, disempowered women lack membership in economic or social groups and are uncomfortable in speaking in public. Children whose mothers were not active members of any credit or microfinance groups were 1.96 times more likely to be stunted, while those whose mothers were not active members of mutual help or insurance groups were 1.73 times more likely to be stunted. On the other hand, speaking in public has different levels of empowerment where women who are more empowered are more likely to have the courage to speak up on issues that may be perceived as controversial or politically incorrect. In this case, children whose mothers did not feel comfortable speaking up in public for example to ensure proper payment of wages for public work or other similar programmes or to protest the misbehaviour of authorities were 1.19 times or 1.25 times more likely to be stunted, respectively (Table 4.47).

Table 4.47: Women Disempowerment in Leadership and Risk for Malnutrition in Children Under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Are you an active member of any credit or microfinance group?					
Yes (n=82)	28	34.1	1.00		
No (n=2,592)	1307	50.4	1.96	[1.23-3.12]	0.004
Are you an active member of a merry-go-round?					
Yes (n=531)	248	46.7	1.00		
No (n=2,143)	1087	50.7	1.17	[0.97-1.42]	0.097
Are you an active member of a mutual help or insurance group?					
Yes (n=100)	37	37	1.00		
No (n=2,574)	1298	50.4	1.73	[1.15-2.62]	0.009
Are you an active member of a trade and business association?					
Yes (n=9)	1	11.1	1.00		
No (n=2,665)	1334	50.1	8.02	[1.00-64.20]	0.050
Do you feel comfortable speaking up in public: to ensure proper payment of wages for public work or other similar programmes?					
Empowered (n=1,218)	578	47.5	1.00		
Disempowered (n=1,477)	765	51.8	1.19	[1.02-1.38]	0.025
Total (n=2,695)	**1343**	**49.8**			
Do you feel comfortable speaking up in public: to protest the misbehaviour of authorities?					
Empowered (n=1,064)	494	46.4	1.00		
Disempowered (n=1,631)	849	52.1	1.25	[1.07-1.46]	0.004
Total (n=2,695)	**1343**	**49.8**			

4.6 Time Allocation in the Household

This empowerment dimension concerns the allocation of time to productive and domestic tasks. The analysis looks at whether individuals worked more than 10.5 hours in the previous 24 hours. Individuals were considered inadequate for time allocation if they worked more than 10.5 hours in the previous 24 hours. Some of the issues assessed are summarised in Table 4.48.

Table 4.48: Summary of Variables for Time Allocation in Households

Time allocation issue	Significance with respect to males and females or case and controls
Activities over 24-hour period	0.000
Amount of sleep	0.001
Satisfaction with amount of sleep	0.000
Satisfaction with work duties	0,000
Satisfaction with leisure activities	0.001
Incidences of sickness	0.001

Results on Time Dimension

In order to evaluate time use among the households, it was necessary to establish whether the previous day was a normal day. Responses are available in Table 4.49. Overall, about 10 percent of the households indicated that the previous day was at least a holiday or non-working day. But for more than 80 percent of the households, the previous day was largely a usual day. On this basis, further observations and evaluations were made about time allocation among the men and women.

Table 4.49: Whether the Previous Day was a Holiday or Non-usual Day

	Case			Control			Total			
	Male	Female	Sig	Male	Female	Sig	Male	Female	N	Sig
Previous day was a holiday	12.20%	8.90%	0.000	11.90%	10.40%	0.200	**12.10%**	**9.70%**	**508**	0.008
Previous day was as usual	83.30%	86.30%	0.044	80.40%	83.80%	0.032	**81.80%**	**85.00%**	**20**	0.003

Main Activities over 24-Hour Period

On a daily basis a number of activities performed over the 24-hour period were significant to child nutrition status. Children in households that spent time eating and watching television were significantly less likely to be stunted compared to those that did not spend time watching television or eating. The odds of stunting for children decreased by 78 percent in such households that spent time together watching television (Table 4.50). Similar results were observed for children in households that spent time eating together where the odds of stunting decreased by 67 percent compared to those that did not spend time eating together.

Table 4.50: Watching TV by Household Heads as a Factor for Stunting in Children under 24 Months

Watching TV	N	%	OR	95% CI.	p
No 374)	179	48	1,00	.	.
Yes (12)	2	17	0.22	0.05-1.02	0.033

On the other hand, time spent in the field farming by the households increased the odds of having a stunted child by 1.8 times. The two sets of activities indicate differences in proximity of mother to the child and hence attention in terms of feeding and care as well as availability of free time to cater for the child.

The results also highlight activities which when done at certain times by the household heads either predispose a child to stunting or not. For example, breastfeeding any time of the day was seen to significantly decrease the odds of having a stunted child; similarly for activities such as eating, listening or watching television, or sleeping in the later part of the day (after 17:00 hours). On the other hand, some activities such as drinking alcohol by the heads of households after 17:00hrs pre-disposed a child to stunting.

4.6.1. Amount of Sleep

Most of the households reported an average amount of seven to nine hours sleep, ranging from 88 percent upwards for both men and women in the case and control categories. However, females generally reported having less than enough sleep as compared with males (Table 4.51). This difference was statistically significant (p=0.002). Similarly, there appeared to be slight differences between case and control households in the amount of sleep. More case households appear to have less than average amount of sleep than control households, and this is statistically significant (p=0.001).

Table 4.51: Satisfaction with the Amount of Sleep

Regarding the amount of sleep you got last night, was that satisfying?	Case		Control		
	Male	Female	Male	Female	
Less than average	5.00%	7.80%	4.10%	6.70%	241
Average	91.30%	88.20%	93.10%	89.70%	3577
More than average	3.70%	4.00%	2.80%	3.50%	140
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**3958**

4.6.2 Satisfaction with Distribution of Work Duties

Of the case households, about 48 percent of the males indicated being averagely or less than averagely satisfied with distribution of duties of work, while about 50 percent of females were less than averagely satisfied. A slightly lower but significant proportion of males (47.5%) and females (47.8%) were less than averagely satisfied under control households. Comparatively between the case and control groups a relatively larger number of control households were satisfied with the work duties in the households (p=0.000) (Table 4.52). With respect to stunting however, distribution of work duties did not significantly affects the odds of stunting in children.

Table 4.52: Satisfaction with Distribution of Work Duties

Levels of satisfaction	Case		Control		
	Male	Female	Male	Female	
1	8.90%	14.80%	9.30%	12.80%	554
2	0.50%	0.30%	0.40%	0.20%	15
3	0.40%	0.30%	0.60%	0.50%	22
4	0.30%	1.30%	0.60%	1.30%	44
5	37.50%	34.40%	36.60%	33.00%	1666
6	2.20%	5.60%	3.00%	4.40%	186
7	5.80%	1.50%	5.10%	2.50%	167
8	6.20%	4.00%	6.80%	3.90%	241
9	1.60%	0.40%	2.50%	0.50%	55
10	36.60%	37.50%	35.10%	40.90%	1784
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**4734**

4.6.3 Satisfaction with Leisure Activities

The proportion of men and women that were not satisfied (picking sum of scales 1 to 4 in Table 4.53) with the time available for leisure activities ranged from 25 percent for females in case households to 26 percent for males. In control households this ranged from 22 percent for females to 23 percent for males. The differences between the men and women as well as between cases and controls were statistically significant (p=0.001). However, this was not associated with stunting in children.

Table 4.53: Satisfaction with Available Time for Leisure Activities (visiting, praying etc)

Scale of Satisfaction	Case		Control		
	Sex of the respondent		Sex of the respondent		
	Male	Female	Male	Female	
1	21.50%	19.80%	22.20%	17.70%	952
2	1.10%	1.20%	0.60%	1.40%	52
3	0.60%	0.80%	0.60%	1.10%	36
4	3.30%	3.00%	2.10%	1.80%	120
5	36.10%	35.50%	36.70%	33.70%	1676
6	4.30%	5.40%	5.40%	4.30%	231
7	4.90%	2.20%	4.80%	3.80%	181
8	3.60%	3.00%	4.20%	2.10%	150
9	1.20%	0.20%	1.60%	0.40%	37
10	23.60%	28.80%	21.80%	33.70%	1299
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**4734**

4.6.4 Incidences of Sickness

Figure 4.29 shows the incidence of sickness among the respondents. The results of enquiries on sickness incidences show a higher level of indisposition among females (31%) than males (22%) under case households. Among males, the sickness incidence level was even lower in control households (18%) while it was almost the same as in the case households among the females (31%). All these proportions were statistically significant at p=0.000 level. The results indicate that males in the case households were more indisposed (significantly) compared with those in the control households. On the other hand, the margins between case and control females remained quite thin but statistically significant. The odds of a child being stunted significantly increased when at least a family member was reported having been sick over the reference period (p=0.002).

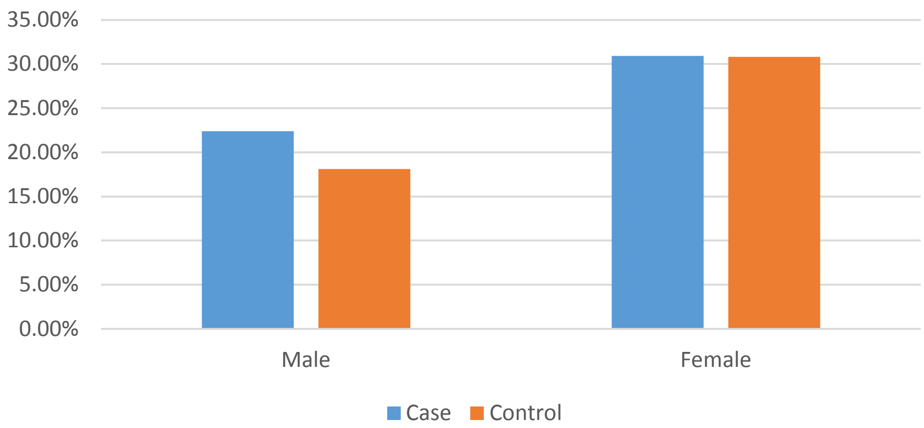


Figure 4.29: Incidence of Sickness in the Last 4 Weeks

Results of the odds ratio show a significant link between the number of days of being unwell and stunting levels in children under 24 months. Thus children in households that were less indisposed for prolonged periods reduced the odds of being stunted by 16 percent relative to children in households that were indisposed. This effect is largely attributed to male health than females, thus showing a link between male head of household and nutrition status of children such that a reduction in male indisposition would significantly reduce the odds of stunting in children.

Table 4.54: Days of Being Unwell as a Factor for Stunting in Children under 24 Months

Whether indisposed or not in the last 4 weeks	Household with a stunted child		OR	95% CI.	p
	N	%			
Yes (2018)	1047	52	1.00	.	.
No (2719)	1291	47	0.84	0.75-0.94	0.003
Total (4737)	**2338**				

4.6.5 Disempowerment in the Time Allocation Domain

In the time domain, disempowered women have more allocation of time to productive and domestic tasks than time for leisure activities; and are dissatisfied with their time use. Children in households where women are dissatisfied and disempowered in decision-making on allocation of time for leisure activities are 1.18 times more likely to have stunted growth (Table 4.55).

Table 4.55: Women Disempowerment in Time Use and Risk for Stunting in Children under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Allocation of time to productive and domestic tasks					
Empowered (n=1,365)	659	48.3	1.00		
Disempowered (n=1,330)	684	51.4	1.13	[0.98–1.32]	0.102
Total (n=2,695)	**1343**	**49.8**			
Satisfaction with the available time for leisure activities					
Empowered (n=1,130)	536	47.4	1.00		
Disempowered (n=1,565)	807	51.6	1.18	[1.01–1.38]	0.034
Total (n=2,695)	**1343**	**49.8**			

4.7 Reproductive Health and Childcare Decisions

Empowerment in health and childcare decisions was analysed through a series of questions targeting health decisions and motivations for the decisions made.

Q1. To what extent are you freely able to make reproductive health decisions?
Q2. What is the motivation for making these reproductive decicions?

A few variables were significantly associated with stunting in children and are summarised in Table 4.56.

Table 4.56: Summary of Significant Reproductive Health and Child Care Variables Evaluated

	Significance with respect to males and females or case and controls
Breastfeeding decisions	0.049
Extent of decision making	0.000
Motivations for decision made	0.040

Reproductive and child health issues are hereby related to the extent to which men and women can make decisions about them, but also to the motivation of making such decisions. On both issues, there were significant differences between men and women in both the case and control households as well as between the case households and control households.

4.7.1 Breastfeeding Decisions

One of the key issues that affect the nutrition of children is breastfeeding. Results in Table 4.57 show that among females, participation in decisions on breastfeeding was key to ensuring that stunting in children was addressed. Participation in breastfeeding decisions significantly decreased the odds of having stunted children by 32 percent.

Table 4.57: Breastfeeding as a Factor for Stunting in Children

Decision making on breastfeeding			Odds	Ratio	95% CI	p
	N	%				
Not at all (124)	70	56	1.00	.	. .	
Small extent (108)	56	52	0.83	0.49	0.49-1.34	0.484
Medium extent (691)	324	47	0.68	3.85	0.46-1.00	0.049
To a high extent (1793)	900	50	0.78	1.82	0.54-1.12	0.178

Table 4.58 indicates that the number of both men and women who were not able to fully decide on family planning issues was higher among case households than control households (about 29% and 27% of males in case and control households; and 21% and 19% of women in case and control households, respectively). Other issues evaluated included feeding habits of children.

Table 4.58: Extent of Decision-making on Reproductive Decisions Extent of decision-making

Extent of decision-making		Case		Control		
		Male	Female	Male	Female	
I can freely decide whether or not to use a method of family planning	Not at all	13.40%	10.00%	14.20%	8.20%	489
	Small extent	15.40%	11.20%	12.80%	10.80%	539
	Medium extent	32.60%	36.00%	32.00%	38.10%	1518
	To a high extent	38.60%	42.80%	41.00%	42.90%	1805
		100.00%	100.00%	100.00%	100.00%	4351
I can freely decide when to have or not to have a baby	Not at all	8.80%	10.90%	9.30%	9.10%	408
	Small extent	15.10%	12.50%	11.40%	10.80%	526
	Medium extent	33.90%	37.30%	37.90%	40.60%	1608
	To a high extent	42.10%	39.30%	41.40%	39.60%	1730
		100.00%	100.00%	100.00%	100.00%	4272

Extent of decision-making		Case		Control		
I can freely decide whether to have or not to have sex with my spouse	Not at all	12.90%	16.60%	12.80%	15.40%	617
	Small extent	13.10%	19.70%	11.20%	16.40%	646
	Medium extent	32.70%	32.00%	33.00%	35.00%	1412
	To a high extent	41.40%	31.80%	43.00%	33.20%	1579
		100.00%	100.00%	100.00%	100.00%	4254
I am able to protect myself from acquiring STIs including HIV	Not at all	0.90%	5.70%	0.80%	5.20%	149
	Small extent	3.90%	11.20%	2.20%	10.50%	326
	Medium extent	12.00%	21.00%	11.90%	22.20%	769
	To a high extent	83.30%	62.20%	85.10%	62.20%	3229
		100.00%	100.00%	100.00%	100.00%	4473
I am able to decide whether or not to breastfeed my babies	Not at all	15.70%	3.80%	16.50%	2.20%	124
	Small extent	18.30%	2.30%	14.00%	2.40%	108
	Medium extent	35.90%	22.50%	31.10%	26.30%	691
	To a high extent	30.10%	71.30%	38.40%	69.10%	1793
		100.00%	100.00%	100.00%	100.00%	2716
I am able to decide when and what to feed my children	Not at all	12.00%	2.40%	11.40%	1.20%	241
	Small extent	15.90%	6.70%	15.00%	5.40%	410
	Medium extent	29.10%	27.90%	30.10%	30.40%	1222
	To a high extent	43.00%	63.00%	43.50%	63.00%	2291
		100.00%	100.00%	100.00%	100.00%	4164
I am able to decide when to take my children to hospital	Not at all	5.60%	3.40%	6.30%	2.70%	180
	Small extent	12.20%	7.20%	9.00%	5.30%	340
	Medium extent	31.60%	27.00%	31.80%	29.60%	1252
	To a high extent	50.60%	62.40%	52.90%	62.40%	2436
		100.00%	100.00%	100.00%	100.00%	4208
I am able to decide where to deliver my babies from	Not at all	12.80%	4.70%	15.00%	4.20%	253
	Small extent	17.00%	10.70%	15.90%	8.10%	394
	Medium extent	38.00%	25.90%	36.30%	27.70%	1018
	To a high extent	32.30%	58.80%	32.70%	60.00%	1717
		100.00%	100.00%	100.00%	100.00%	3382
I am able to discuss my reproductive health concerns with my spouse	Not at all	7.00%	7.10%	8.30%	6.00%	284
	Small extent	6.90%	12.40%	6.30%	10.40%	369
	Medium extent	25.00%	26.30%	24.00%	29.00%	1055
	To a high extent	61.10%	54.10%	61.40%	54.60%	2312
		100.00%	100.00%	100.00%	100.00%	4020

4.7.2 Motivations for Making Reproductive Decisions

The motivation for making reproductive and childcare decisions varied depending on the issue being decided upon. All results show significant differences between the case and control households and between men and women. Among the reported ones, most important motivations are fear of breaking relationships in deciding whether to use family planning or not, followed by family planning being a woman's responsibility (p=0.04), and taking health as a personal responsibility (0.05).

Similarly, an important motivation when deciding when to have a baby is fear of breaking a relationship or marriage. An additional important motivation for deciding on having sex with partners is fear that the partners would become unfaithful and this is held more among females than males. Fear of being branded irresponsible seems to drive decisions on breastfeeding, in addition to losing children and taking them to hospitals for various reasons. In addition, decisions on where to give birth have correlations with fear of breaking relationships among the men than females.

The main motivations for making health and reproductive decisions was that family planning was mainly a woman's responsibility, and the wish to take health issues as a personal responsibility by the woman. To a lesser extent was the fear of being seen to be irresponsible when it comes to these issues. Households that considered these fears and motivations had lower odds of having children that were stunted.

4.7.3 Disempowerment in the Health Domain

In the health domain, disempowered women have reduced capacity to make informed and appropriate reproductive health decisions. Children in households where women were disempowered in their capacity to make informed and appropriate reproductive health decisions were 1.33 times more likely to have stunted growth, while those in households where mothers were disempowered in decision-making on where to deliver babies were 1.30 times more likely to be stunted (Table 4.59).

Table 4.59: Women Disempowerment in Autonomy in Making Appropriate Reproductive Health and Childcare Decisions and Risk for Stunting in Children Under 24 Months

	Household with a stunted child		OR	95% CI	p
	N	%			
Extent of decision-making: freely decide whether to have or not to have sex					
Empowered (n=1,528)	720	47.1	1.00		
Disempowered (n=778)	402	51.7	1.20	[1.01-1.43]	0.039
Total (n=2,306)	**1122**	**48.7**			
Extent of decision-making: able to discuss reproductive health concerns with spouse					
Empowered (n=1,851)	881	47.6	1.00		
Disempowered (n=404)	214	53	1.24	[1.00-1.54]	0.050
Total (n=2,255)	**1095**	**48.6**			
Capacity to make informed and appropriate reproductive health decisions (all above combined)					
Empowered (n=1,523)	714	46.9	1.00		
Disempowered (n=1,088)	587	54	1.33	[1.14-1.55]	0.000
Total (n=2,611)	**1301**	**49.8**			
Extent of decision-making: able to decide when and what to feed children					
Empowered (n=2,354)	1156	49.1	1.00		
Disempowered (n=197)	111	56.3	1.34	[1.00-1.79]	0.052
Total (n=2,551)	**1267**	**49.7**			
Extent of decision-making: able to decide when to take children to hospital					
Empowered (n=2,261)	1121	49.6	1.00		
Disempowered (n=229)	129	56.3	1.31	[1.00-1.73]	0.052
Total (n=2,490)	**1250**	**50.2**			
Extent of decision-making: able to decide where to deliver babies from					
Empowered (n=2,038)	997	48.9	1.00		
Disempowered (n=330)	183	55.5	1.30	[1.03-1.64]	0.028
Total (n=2,368)	**1180**	**49.8**			
Capacity to make informed and appropriate decisions on children (all above combined)					
Empowered (n=2,149)	1058	49.2	1.00		
Disempowered (n=453)	234	51.7	1.30	[0.90-1.35]	0.349
Total (n=2,602)	**1292**		**49.7**		

Public health interventions that aim to influence stunting among children under 24 months should consider implementing programming aimed at increasing women's empowerment in the 6 domains highlighted. This is indicated by the fact that women disempowerment in autonomy when making appropriate reproductive health and childcare decisions is a risk factor for stunting in children under 24 months only when all important components of this decision are considered jointly.

4.8 Gender Empowerment and Risk of Child Malnutrition

Studies have sought to measure whether mother's empowerment – measured by her education attainment relative to the father's, domestic violence, and autonomy – is related to children's nutritional status. On the other hand, innovative programmes around the world are demonstrating that integrating women's empowerment programmes with more traditional health and nutrition interventions can make a big difference in maternal and child nutrition outcomes. From this study's results, it is clear that women empowerment does matter at different degrees in the various domains as analysed in the following sections.

Evidently, there are different levels of empowerment, and it is plausible that these different levels may impact nutrition outcomes differently. What is clear from the data is that for women's empowerment to work for maternal and child nutrition, empowerment should be redefined in the context of nutrition. For example, what does women empowerment look like when mothers' nutrition knowledge, attitudes, and practices are optimised? What policies need to be in place to advance this transformation and what programmatic actions and tools are needed to implement and measure empowerment for nutrition, and outside agriculture?

4.8.1 Measurement of Empowerment

The study used an adaptation of Alkire et al. (2013) WEAI as a measure of women empowerment. The adaptation involved changes in the indicators of empowerment and cut-off weights following Mutua et al. (2014). The total domains were increased from 5 to 6, with inclusion of a health domain. The health domain had reproductive health as its indicator and was intended to capture the ability to make appropriate reproductive health decisions. In the leadership domain, an additional indicator on ownership of identity card is included so as to capture the ability to keep and use identification document at will without consulting another. Time dimension had two indicators; leisure and work distribution, with sufficiency being attained if the individual expressed no dissatisfaction with the distribution of work and leisure time available.

Two measurements of empowerment were used in order to analyse relationships between empowerment and nutrition. The first one was to use individual adequacy in each of the indicators of empowerment. This was then used to compute odds ratios of empowerment in each of the indicators for case and control groups. In determining whether an individual was empowered or disempowered in a particular indicator, a cut-off for each indicator was used to decide whether an individual has adequate or inadequate achievement and is assigned 0 if adequate and 1 if inadequate (Alkire et al. 2013).

The second one was the use of individual empowerment scores over all the indicators and these were used to compare the mean difference for men and women in case and control groups. To compute the individual empowerment scores, the indicators are weighted using the indicator weights fixed at 1/6 per indicator and summed up to generate an inadequacy score ranging from 0 to 1 for individuals with no inadequacy and those with inadequacy in all the indicators respectively. The empowerment score is then computed by subtracting the inadequacy score from 1. This was then used to test for the significance of mean difference for men and women in the control and those in the case groups.

4.8.2 The Association Between Empowerment and Child Nutrition

In the analysis, inadequacy in some of the empowerment indicators was found to be associated with child stunting (Table 4.60). This means that compared to households where men and women were adequate in some indicators of empowerment (specifically asset ownership, access to and decision on credit, group membership, speaking in public, identification card and reproductive health), children in households where men and women in general were not empowered in these domains were more likely to have stunted growth as follows: inadequacy in asset ownership – 24 percent higher odds of stunting; inadequacy in access to and decision on credit – 28 percent higher odds of stunting; inadequacy in group membership – 26 percent higher odds of stunting; inadequacy in speaking in public – 24 percent higher odds of stunting; inadequacy in identification card – 30 percent higher odds of stunting; and inadequacy in reproductive health – 11 percent higher odds of stunting.

Table 4.60: Gender Empowerment and Odds of Stunting with Controls as Reference Group

	Variable	OR	95% CI	p
Control		1.00	-	.
Case	Ownership of assets	1.24	1.08-1.43	0.003
	Access to and decisions on credit	1.28	1.02-1.60	0.031
	Group membership	1.26	1.12-1.42	0.000
	Speaking in public	1.24	1.08-1.43	0.003
	Identity card	1.30	1.037-1.62	0.023
	Reproductive health	1.11	0.99-1.24	0.08

In addition to the computation of odds ratios, a comparison of mean difference in individual empowerment scores of men and women with cases of child stunting and those without was done. Results indicated that overall empowerment scores were significantly higher for men and women from households that did not have cases of child stunting (Table 4.61). Even when men and women were not disaggregated, empowerment was still higher in households without child stunting. It also emerged that men were more empowered than women across the two categories of households.

Table 4.61: Comparison of Mean Differences in Individual Empowerment Scores

	Case				Control				Overall
Empowerment score	Male	Female	p	Total	Male	Female	p	Total	p
Mean	0.519	0.492	0	0.504	0.526	0.506	0.004	0.517	0.002
sd	0.133	0.143		0.139	0.126	0.137		0.134	
n	965	1250		2215	1009	1259		2268	

Asset ownership is important in that households without assets (such as land, livestock etc) are poorer and children in such households may not only be able to get adequate nutrition, but also may miss out on quality healthcare and sanitation. Access to and decision on credit is important in child nutrition as it helps to not only raise consumption, but also helps in generating more income and even access to healthcare. Group membership may not be directly related to child nutrition, but it is through group membership that men and women obtain information and other services important in agriculture, that leads to better production and ultimately better access to food and nutrition. Likewise, ability to speak comfortably in public may not be directly linked to better nutrition, but can be a sign of the ability for women to negotiate better care for their children. The ability to own and use identification documents indicates empowerment since it enables one not only to move freely but also conduct transactions that improve agricultural production. It enables participation in formal transactions such as group membership, credit access etc. People empowered enough to be able to make appropriate reproductive health decisions are expected to have better child nutrition outcomes, and these findings support that hypothesis.

The finding of significant association between child nutrition and empowerment in general and in some indicators in this study does not imply causality. However, the findings suggests that attention should be given to not only gender empowerment in general, but specifically to enabling men and women to own assets, to access and be able to make decisions regarding credit, as well as enabling them to participate in groups. Equally important is building their confidence to speak in public over issues that affect them, enabling them to own and freely use identification documents and empowering them to be able to make appropriate reproductive health decisions that can trickle down to better child nutrition.

Table 4.62: Summary of List of Determinants of Stunting

Factor category	List of determinants for stunting
Production decisions	Overall agricultural production decisions
	Inputs to buy for agricultural production
	Types of crops to grow
	Crop harvesting decisions
	Type of livestock to rear
	Sale of live animals
	Labour from family members
	Decisions on daily tasks to be done
Resources	Who decides on whether to sell or give away land
	Who decides whether to sell non-mechanised farm equipment or mobile phone
	Who decides whether to purchase a mobile phone or agricultural land
Incomes and credit	None
leadership	Ability to cause change in community
	Contribution to community infrastructure building and its maintenance
	Ability to protest misbehavior of authorities
	Ability to intervene in family disputes
	Possession of elector’s card
	Position on influence ladder
	Group membership
Time use	Watching TV
	Days of being unwell in a month
	Satisfaction with leisure time
Reproductive health	Breastfeeding decisions

5.0

DRIVERS OF STUNTING: THE NUTRITION, MARKETS AND GENDER ANALYSIS

5.1 Analytical Methodology for Significant Variables for Stunting

Data collected in the NMG Survey were mainly informed by the UNICEF framework for malnutrition. The framework, first developed in 1990, has been verified by the nutrition community and was further validated in the Lancet (Black et al 2008, Black et al 2013) maternal and child nutrition series.

The framework distinguishes between the determinants of malnutrition including its immediate, underlying and basic causes. Nutrient intake and health status at the level of the individual are the immediate determinants of nutritional status. Underlying these are the food, health, and care determinants; and finally, at a basic level, political, economic and institutional determinants underpin all of these factors. Given these multiple causes, it is clear that stunting is the result of a complex interaction between many risk factors and no single factor can address malnutrition alone. Thus, building on the adapted UNICEF framework (Figure 1.1), this chapter focuses on identifying the contribution of significant risk factors identified in the nutrition, markets, and gender components to stunting in children under 24 months in Rwanda.

This chapter uses the data collected under the NMG Survey in 2014 to provide a summary of The individual factors that impact child nutrition status based on the strength of the odds ratios realised. It starts with the large number of significant variables and goes further to establish the causality of the factors on the stunting levels among children under 24 months.

The large number of significant variables was further evaluated by assessing the factors' correlation to each other. This step was necessary to identify factors that were similar and thus could be considered as having the same effect on child nutrition outcome. Using a significance cut-off level of 0.05, the large number of factors that were either risk factors or protective of stunting in children were further subjected to multi-collinearity tests to establish how much they were able to predict each other within each cluster. A few variables were dropped due to high collinearities (VIF>10), meaning that these variables could easily be used to represent each other without losing much information. A series of correlation matrices were further generated (Appendix 7.4) from which a fewer number of variables were selected.

The correlation analyses indicated that the large number of factors under each cluster were in essence similar in effect on stunting and were actually proxies of each other. For example, among the wealth or asset-related factors, type of floor was highly correlated with ownership of mobile phone, radio or type of fuel used. All these factors also had high associations with nutrition status. Hence, for example, type of floor as a proxy for wealth indicator was adopted. In a similar manner, literacy of the mother was used to represent the education levels of the household head and spouse. Furthermore, among childbirth factors, birth weight had the strongest influence on stunting and was adopted. The rest of the variables were treated in a similar manner to generate the most significant variables and the results of the analyses are shown in a correlation matrix in Table 5.1. The most significant and independent factors were selected for use in the probit model for the key drivers of stunting that are discussed in the next section.

Table 5.1: A Correlation Matrix of the Key Determinants of Stunting

Variable	Case or control	Birthweight of child	Maternal education	Active membership in group	Empowerment in public affairs	Number of occasions washed hands	Knowledge of biofortified foods	Type of floor	Use of mineral fertilizers	Use of ditches to control soil erosion
Case or control	1									
Birthweight of child	0.134*	1								
Maternal education	0.102*	0.071*	1							
Active membership in group	-0.059*	-0.02	-0.02	1						
Empowerment in public affairs	-0.055*	-0.028	-0.080*	0.016	1					
Number of occasions washed hands	-0.044*	-0.019	-0.132*	0.015	0.040*	1				
Knowledge of biofortified foods	0.074*	0.040*	0.105*	-0.013	-0.023	-0.009	1			
Type of floor	-0.106*	-0.003	-0.037	0.023	0.002	0.025	0.006	1		
Use of mineral fertilizers	-0.067*	-0.062*	-0.119*	-0.057*	0.021	0.01	-0.043	0.026	1	
Use of ditches to control soil erosion	0.049*	-0.028	-0.089*	* 0.03	-0.016	-0.002	0.016	0.022	0.099*	1

**Significant at 0.05 level*

A Model for Determinants of Stunting in Children Under 24 Months

A fewer number of factors were selected to explain the causes of stunting among children under 24 months. The selection was based on the strength of their causality. The joint effect of the factors meant that a large number of the factors that would normally have an effect on stunting were dropped since they were multi-collinear (more of the factors being highly correlated and thereby being almost similar in effect on the explained variable). Such collinear variables are not independent of each other, which is a necessary condition when analysing the determinants of stunting.

Using the clusters of variables generated, further analyses were conducted to establish the joint effect of the factors on the levels of observed stunting through probit regression analyses. The purpose of using a regression was to identify the joint effect of a set of factors that are hypothesised to influence or determine stunting among children under 24 months in Rwanda. The probit model was adopted due to the inherent order in the outcome variable (stunting) that was measured as cases (households with stunted child) and controls (household without a stunted child). Based on the UNICEF model and Headey (2014) child stunting (S) as a nutrition outcome for a child i is modelled as a function of 7 vector categories of factors (X), viz (X1,…, .X7) in addition to the error term (uijk):

$$Sik = \beta Xijk + Uijk \qquad (1)$$

The seven factors are categorised as childbirth factors, maternal factors, woman empowerment in decision-making and access to productive assets, household wealth factors, nutrition awareness factors, WASH factors, and agricultural production factors. These categories are represented by one or two variables that are used as proxies to measure the factors.

The parameters indicated by **β** provide the factors that contribute to the nutrition outcome of stunting, controlling for the effect of each other. The different factors were classified as summarised below. They were arrived at through a rigorous process of establishing the interrelationships through correlation analyses. Results of the correlations analyses showed that a large number of the variables were highly correlated and could be used as proxies of each other. For example, there were many indicators of empowerment for women which practically measured the same thing; and among the health related variables, decisions such as where to give birth and use of birth control measured the same issue. The variables that were selected to represent each category, based on their strength of influence on the nutrition status of children, are summarised in Table 5.2.

Table 5.2: Summary of Factors Influencing the Stunting Levels among Children under 24 Months in Rwanda

Category	Variable	Variable measurement
Response variable	Is child stunted or not	Stunted versus non-stunted child
Child birth factors	Birth weight of child	The birth weight (kg) of the child when she/he was born
Maternal factors	Education of spouse	The level of education of the spouse of head of household
Women empowerment factors	Decision-making on daily tasks	Empowerment to makes decisions on what kind of tasks you will do on a particular day
	Active membership in credit group	Active membership of credit or micro-finance group
	Being comfortable to speak against public injustices	Whether able to speak in public against injustices or misbehaviour of authorities
WASH factors	Number of occasions washed hands	Number of occasions when it is important to wash hands
Nutritional awareness and access to information	Awareness of nutritional value of foods	Whether heard about nutritional value of foods such as bio-fortified foods
Household wealth factors	Type of floor of house	Type of floor: cement or otherwise
Agricultural production characteristics	Use of mineral fertilizer	Whether used mineral fertilizer or not
	Use of ditches	Whether used ditches to control soil erosion or not

A model for the causes of stunting was implemented in probit regression. The probit regression was based on the assumption that the observed level of stunting has an inherent order; that is the presence of stunting versus non-stunting in a population can be ordered or ranked for the population of interest.

5.2 Factors that Contribute to the Nutrition Outcome of Stunting

The model results indicate that overall, the factors being evaluated significantly contributed to the observed stunting in the children under 24 months. The chi square value is significant (0.000) thus supporting the siginificance of the factors in the model. The results of the probit regression model are presented in Table 5.3.

Table 5.3: Probit Model Results for Drivers of Stunting in Children under 24 Months in Rwanda

Variable	Coef.	Std. Err.	z	[95% CI	p
Response Variable: case (0) or control (1)					
Birth weight of child	0.125	0.027	4.71	.07-.18	0.000
Maternal education (Reference: No education)					
Some primary	0.034	0.075	0.45	-0.29	0.650
Completed primary	0.019	0.087	0.22	-0.34	0.824
Some secondary	0.088	0.164	0.54	-0.64	0.591
Completed secondary	0.458	0.279	1.64	-1.09	0.101
University or college	0.266	0.391	0.68	-1.53	0.496
Empowerment in decision making					
Decision-making on daily tasks					
Disempowered	-0.186	0.084	-2.21	-0.37	0.027
Active membership in credit group					
Not active member	-0.466	0.193	-2.42	-0.75	0.016
Empowerment in community affairs					
Disempowered	-0.117	0.064	-1.85	-0.25	0.065
Number of occasions washed hands	0.017	0.012	1.35	-0.05	0.176
Awareness and access to nutrition information					
(Reference: no knowledge)					
Yes, had knowledge	0.132	0.065	2.02	.00-.26	0.043
Type of floor (Ref. Mud floor)					
Cement	0.232	0.1	2.33	.04-.437	0.020
Other types of floor	-0.179	0.353	-0.51	-1.38	0.612
Crop improvement practices					
Use of mineral fertilizers					
Did not use	-0.149	0.081	-1.84	-0.32	0.065
Use of ditches to control soil erosion					
Did not use	0.152	0.062	2.44	.03-.27	0.015
Constant term	0.078	0.241	0.33	-0.94	0.745

N=2362; L.R chi2 (10) = 89.40; Prob >chi2 =0.000

5.2.1 Child Birth Factors

The model results indicate that factors such as the weight of the child at birth have an influence on the growth outcome of the child. The birth weight is a function of factors such as maternal health and nutritional wellbeing – pre-conception and during pregnancy – and therefore would call for interventions that focus on the pregnant mother during the antenatal period. A higher weight at birth was thus favourable to the nutrition outcome of the child during the 1000 days period. However, this indicator is not just about the baby's weight at birth but also includes indicators of whether the baby is born too small or too soon. Interventions should target adolescent girls and women of reproductive age to improve both their macro- and micronutrient status as these influence pregnancy outcomes. In addition, antenatal care (which directly influences pregnancy outcomes) should be integrated into health extension to ensure that pregnant mothers access care immediately following conception. The quality, ease of access, and coverage of antenatal care should be monitored and continuously improved to ensure good pregnancy outcomes as they influence stunting during the 1000 days.

5.2.2 Maternal Factors

The literacy level of the spouse did not have a significant effect on stunting levels. More literate mothers were less likely to have a stunted child compared to less literate counterparts. It is plausible that the ability to process information with respect to childcare improves with better educational levels. However, the role of education in reducing child malnutrition was not significant. This may be because education, in this case, primarily acts as a proxy for the socioeconomic status of the family and geographic area of residence. As such, even though there is no strong correlation between maternal literacy/education and indicators of child health, the effect could be muted due to the close association of education with other key indicators of malnutrition (e.g. empowerment and wealth). The exact mechanisms through which education can act to affect child health needs to be better understood. A causal pathway to better guide investments in women's education for improved child health is important in this regard. Literacy programmes and interventions that promote social behavioural change communication messages on maternal and child health can help enhance the capacity and confidence of mothers with low education attainment to adequately care for their pregnancies, infants and young children.

5.2.3 Gender Empowerment and Decision-making

The empowerment of women also contributes to child nutrition status. When women feel less empowered to make decisions on their daily tasks, this increases the likelihood of having a stunted child. Being able to take charge of their daily activities gives them the opportunity to plan for the child in ways that are optimal to improve the child's wellbeing. Restrictions or feelings of not being in control of their daily programme have negative effects on how women care for their children. For women who have employment with a time burden, for example in agriculture, time spent on livelihood activities competes with time needed for resting, childcare and food preparation, and can have unintended negative consequences for child growth outcomes. Identifying the ways in which time burden is managed is the starting point for gender-sensitive policies for improved nutrition. Policies on women employment should aim to address efficient time use and effective energy expenditure that allows women – especially those who are pregnant and/or lactating – to meet their other physiological demands. For example, female-friendly agricultural practices such as mechanisation that allow women to work faster and expend less energy can allow women who are pregnant, lactating, or caring for infants and young children to better care for these responsibilities.

5.2.4 Gender Empowerment and Access to Productive Resources

A further pointer to empowerment, besides decision-making, is access to productive resources such as credit that is necessary for women to meet their requirements for production and even consumption. Low empowerment to participate in resource-raising activities limits women's ability to take care of children, thus contributing to stunting among children. The results show that access to credit was significantly different for households that had a stunted child and those that did not have a stunted child. Research shows that in many places around the world, income controlled by women is more frequently used on food and healthcare for the family particularly for children. Often, the best way for women to influence how household income is spent is by earning incomes that complement the rest of the family income. In some cases this requires access to credit, which can be used to invest for more income generation for the family.

5.2.5 Gender Empowerment and Leadership in the Community

The ability of a woman to stand up against injustices such as low wages or mistreatment highly influenced stunting in children. As an indicator of leadership empowerment, mothers who are able to raise concerns about the welfare of other people are also most likely to raise similar concerns when it comes to child welfare in their own homes. While the link may not be direct or very strong, the ability to comprehensively make decisions that affect children requires courage to face others that may have a contribution to improve or worsen a child's health status. In other words, children nutrition decisions require taking leadership initiatives for the benefit of the household.

5.2.6 Water, Santitation and Hygiene (WASH)

One indicator for WASH was the number of occasions that mothers washed their hands. The higher the number of occasions that hands were washed, the better the outcomes for child nutrition. Access to and regular use of portable water and improved sanitation facilities is key. There are certain times when hand-washing is particularly important to protect your own health and that of others. Social behavioural change communication can include a community and school curriculum that emphasises proper washing of hands for the following occasions: after using the toilet; after changing diapers or helping a child to use the toilet; before and after treating a wound or a cut; before and after being with someone who is sick; before preparing, serving, or eating food; after sneezing, coughing or blowing your nose; and after touching an animal or animal waste. It is important that households source water from improved sources, treat water before drinking, and ensure that they store treated water in clean, covered containers to protect it from possible re-contamination. All these WASH factors were highly correlated with each other but also correlated to other factors such as gender empowerment and education levels and thus their effects appeared muted in relation to the rest of the factors.

5.2.7 Nutrition Awareness and Access to Knowledge

Awareness and access to nutrition information is critical to good nutrition outcomes. Well-designed pro-nutrition information can lead to positive improvements in knowledge, attitudes, and practices. Both nutrition messaging through popular communication channels such as radio or interventions that include targeted nutrition education should be integrated into key nutrition activities for the 1000 days programmes. The goal of information should be to incorporate nutrition promotion and education that builds on local knowledge. Information particularly on supplementation, food fortification, and biofortification is necessary to help households improve their nutrient adequacy.

5.2.8 Household Wealth

How does wealth or asset base of the household contribute to stunting? Two indicators were available to use for measuring the wealth situation of households: type of floor and type of fuel used by the households. Each of these indicators was highly correlated with most of the wealth measures such as incomes, expenditures, assets such as television, or presence of electricity. It was also noted that the type of fuel had a close relationship with other indicators of women empowerment in households. Type of floor was thus selected as an indicator for household wealth without any loss in explanation power of the model. With respect to the type of floor, households that had cement for floors were less likely to have stunted children (this compares closely with households that used charcoal as opposed to firewood). Stunting levels in children are thus more likely to be higher in poorer households compared to better-off households. Better floors also have an effect on management of hygiene of the households, being easier to clean and effect WASH practices; thus floor type goes beyond being a wealth indicator. However, the prevalence data indicates that poverty alone may not explain stunting. Although increases in income and assets can allow households to meet their nutrition needs for food, care and WASH, if these are not prioritised at the household level, improvements in income will not correlate with positive changes in nutrition. Hence in addition to the poverty eradication efforts led by the government, a suite of (multi-sectoral) pro-nutrition interventions targeting vulnerable households are required to adequately address stunting.

5.2.9 Agricultural Productivity

The survey results bring out significant relationships between productivity-enhancing practices and child nutrition outcomes although the relationship is not direct. The effect on nutrition is through production and productivity, which is necessary for food security although it may not be sufficient to reduce stunting. The presence of good production from use of modern agricultural practices such as use of mineral fertilisers and type of land the households use for production highly correlate with better nutrition outcomes for children under 24 months. While fertiliser use shows an association with reduced stunting in children, use of ditches on the farms most likely indicates that the land the households are using are on steep hills or prone to erosion and thus predisposing the households to low production. The negative relationship from use of ditches imply that households that are using land that required soil conservation measures are not able to produce adequate amounts of food to meet the nutrition requirements of the household including the children. More interventions to maintain the fertility of the land are needed for such households. The survey also illustrates the need for quality seed supplies in the sense that seed supplied from others farmers or saved from previous harvests or bought from grain markets appears to have a negative association with childhood stunting, though not significant statistically. This compares with the use of seed from the government, research organizations, and agrodealers that show a protective association with stunting in children. Thus among the large number of potential interventions, increasing productivity for nutrition still plays a key role in child nutrition as a source of nutrients for a majority of the farming households. Increasing productivity is a major contributor to the food security of the household.

5.3 Implications and Recommended Action Plan for Nutrition

Rwanda has made progress in reducing the number of children and women suffering from malnutrition through major initiatives to identify and treat severe acute malnutrition. The Ministry of Health with its development partners has advanced progress in nutrition through a package of interventions that has resulted in multi-sectoral collaborations that have scaled up nutrition in Rwanda.

There is indeed room to do more. What innovative approaches can help catalyse further progress in nutrition while sustaining gains in national efforts to eliminate malnutrition? How can these efforts be coordinated?

5.3.1 The 1000 days: A Window of Opportunity for Child Growth Outcomes

The 2008 Lancet Series (Black et al 2008) on maternal and child nutrition identified the need to focus on the crucial period from conception to a child's second birthday – the 1000 days in which good nutrition and a healthy growth have lasting benefits throughout life. The NMG survey results suggest that the window of opportunity can be divided into three critical and distinct sections that need to be addressed to ensure good child growth outcomes as shown below (Figure 5.1).

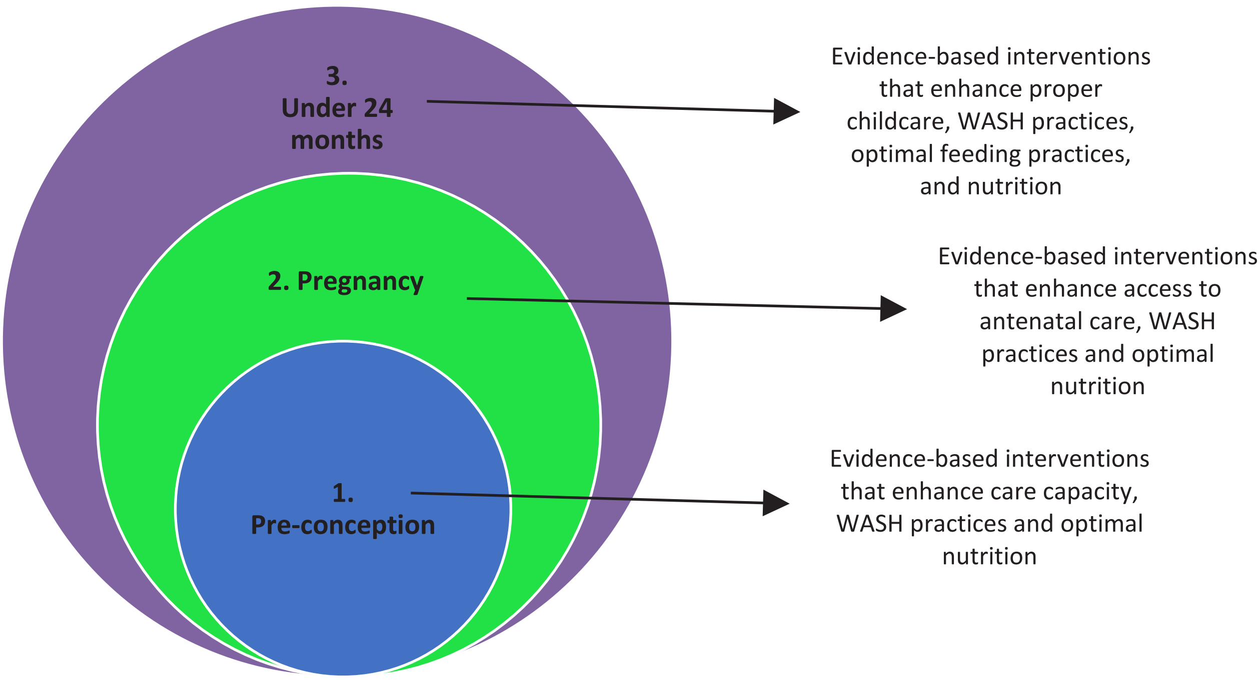


Figure 5.1: Three Critical and Distinct Sections for the 1000 Days Period

The pre-conception period is at the core of the 1000 days in Rwanda, followed by the pregnancy period, and finally the 0-23.9 month period. Undernourished women are more likely to give birth prematurely and to have babies who are too small for their gestational age. The data emphasises the importance of intervening early in pregnancy and even before conception. It is important that women have enough knowledge on maternal and childcare, and enter pregnancy in a state of optimum nutrition. This is an emerging platform for social behavioural change communication and adolescent health as an entry point to improve the health of women and children. Evidence-based interventions must be introduced in the preconception period and in adolescents. The results also reinforce the importance of adequate antenatal care soon after conception and regularly during pregnancy; both for the health of the mother and for ensuring healthy foetal growth and development. Following good pregnancy outcomes, optimal childcare practices will reduce the risk of stunting in children under 24 months.

5.3.2 Pathways Linking Agriculture to Nutrition

Stakeholders and practitioners in the nutrition sector can attest that nutrition problems can be complicated, but that their solutions must be simple if they are going to be embraced, implemented and effective. Reducing stunting in children as a global goal is a complex issue. From the NMG analysis, it is clear that there are various pathways to reducing stunting in Rwanda; but given the number of variables in the NMG analysis, it is easy to feel overwhelmed. So how does the country traverse and embrace this complexity but also identify key practical interventions for addressing malnutrition in Rwanda? The answer lies in identifying the sector with the most potential to impact nutrition outcomes in the country. That sector is agriculture. Will linking agriculture to nutrition and health result in an improved package of innovative home-grown solutions to address stunting?

Why agriculture? Sustainable agriculture in Rwanda can contribute to reducing poverty via employment and incomes from agricultural markets, ensuring all year availability of diverse and nutritious foods, and promoting inclusive and sustainable growth that enhances women empowerment. In addition, taking action to combat climate change and reducing land sizes can allow sustainable agriculture in Rwanda to better link to good nutrition outcomes for especially vulnerable households.

The Lancet 2013 series (Black et al 2013) on maternal and child nutrition suggests that direct nutrition interventions, even if implemented at 90 percent coverage in countries with a high burden of malnutrition, would only reduce global stunting by only 20 percent. With agriculture moving higher on the global agenda, there is growing recognition that it can be leveraged to address malnutrition and optimise nutrition outcomes especially among mothers and children.

The following recommended actions aim at enhancing the contribution and complementarity of agriculture to nutrition and health in Rwanda; and increasing investments and commitment to nutrition. Validating critical pathways linking agriculture to nutrition in Rwanda and attaching explicit health and nutrition goals to these components is critical to sustainable interventions. The proposed conceptual pathway that links agriculture, nutrition and health is depicted in Figure 5.2. Three key pathways link agriculture to nutrition outcomes in Rwanda. These pathways are food production, agricultural income and maternal empowerment. They are however dependent on sustainable agricultural practices that are able to enhance soil and water conservation while enhancing landscape and production diversity.

Food production pathway

The pathway from food production to nutrition outcomes is critical especially for smallholder households that are net food buyers. These households purchase more food from the markets than they get from their own production. Thus, food availability in markets and prevailing food prices affect their food purchases and consequently their dietary intake. In addition, women often produce some amount of food such as vegetables for household consumption to secure access to the nutrients they need. The ability of households to process, preserve, and store diverse foods influences the household diet.

The agriculture sector, as a major source of nutrition and livelihoods, needs to reassess the needs of their main stakeholders who are the farmers and especially marginal producers who are at a higher risk of malnutrition. Targeted interventions for marginal producers are necessary to ensure that they enhance farm productivity and that they do not sell most of the food for income; rather alternatives for income generation are made available to them. The options can include agricultural productivity support programmes, facilitating production diversification, increasing production of nutrient-dense crops and livestock, improving equity, and offering opportunities for alternative livelihood sources. At the individual level, farmers have to shift their mindset and view what they produce not just as an asset, but also for their own food – for household consumption.

The study results provide no strong evidence that marketing part of the harvest significantly contributes to the persistent malnutrition in Rwanda. On the contrary, low use of inputs such as fertilisers, and access to information on production and nutrition appear to be stronger areas of intervention to increase nutrition outcomes. The presence of good production from use of modern agricultural practices such as use of mineral fertilisers and quality of land highly correlate with better nutrition for children under 24 months. While majority of households do not use mineral fertilisers, the results from multivariate analysis show that, on average, these households that do not use chemical fertilisers were more likely to have stunted children than those who use chemical fertilisers. This means that imperfections in the input markets which hinder better access and utilization of land-enhancing inputs negatively affect nutrition through lower productivity. Some of the interventions should therefore account for the current imperfections in the input markets that constrain access. In addition, management of degraded soils should be given priority if households are to generate enough production from using such land. All in all, results from this analysis support the conclusion that among the large number of potential interventions for improving nutrition in Rwanda, increasing productivity is still critical despite progressive improvements in the recent past.

Agricultural income pathway

Overall, income and nutrition are related. However, the agricultural income pathway is not linear; and the effect of income on health and nutrition is especially moderated by household food and non-food expenditure. Among vulnerable households, food and health expenditures can easily become secondary to non-food expenditures. Therefore food and healthcare expenditure must be elevated as a priority in households. This calls for agriculture to become more remunerative, and for the resilience of farmers to be enhanced through targeted social safety nets such as production insurance against drought or crop/livestock failure.

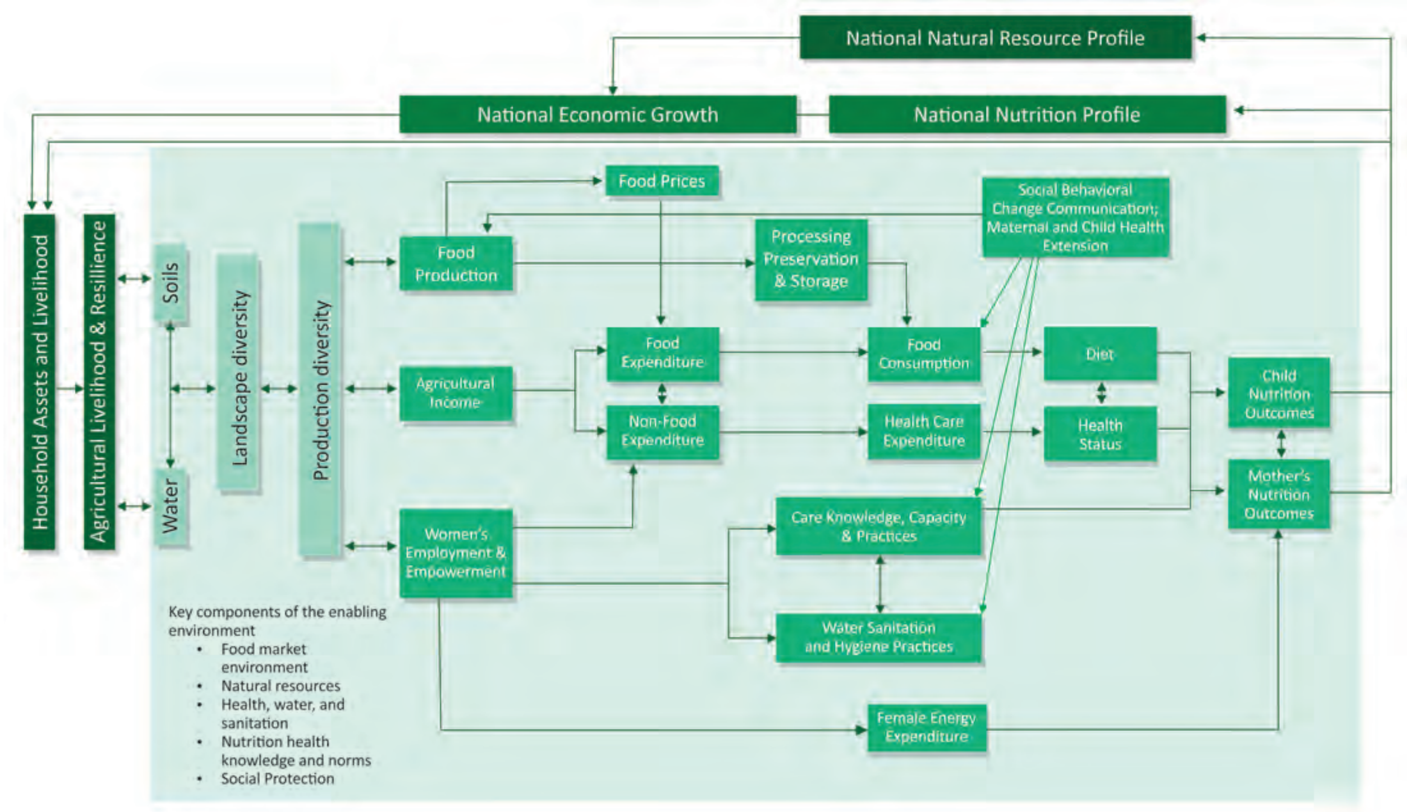
On the other hand, in households where women have access to income, the decisions they make have a positive impact on household nutrition. Therefore, social behavioural change communication, and nutrition education and promotion activities that reinforce the use of income on diverse nutrient-dense foods and health services that benefit nutrition outcomes should be promoted. This requires that the sector ministries on nutrition collaborate and coordinate efforts with other relevant sectors. In addition, agriculture could seek to improve or diversify livelihoods through integrated agricultural production and value addition to stabilise markets and boost incomes especially among women and the youth.

Women empowerment pathway

The pathway from women's empowerment to improved nutrition is influenced by a number of factors including social norms, knowledge, skills, and how decision-making power is shared within households. The pathway consists of four interrelated components: women's use of income for food and non-food expenditures; the ability of women to care for themselves and their families; water, health, and sanitation practices; and women's energy expenditure. Social behavioural change communication to improve especially the ability of women to care for themselves and their families, and WASH practices, would further empower women and improve nutrition outcomes.

Access to productive resources such as credit was one of the most important determinants for stunting in children. This reflects the complementary benefits women can derive from participation in credit groups and draws attention to the importance of access to capital that can be used for farm production and income generation purposes or supplementing consumption. In addition to credit access, such groups are platforms for information exchange on production and childcare; and provide social insurance to deal with risks. These findings suggest that there is need to identify and implement strategies that enhance women empowerment. In particular, reducing time burden on women requires female-friendly agricultural labour-saving technologies such as mechanisation that allow women to work faster and expend less energy so that they can better care for other responsibilities especially for those related with reproductive roles and childcare. As evident from descriptive results, women that spend more than average time in agriculture are less likely to breastfeed their children any time or ensure sanitation of their children, which is associated with child stunting.

Women empowerment in agriculture must also focus on either strengthening the position of women along commodity value chains; or repositioning women along value chains to segments that allow women to be effective in their time use and energy expenditure. Empowering women to make decisions on food, child, and healthcare can impact nutrition positively.



Adapted from Herforth & Harris 2014, and Du, 2014.

Figure 5.2: Conceptual Pathways Linking Agriculture, Health, and Nutrition Outcomes in Rwanda

5.3.3 Other Recommendations

1. Together with nutrition sector ministries (agriculture, health, finance, economic planning, gender, and infrastructure), review existing policy documents and action plans for nutrition against the five key recommendations for improving nutrition through agriculture (FAO 2015).
2. Upgrade current agricultural-led programmes and investments using the 10 guiding principles for improving nutrition through agriculture (FAO 2015), and integrate tailored nutrition interventions into these planned and ongoing agricultural investments.
3. Conduct a data audit for nutrition and create standardised metrics for key nutrition indicators, and for measuring progress in nutrition.
4. Establish new opportunities for joint efforts in nutrition programming that can be optimised to address stunting in Rwanda, and pilot innovation as action research to document best practices and evidence-adding to the agriculture for nutrition and health knowledge base.
5. Seek to build more capacity of public sector extension (community health workers, agriculture extension agents) and non-governmental organisational personnel to effectively implement nutrition initiatives aimed at social behavioural change communication and maternal and child health promotion/health extension.

6. Foster and expand favourable policy environments for nutrition and health, and specific and sensitive interventions for combating stunting through a team of champions, advocates and change agents.
7. Gender empowerment at community levels needs to be enhanced to refocus community efforts towards empowering women in their roles of nutrition needs of their families. While gender empowerment has progressed well at national levels, more efforts are required at community and household levels given the importance of empowerment on the nutrition status of children. It is clear that gender issues impact both agricultural production and how the food is utilised in households; as well as how decisions that impact the nutrition of children are made at the household level.

Finally, the NMG Survey tested a novel approach to understanding the causes of malnutrition in children under 24 months by integrating the three components of nutrition, markets and agriculture, and gender. Results clearly show that a well co-ordinated multi-sectoral approach (focused on nutrition interventions, agricultural and markets interventions, and gender empowerment interventions) is required to addressing stunting in Rwanda.

6.0

REFERENCE LIST

Alkire S, Meinzen-dick R, Peterman A, Quisumbing A, Vaz ANA. 2013. *The Women's Empowerment in Agriculture Index. World Development, 52:71–91.*

Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J. 2008. Maternal and child undernutrition: global and regional exposures and health consequences. *The Lancet, 371 (9608):243–260.*

Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, Ezzati M, Grantham-McGregor S, Katz J, Martorell R, Uauy R. 2013. Maternal and child nutrition 1: Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet, (9890): 427–451.*

Cunningham K, Ploubidis G, Menon P, Ruel M, Kadiyala S, Uauy R, Ferguson E. 2015. Women's empowerment in agriculture and child nutritional status in rural Nepal. *Public Health Nutrition, doi:10.1017/S1368980015000683.*

Daff ME, Doll R, Kennaway EL. 1951. Cancer of the lung in relation to tobacco. *British Journal of Cancer 5(1):1-20.*

Du L. 2014. Leveraging agriculture for nutritional impact through the Feed the Future Initiative: A landscape analysis of activities across 19 focus countries. Arlington, VA: USAID/Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) Project.

[FAO] Food and Agriculture Organization of the United Nations 2015. *Key recommendations for improving nutrition through agriculture and food systems.* http://www.fao.org/3/a-i4922e.pdf (Accessed September 2014).

Gibson R S, Ferguson E L. 1999. *An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries.* Washington D.C: ILSI Press, and Cali: International Food Policy Research Institute (IFPRI) and International Center for Tropical Agriculture (CIAT). Copyright HarvestPlus, 2008.

Headey DD. 2014. An analysis of trends and determinants of child undernutrition in Ethiopia, 2000-2011. ESSP working papers 70, Addis Ababa: Ethiopia Strategy Support Program II (ESSP II). International Food Policy Research Institute (IFPRI).

Herforth A, Harris J. 2014. Understanding and applying primary pathways and principles. Brief #1. *Improving nutrition through agriculture technical brief series.* Arlington, VA: USAID/Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) Project.

Malapit Hazel J, Kovarik C, Sproule K, Meinzen-Dick RS, Quisumbing AR. 2015. Instructional guide on the abbreviated Women's Empowerment in Agriculture Index (A-WEAI). Washington, D.C.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129719

Maluccio J, Flores R. 2005. *Impact evaluation of a conditional cash transfer program: The Nicaraguan Red de Proteccion Social.* Research Report 141. Washington, DC: International Food Policy Research Institute.

Mutua E, Waithanji E, Korir L, Mukewa E. 2014. Measuring women's social and economic empowerment. ILRI Research Brief 36, December 2014.

[NISR] National Institute of Statistics of Rwanda, and ORC Macro. 2005. *Rwanda demographic and health survey (DHS 2005).* Calverton, MD: NISR and ORC Macro.

[NISR] National Institute of Statistics of Rwanda, and ORC Macro. 2010. *Rwanda demographic and health survey (DHS 2010)*, Calverton, MD: NISR and ORC Macro.

[NISR] National Institute of Statistics of Rwanda, and ORC Macro. 2015. *Key findings from the Rwanda demographic and health survey (DHS 2014/2015).* Calverton, MD: NISR and ORC Macro.

[NISR] National Institute of Statistics of Rwanda. 2012. *Comprehensive food security and vulnerability and nutrition analysis (CFSVA, 2012).* Kigali: NISR, Ministry of Agriculture and World Food Programme.

Ochieng J, Niyuhire MC, Birachi E, Ruraduma C and Ouma E. 2014. Bean utilization and commercialization in Great Lakes region of Central Africa: The case of smallholder farmers in Burundi. In: B Vanlauwe, P VanAsten and G Blomme, eds. 2014. *Challenges and opportunities for agricultural intensification of the humid highland system of Sub-Saharan Africa.* Springer International Publishing Switzerland.

Ouma E, Birachi E, and Pypers P. 2012. *Household livelihood status in agro-based systems of central Africa: CIALCA livelihoods baseline*. Lambert Publishing.

Rutstein SO, Kiersten J. 2004. *The DHS Wealth Index*. DHS Comparative Reports No. 6. Calverton, Maryland: ORC Macro. http://www.dhsprogram.com/pubs/pdf/CR6/CR6.pdf

WHO, World Health Organisation (2006) *MGRS Anthropometry Training Video*. [video] Available at <www.youtube.com/watch?v=UVcEZoCDV20>

[WHO] World Health Organization. 2010. *Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide*. http://www.who.int/nutrition/nlis_interpretation_guide.pdf

[WHO] World Health Organization. 2011. *Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity*. Vitamin and Mineral Nutrition Information System. (WHO/NMH/NHD/MNM/11.1) Geneva: World Health Organization http://www.who.int/vmnis/indicators/haemoglobin. pdf

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APPENDICES

Appendix 7.1 Details of Site Selection with Prevalence of Stunting

Appendix 7.2 List of All Screened Villages

Appendix 7.3 Screening Questionnaire

Appendix 7.4 Correlation Matrices

Appendix 7.5 List of Anthropometry Team

Appendix 7.6 List of Survey Supervisors

Appendix 7.7 List of Project Team and Staffing

Appendix 7.1: Details of Site Selection with Prevalence of Stunting

Table 7.1.1a: East Province

Province	District	DHS 2010	CFSVA 2012	Random numbers		Sectors
East Province	Rwamagana	29.2		6		
East Province	Nyagatare	42.2		1	Selected	Nyagatare
East Province	Gatsibo	51.5		3		
East Province	Kayonza	44.5		18		
East Province	Kirehe	50.7		20	Selected	Kigarama
East Province	Ngoma	50.2		11		
East Province	Bugesera	38.2		9		

Table 7.1.1b: East Province Sector Selection

Sectors	Random numbers	http://andrew.hedges.name/experiments/random/
Gatunda	1	
Kiyombe	2	
Karama	3	
Karangazi	4	
Katabagemu	5	
Matimba	6	
Mimuli	7	
Mukama	8	
Musheli	9	
Nyagatare	**10**	**Selected**
Rukomo	11	
Rwempasha	12	
Rwimiyaga	13	
Tabagwe	14	
Gahara	1	
Gatore	2	
Kigarama	**3**	**Selected**
Kigina	4	
Kirehe	5	
Mahama	6	
Mpanga	7	
Musaza.	8	
Mushikiri	9	
Nasho	10	
Nyamugari	11	
Nyarubuye	12	
Kigina	4	
Kirehe	5	
Mahama	6	
Mpanga	7	
Musaza.	8	
Mushikiri	9	
Nasho	10	
Nyamugari	11	
Nyarubuye	12	

Table 7.1.2a: North Province

Province	District	DHS 2010	CFSVA 2012	Random numbers		Sectors
North Province	Rulindo	42.9		18		
North Province	Gakenke	63.6		20	Selected	Gakenke
North Province	Musanze	45.3		7	Selected	Cyuve
North Province	Burera	52		3		
North Province	Gicumbi	46.6		15		

Table 7.1.2b: North Province Sector Selection

Sectors	Random numbers	http://andrew.hedges.name/experiments/random/
Busengo	1	
Coko	2	
Cyabingo	3	
Gakenke	**4**	**Selected**
Gashenyi	5	
Mugunga	6	
Janja	7	
Kamubuga	8	
Karambo	9	
Kivuruga	10	
Mataba	11	
Minazi	12	
Muhondo	13	
Muyongwe	14	
Muzo	15	
Nemba	16	
Ruli	17	
Rusasa	18	
Rushashi	19	
Busogo	1	
Cyuve	**2**	**Selected**
Gacaca	3	
Gashaki	4	
Gatagara	5	
Kimonyi	6	
Kinigi	7	
Muhoza	8	
Muko	9	
Musanze	10	
Nkotsi	11	
Nyange	12	
Remera	13	
Rwaza	14	
Shingiro	15	

Table 7.1.3a: West Province

Province	District	DHS 2010	CFSVA 2012	Random numbers		Sectors
West Province	Karongi	56.7		17		
West Province	Rutsiro	60.3		3		
West Province	**Rubavu**	**54.9**		**13**	**Selected**	**Gisenyi**
West Province	Nyabihu	51.5		5		
West Province	**Ngororero**	**53.4**		**8**	**Selected**	**Matyazo**
West Province	Rusizi	40.9		11		
West Province	Nyamasheke	33.2		4		

Table 7.1.3b: West Province Sector Selection

Sectors	Random numbers	http://andrew.hedges.name/ experiments/random/
Bugeshi	1	
Busasamana	2	
Cyanzarwe	3	
Gisenyi	**4**	**Selected**
Kanama	5	
Kanzenze	6	
Mudende	7	
Nyakiliba	8	
Nyanyumba	9	
Nyundo	10	
Rubavu	11	
Rugerero	12	
Bwira	1	
Gatumba	2	
Hindiro	3	
Kabaya	4	
Kageyo	5	
Kavumu	6	
Matyazo	**7**	**Selected**
Muhanda	8	
Nyange	9	
Ndaro	10	
Ngororero	11	
Sovu	12	
Muhororo	13	

Table 7.1.4a: South Province

Province	District	DHS 2010	CFSVA 2012	Random numbers		Sectors
South Province	Nyanza	26.4		3		
South Province	Gisagara	47.6		9		
South Province	**Nyaruguru**	**45.4**		**19**	**Selected**	**Kibeho**
South Province	Huye	45		10		
South Province	**Nyamagabe**	**53.5**		**12**	**Selected**	**Cyanika**
South Province	Ruhango	20.7		13		
South Province	Muhanga	46.7		18		
South Province	Kamonyi	45.3		2		

Table 7.1.4b: South Province Sector Selection

Sectors	Random numbers	http://andrew.hedges.name/experiments/random/
Buruhukiro	1	
Cyanika	**2**	**Selected**
Kaduha	3	
Kamegeli	4	
Kibirizi	5	
Kibumbwe	6	
Kitabi	7	
Mbazi	8	
Mugano.	9	
Musange	10	
Musebeya	11	
Mushubi	12	
Nkomane	13	
Gasaka	14	
Tare	15	
Uwinkingi	16	
Gatare	17	
Cyahinda	1	
Kibeho	**2**	**Selected**
Kivu	3	
Ngera	4	
Ngoma	5	
Nyabimata	6	
Nyagisozi	7	
Muganza	8	
Ruheru	9	
Ruramba	10	
Rusenge	11	
Busanze	12	
Mata	13	
Munini	14	

Table 7.1.5a: Kigali Province

Province	District	DHS 2010	CFSVA 2012	Random numbers		Sector(s)
Kigali province	Nyarugenge	28.3		11		
Kigali province	**Gasabo**	**23.8**		**17**	**Selected**	**Rusororo**
Kigali province	Kicukiro	18.9		13		

Table 7.1.5b: Kigali Sector Selection

Sectors	Random numbers	http://andrew.hedges.name/experiments/random/
Bumbogo	1	
Gatsata	2	
Jali	3	
Gikomero	4	
Gisozi	5	
Jabana	6	
Kinyinya	7	
Ndera	8	
Nduba	9	
Rusororo	**10**	**selected**
Rutunga	11	
Kacyiru	12	
Kimihurura	13	
Kimironko	14	
Remera	15	

Appendix 7.2: List of All Screened Villages

Table 7.2.1: Nyagatare District

#	District	Sector	Cell	Village
1	Nyagatare	Nyagatare	Bushoga	Bushoga
2	Nyagatare	Nyagatare	Bushoga	Cyabahanga
3	Nyagatare	Nyagatare	Bushoga	Cyonyo
4	Nyagatare	Nyagatare	Cyabayaga	Akamonyi
5	Nyagatare	Nyagatare	Cyabayaga	Cyabayaga
6	Nyagatare	Nyagatare	Gakirage	Gakirage
7	Nyagatare	Nyagatare	Gakirage	Mihingo
8	Nyagatare	Nyagatare	Gakirage	Urumuri
9	Nyagatare	Nyagatare	Kamagiri	Kamagiri
10	Nyagatare	Nyagatare	Kamagiri	Karungi
11	Nyagatare	Nyagatare	Kamagiri	Nkerenke
12	Nyagatare	Nyagatare	Nsheke	Kabare
13	Nyagatare	Nyagatare	Nyagatare	Mirama I
14	Nyagatare	Nyagatare	Nyagatare	Mirama II
15	Nyagatare	Nyagatare	Nyagatare	Nyagatare i
16	Nyagatare	Nyagatare	Rutaraka	Gihorobwa
17	Nyagatare	Nyagatare	Rutaraka	Mugari
18	Nyagatare	Nyagatare	Rutaraka	Rutaraka
19	Nyagatare	Nyagatare	Ryabega	Ryabega

Table 7.2.2: Kirehe District

#	District	Sector	Cell	Village
1	Kirehe	Kigarama	Cyanya	Kabimba II
2	Kirehe	Kigarama	Kigarama	Gahindu
3	Kirehe	Kigarama	Kigarama	Kiravunga
4	Kirehe	Kigarama	Kigarama	Nyamiyaga
5	Kirehe	Kigarama	Kigarama	Nyarutojo
6	Kirehe	Kigarama	Kiremera	Bweranka2
7	Kirehe	Kigarama	Kiremera	Cyanika
8	Kirehe	Kigarama	Kiremera	Kagorogoro
9	Kirehe	Kigarama	Kiremera	Kayiraryе
10	Kirehe	Kigarama	Kiremera	Nyaryenge
11	Kirehe	Kigarama	Kiremera	Rama
12	Kirehe	Kigarama	Kiremera	Rwesinge
13	Kirehe	Kigarama	Kiremera	Umunezero
14	Kirehe	Kigarama	Nyankurazo	Kabeza
15	Kirehe	Kigarama	Nyankurazo	Kivu
16	Kirehe	Kigarama	Nyankurazo	Marembo
17	Kirehe	Kigarama	Nyankurazo	Nshungerezi
18	Kirehe	Kigarama	Nyankurazo	Nyagahanga
19	Kirehe	Kigarama	Nyankurazo	Nyakabungo
20	Kirehe	Kigarama	Nyankurazo	Nyakigera
21	Kirehe	Kigarama	Nyankurazo	Nyakwisi
22	Kirehe	Kigarama	Nyankurazo	Rama
23	Kirehe	Kigarama	Nyankurazo	Ruhuha
24	Kirehe	Kigarama	Nyakerera	Rukiri
25	Kirehe	Kigarama	Nyankurazo	Rusumo

Table 7.2.3: Gakenke District

#	District	Sector	Cell	Village
1	Gakenke	Gakenke	Buheta	Buyagiro
2	Gakenke	Gakenke	Buheta	Gatwa
3	Gakenke	Gakenke	Buheta	Ndora
4	Gakenke	Gakenke	Buheta	Rusebeya
5	Gakenke	Gakenke	Buheta	Gihemba
6	Gakenke	Gakenke	Kagoma	Gitenga
7	Gakenke	Gakenke	Kagoma	Kamatare
8	Gakenke	Gakenke	Kagoma	Murambi
9	Gakenke	Gakenke	Kagoma	Musave
10	Gakenke	Gakenke	Nganzo	Gahondo
11	Gakenke	Gakenke	Nganzo	Kanyiramanyana
12	Gakenke	Gakenke	Nganzo	Karehe
13	Gakenke	Gakenke	Nganzo	Karuganda
14	Gakenke	Gakenke	Nganzo	Muyira
15	Gakenke	Gakenke	Rusagara	Akarugamba
16	Gakenke	Gakenke	Rusagara	Kivumu
17	Gakenke	Gakenke	Rusagara	Nyamabuye
18	Gakenke	Gakenke	Rusagara	Ruberano
19	Gakenke	Gakenke	Rusagara	Umujyi wa gakenke
20	Gakenke	Gakenke	Rusagara	Museke

Table 7.2.4: Musanze District

#	District	Sector	Cell	Villages
1	Musanze	Cyuve	Bukinanyana	Murambi
2	Musanze	Cyuve	Bukinanyana	Rugeshi
3	Musanze	Cyuve	Buruba	Kabahama
4	Musanze	Cyuve	Cyanya	Mubuga
5	Musanze	Cyuve	Cyanya	Mugarama
6	Musanze	Cyuve	Cyanya	Rebero
7	Musanze	Cyuve	Kabeza	Bucuzi
8	Musanze	Cyuve	Kabeza	Kareba
9	Musanze	Cyuve	Kabeza	Karunyura
10	Musanze	Cyuve	Migeshi	Buremu
11	Musanze	Cyuve	Migeshi	Gakenke
12	Musanze	Cyuve	Migeshi	Kabaya
13	Musanze	Cyuve	Migeshi	Kamanga
14	Musanze	Cyuve	Migeshi	Kiviriza
15	Musanze	Cyuve	Migeshi	Nyaruyaga
16	Musanze	Cyuve	Rwebeya	Nganzo

Table 7.2.5: Rubavu District

#	District	Sector	Cell	Village
1	Rubavu	Gisenyi	Kivumu	Muduha
2	Rubavu	Gisenyi	Umuganda	Kabuga
3	Rubavu	Gisenyi	Mbugangari	Abahuje
4	Rubavu	Gisenyi	Mbugangari	Rebero
5	Rubavu	Gisenyi	Mbugangari	Nyarubande
6	Rubavu	Gisenyi	Umuganda	Bonde
7	Rubavu	Gisenyi	Mbugangari	Amajyambere
8	Rubavu	Gisenyi	Amahoro	Umunezero
9	Rubavu	Gisenyi	Amahoro	Murakazaneza
10	Rubavu	Gisenyi	Umuganda	Majengo
11	Rubavu	Gisenyi	Bugoyi	Nyakabungo
12	Rubavu	Gisenyi	Kivumu	Umurava
13	Rubavu	Gisenyi	Bugoyi	Ubwiza
14	Rubavu	Gisenyi	Nengo	Nyaburanga
15	Rubavu	Gisenyi	Rubavu	Gahojo
16	Rubavu	Gisenyi	Nengo	Kivu
17	Rubavu	Gisenyi	Mbugangari	Uburanga

#	District	Sector	Cell	Village
18	Rubavu	Gisenyi	Mbugangari	Karundo
19	Rubavu	Gisenyi	Mbugangari	Ubwiyunge
20	Rubavu	Gisenyi	Mbugangari	Ikibuga
21	Rubavu	Gisenyi	Mbugangari	Ikaze
22	Rubavu	Gisenyi	Mbugangari	Ihumure
23	Rubavu	Gisenyi	Mbugangari	Iyobokamana
24	Rubavu	Gisenyi	Mbugangari	Gasutamo
25	Rubavu	Gisenyi	Mbugangari	Ikinyambo
26	Rubavu	Gisenyi	Mbugangari	Umutekano
27	Rubavu	Gisenyi	Kivumu	Itangazamakuru
28	Rubavu	Gisenyi	Kivumu	Giponda
29	Rubavu	Gisenyi	Kivumu	Ubutabazi
30	Rubavu	Gisenyi	Kivumu	Urumuri
31	Rubavu	Gisenyi	Kivumu	Kivumu
32	Rubavu	Gisenyi	Kivumu	Ubumwe
33	Rubavu	Gisenyi	Kivumu	Ubukerarugendo
34	Rubavu	Gisenyi	Bugoyi	Amataba
35	Rubavu	Gisenyi	Bugoyi	Giraneza
36	Rubavu	Gisenyi	Bugoyi	Isangano
37	Rubavu	Gisenyi	Bugoyi	Bugoyi
38	Rubavu	Gisenyi	Bugoyi	Irakiza
39	Rubavu	Gisenyi	Bugoyi	Ituze
40	Rubavu	Gisenyi	Rubavu	Rubavu
41	Rubavu	Gisenyi	Rubavu	Munini
42	Rubavu	Gisenyi	Rubavu	Ruliba
43	Rubavu	Gisenyi	Amahoro	Muhabura
44	Rubavu	Gisenyi	Amahoro	Kitagabwa
45	Rubavu	Gisenyi	Amahoro	Amahoro
46	Rubavu	Gisenyi	Nengo	Nyabagobe
47	Rubavu	Gisenyi	Nengo	Ubucuruzi
48	Rubavu	Gisenyi	Nengo	Gacuba
49	Rubavu	Gisenyi	Nengo	Urubyiruko
50	Rubavu	Gisenyi	Nengo	Gikarani
51	Rubavu	Gisenyi	Umuganda	Muhato
52	Rubavu	Gisenyi	Umuganda	Umuganda
53	Rubavu	Gisenyi	Umuganda	Umunyinya
54	Rubavu	Gisenyi	Umuganda	Dukore
55	Rubavu	Gisenyi	Umuganda	Ihuriro

Table 7.2.6: Ngororero District

#	District	Sector	Cell	Village
1	Ngororero	Matyazo	Binana	Busoro
2	Ngororero	Matyazo	Binana	Kaseke
3	Ngororero	Matyazo	Binana	Nyagisozi
4	Ngororero	Matyazo	Gitega	Barama
5	Ngororero	Matyazo	Gitega	Gahanda
6	Ngororero	Matyazo	Gitega	Gasayo
7	Ngororero	Matyazo	Matare	Gitega
8	Ngororero	Matyazo	Matare	Kamasorori
9	Ngororero	Matyazo	Matare	Munyinya
10	Ngororero	Matyazo	Matare	Mwumba
11	Ngororero	Matyazo	Matare	Nyenyeri
12	Ngororero	Matyazo	Rutare	Nyakiriba
13	Ngororero	Matyazo	Rutare	Ruhurura
14	Ngororero	Matyazo	Rutare	Shori
15	Ngororero	Matyazo	Rwamiko	Butare
16	Ngororero	Matyazo	Rwamiko	Rwamiko

Table 7.2.7: Nyaruguru District

#	District	Sector	Cell	Village
1	Nyaruguru	Kibeho	Mubuga	Mubuga
2	Nyaruguru	Kibeho	Mubuga	Uwintobo
3	Nyaruguru	Kibeho	Mbasa	Migina
4	Nyaruguru	Kibeho	Nyange	Agateko
5	Nyaruguru	Kibeho	Mubuga	Nyarusovu
6	Nyaruguru	Kibeho	Kibeho	Agateko
7	Nyaruguru	Kibeho	Mpanda	Munege
8	Nyaruguru	Kibeho	Mpanda	Banga
9	Nyaruguru	Kibeho	Nyange	Kigona
10	Nyaruguru	Kibeho	Kibeho	Akajonge
11	Nyaruguru	Kibeho	Gakoma	Viro
12	Nyaruguru	Kibeho	Mubuga	Umurambi
13	Nyaruguru	Kibeho	Gakoma	Nyagishayo
14	Nyaruguru	Kibeho	Mpanda	Mpanda
15	Nyaruguru	Kibeho	Gakoma	Rurembo
16	Nyaruguru	Kibeho	Nyange	Mpatswe
17	Nyaruguru	Kibeho	Kibeho	Sinayi
18	Nyaruguru	Kibeho	Nyange	Nkomero
19	Nyaruguru	Kibeho	Mbasa	Migina
20	Nyaruguru	Kibeho	Mbasa	Rwingogo
21	Nyaruguru	Kibeho	Mbasa	Kinazi
22	Nyaruguru	Kibeho	Mbanda	Kibaye
23	Nyaruguru	Kibeho	Mubuga	Nyarugumba
24	Nyaruguru	Kibeho	Gorwe	Ruhunga

Table 7.2.8: Nyamagabe District

#	District	Sector	Cell	Village
1	Nyamagabe	Cyanika	Gitega	Butare
2	Nyamagabe	Cyanika	Gitega	Miko
3	Nyamagabe	Cyanika	Gitega	Gaseke
4	Nyamagabe	Cyanika	Gitega	Musasa
5	Nyamagabe	Cyanika	Gitega	Gasharu
6	Nyamagabe	Cyanika	Gitega	Rwingoma
7	Nyamagabe	Cyanika	Gitega	Munyereri
8	Nyamagabe	Cyanika	Gitega	Kigarama

#	District	Sector	Cell	Village
9	Nyamagabe	Cyanika	Gitega	Rusarasi
10	Nyamagabe	Cyanika	Gitega	Gitega
11	Nyamagabe	Cyanika	Karama	Birambo
12	Nyamagabe	Cyanika	Karama	Munyinya
13	Nyamagabe	Cyanika	Karama	Rwamagana
14	Nyamagabe	Cyanika	Karama	Karaba
15	Nyamagabe	Cyanika	Karama	Nyanza
16	Nyamagabe	Cyanika	Karama	Nyamisave
17	Nyamagabe	Cyanika	Karama	Mugamba
18	Nyamagabe	Cyanika	Karama	Karama
19	Nyamagabe	Cyanika	Nyanzoga	Mbeho
20	Nyamagabe	Cyanika	Nyanzoga	Bigazi
21	Nyamagabe	Cyanika	Nyanzoga	Mugari
22	Nyamagabe	Cyanika	Nyanzoga	Gafuhisha
23	Nyamagabe	Cyanika	Nyanzoga	Rusenyi
24	Nyamagabe	Cyanika	Nyanzoga	Kagarama
25	Nyamagabe	Cyanika	Nyanzoga	Karuvenya
26	Nyamagabe	Cyanika	Nyanzoga	Nyamirama
27	Nyamagabe	Cyanika	Kiyumba	Gatentwe
28	Nyamagabe	Cyanika	Kiyumba	Kagarama
29	Nyamagabe	Cyanika	Kiyumba	Nyarucyamu
30	Nyamagabe	Cyanika	Kiyumba	Gatare
31	Nyamagabe	Cyanika	Kiyumba	Gikomero
32	Nyamagabe	Cyanika	Kiyumba	Gishike
33	Nyamagabe	Cyanika	Kiyumba	Kaviri
34	Nyamagabe	Cyanika	Ngoma	Kamuhirwa
35	Nyamagabe	Cyanika	Ngoma	Kinga
36	Nyamagabe	Cyanika	Ngoma	Nyamirambo
37	Nyamagabe	Cyanika	Ngoma	Murama
38	Nyamagabe	Cyanika	Ngoma	Kavumu
39	Nyamagabe	Cyanika	Ngoma	Kabarera
40	Nyamagabe	Cyanika	Nyanza	Buhiga
41	Nyamagabe	Cyanika	Nyanza	Kibingo
42	Nyamagabe	Cyanika	Nyanza	Rugaragara
43	Nyamagabe	Cyanika	Nyanza	Mugombwa
44	Nyamagabe	Cyanika	Nyanza	Nyabisindu
45	Nyamagabe	Cyanika	Nyanza	Mirama

Table 7.2.9: Gasabo District

#	District	Sector	Cell	Village
1	Gasabo	Rusororo	Kabuga I	Isangano
2	Gasabo	Rusororo	Nyagahinga	Kabutare
3	Gasabo	Rusororo	Mbandazi	Cyeru
4	Gasabo	Rusororo	Mbandazi	Karambo
5	Gasabo	Rusororo	Nyagahinga	Kigarama
6	Gasabo	Rusororo	Bisenga	Gasiza
7	Gasabo	Rusororo	Kabuga I	Amahoro
8	Gasabo	Rusororo	Mbandazi	Kataruha
9	Gasabo	Rusororo	Kinyana	Kinyana
10	Gasabo	Rusororo	Bisenga	Kidogo
11	Gasabo	Rusororo	Ruhanga	Mirama
12	Gasabo	Rusororo	Kinyana	Kigabiro
13	Gasabo	Rusororo	Gasagara	Rugagi
14	Gasabo	Rusororo	Kinyana	Busenyi
15	Gasabo	Rusororo	Kabuga II	Cyanamo
16	Gasabo	Rusororo	Gasagara	Agatare
17	Gasabo	Rusororo	Gasagara	Ryabazana
18	Gasabo	Rusororo	Gasagara	Kamasasa
19	Gasabo	Rusororo	Gasagara	Gasagara
20	Gasabo	Rusororo	Bisenga	Bisenga
21	Gasabo	Rusororo	Bisenga	Gakenyeri
22	Gasabo	Rusororo	Mbandazi	Mugeyo

Appendix 7.3: Screening Questionnaire

Screening Questionnaire

(Imirire, Amasoko n'igitsina: Uburyo buhamye bwo gufasha abaturage bugarijwe n'ikibazo cy'imirire mibi mu Rwanda

Child Information (Umwirondoro w'Umwana)

Date (itariki): ____

Study ID (Inimero y'ubushakashatsi): ____

Head of Household (Umutware w'urugo): ____

Ubudehe (Icyiciro cy'Ubudehe): ____

Location (Aho abarizwa (Umurenge,Akagari,Umudugudu): ______________________________

Child Name (izina ry'Umwana): ________________________ Gender (igitsina): ______________________

Age (imyaka): _______________________________________

Child's study data (ibipimo by'ubushakashatsi by'umwana)

Height (uburebure): __________________________________ Weight (ibiro): ________________________

MUAC (umuzenguruko w'ikizigira): ______________________

Oedema (kubyimba):

Mother's Study data (ibipimo by'ubushakashatsi by' Umubyeyi)

Name (izina): ____ Age (Imyaka):________________________

Weight (Ibiro): ______________________________________ Height (Uburebure):___________________

MUAC (umuzenguruko w'ikizigira): ______________________

Pregnancy status (ugutwita): ____________________________

Appendix 7.4: Correlation Matrices

Table 7.4.1: Wealth Factors

	Whether household has a stunted child	Floor material of the house	Number of sleeping rooms in the dwelling unit	If household has electricity	If household has radio	If household has television	Whether household has mobile phones	Whether household has a motorcycle
Whether household has a stunted child	1							
Floor material of the house	0.1060*	1						
Number of sleeping rooms in the dwelling unit	0.0678*	0.2094*	1					
If household has electricity	-0.0653*	-0.5941*	-0.1688*	1				
If household has radio	-0.0736*	-0.2492*	-0.1371*	0.2636*	1			
If household has television	-0.0804*	-0.5020*	-0.2182*	0.6007*	0.2310*	1		
Whether household has mobile phones	-0.0881*	-0.3444*	-0.1411*	0.3644*	0.3014*	0.2604*	1	
Whether household has a motorcycle	-0.0538*	-0.1848*	-0.0655*	0.1266*	0.0966*	0.1540*	0.0948*	1

Table 7.4.2: Demographic Factors

	Whether household has a stunted child	Can head of household read/ write	Can the spouse of household head read/ write	Level of education of head of household	Level of education of the spouse of head of household
Whether household has a stunted child	1				
Can head of household read/ write	-0.0498*	1			
Can the spouse of household head read/write	-0.0608*	0.2401*	1		
Level of education of head of household	0.1045*	-0.5839*	-0.2884*	1	
Level of education of the spouse of head of household	0.1022*	-0.2738*	-0.6132*	0.6333*	1

Table 7.4.3: Wash and Health Factors

	Whether household has a stunted child	At least one household member has health insurance 1=yes	Number of occasions when it is important to wash hands	If you wash hands after using toilet, what do you use to wash your hands	If you wash hands after using toilet, do you use soap and water	If washing place observed, Is there water at the handwashing place	What type of facilities are available for the wash water
Whether household has a stunted child	1						
At least one household member has health insurance 1=yes	0.0714*	1					
Number of occasions when it is important to wash hands	0.0745*	0.004	1				
If you was hands after using toilet, what do you use to wash your hands	0.0795*	0.038	0.0696*	1			
If you wash hands after using toilet, do you use soap and water	-0.0890*	-0.031	-0.0650*	-0.9628*	1		
If washing place observed, Is there water at the hand-washing place	0.041	0.008	0.2531*	0.2721*	-0.2837*	1	
What type of facilities are available for the wash water	-0.2144*	-0.010	0.001	-0.144	0.153	.	1

Table 7.4.4: Mother and Child Birth Factors

	Whether household has a stunted child	Is this child a twin	Gestation age (months of pregnancy) when reference child was born	Birth weight (kg) of the child when she/he was born	Birth length (cm) of the child when she/he was born	Number of children younger than the reference child	During the reference child's pregnancy did the mother eat a diverse diet	During the reference child's pregnancy did the mother usually have good appetite	During the reference child's pregnancy did the mother usually have enough food	Does mother of reference child take the child when she goes to work
Whether household has a stunted child	1									
Is reference child a twin	-0.0615*	1								
Gestation age (months of pregnancy) when reference child was born	0.0658*	-0.0978*	1							
Birth weight (kg) of the child when she/he was born	0.1342*	-0.0840*	0.1454*	1						
Birth length (cm) of the child when she/he was born	0.003	0.022	0.008	0.005	1					
Number of children younger than reference child	-0.0468*	0.032	-0.027	-0.020	-0.012	1				
During the reference child's pregnancy did the mother eat a diverse diet	0.026	0.0719*	0.018	-0.032	-0.003	-0.026	1			
During the reference child's pregnancy did the mother usually have good appetite	-0.005	0.1040*	-0.020	-0.0624*	0.003	-0.007	0.5773*	1		
During the reference child's pregnancy did the mother usually have enough food	0.0396*	0.0849*	-0.033	-0.0550*	-0.002	0.012	0.4792*	0.6984*	1	
Does mother of reference child take the child when she goes to work	-0.0607*	-0.035	0.008	-0.028	0.015	0.003	-0.0789*	-0.0576*	-0.0823*	1

Table 7.4.5: Empowerment in Decision-making

	Whether household has a stunted child	Who can decide whether to sell farm equipment (non-mechanised) most of the time	Who can decide to sell mobile phone most of the time	Who can decide whether to give away agricultural land most of the time	Who can decide to give away mobile phone most of the time	Who contributes most to decisions regarding a new purchase of agricultural land	Are you an active member of a credit or micro-finance group?	Are you an active member of a merry go round?	Are you an active member of a mutual help group?	Are you an active member of a trade & business association?
Whether household has a stunted child	1									
Who can decide whether to sell farm equipment (non-mechanised) most of the time	-0.070	1								
Who can decide to sell mobile phone most of the time	-0.0748*	0.2306*	1							
Who can decide whether to give away agricultural land most of the time	-0.0759*	0.6375*	0.2111*	1						
Who can decide to give away mobile phone most of the time	-0.1086*	0.2196*	0.9562*	0.2249*	1					
Who contributes most to decisions regarding a new purchase of agricultural land	-0.053	0.6023*	0.2448*	0.6946*	0.2612*	1				
Are you an active member of a credit or micro-finance group?	-0.0556*	-0.049	0.040	-0.017	0.030	0.023	1			
Are you an active member of a merry go round?	-0.032	-0.016	0.019	0.001	0.015	-0.047	-0.0390*	1		
Are you an active member of a mutual help group?	-0.0549*	-0.017	-0.0756*	0.028	-0.0889*	0.039	0.003	-0.022	1	
Are you an active member of a trade and business association?	-0.0417*	.	0.051	0.017	0.052	0.016	-0.010	-0.010	0.026	1

Table 7.4.6: Empowerment in Income, Leadership and Health

	Whether household has a stunted child	Do you feel comfortable speaking up in public to ensure proper payment of wages for public work or other similar programmes?	Do you feel comfortable speaking up in public to protest the misbehavior of authorities or elected officials?	Satisfaction with available time for leisure	If can freely decide when to have or not to have a baby	If can freely decide whether to have or not to have sex with my spouse	Able to decide when and what to feed my children	Able to decide when to take my children to hospital	Able to decide where to deliver my babies from
Whether household has a stunted child	1								
Do you feel comfortable speaking up in public to ensure proper payment of wages for public work or other similar programs?	-0.0440*	1							
Do you feel comfortable speaking up in public to protest the misbehavior of authorities or elected officials?	-0.0590*	0.5971*	1						
Satisfaction with available time for leisure	-0.0484*	0.2354*	0.1756*	1					
If can freely decide when to have or not to have a baby	-0.0433*	0.0443*	0.0663*	0.0762*	1				
If can freely decide whether to have or not to have sex with my spouse	-0.0478*	0.0814*	0.1150*	0.1282*	0.3561*	1			
Able to decide when and what to feed my children	-0.0438*	0.0753*	0.0603*	0.0804*	0.1479*	0.1228*	1		
Able to decide when to take my children to hospital	-0.0439*	0.1202*	0.0776*	0.1149*	0.1965*	0.1876*	0.3702*	1	
Able to decide where to deliver my babies from	-0.0440*	0.1234*	0.0958*	0.1299*	0.1973*	0.1820*	0.2243*	0.3941*	1

Table 7.4.7: Incomes and Livelihoods Variables

	Whether household has a stunted child	Income from first livelihood activity in Rwandan Francs	Agriculture ranked as first livelihood activity	Number of livelihood activities that the household has	Percentage contribution of first livelihood activity to household income
Whether household has a stunted child	1				
Income from first livelihood activity in Rwandan Francs	0.0614*	1			
Agriculture ranked as first livelihood activity	0.009	0.1936*	1		
Number of livelihood activities that the household has	0.0400*	-0.033	-0.2371*	1	
Percentage contribution of first livelihood activity to household income	-0.0495*	0.0702*	0.1850*	-0.7898*	1

Table 7.4.8: Agricultural Production

	Whether household has a stunted child	Spend money on cereals (grain or flour) in the last 30 days	Spend money on bread in the last 30 days	Spend money on banana (cooking, and fruit) in the last 30 days	Spend money on meat/poultry/fish in the last 30 days	Spend money on egg in the last 30 days	Spend money on milk and other dairy products in the last 30 days	Spend money on fresh fruits in the last 30 days	Spend money on vegetables in the last 30 days	Spend money on sugar and sweets in the last 30 days
Whether household has a stunted child	1									
Spend money on cereals (grain or flour) in the last 30 days	0.034	1								
Spend money on bread in the last 30 days	0.030	0.3967*	1							
Spend money on banana (cooking, and fruit) in the last 30 days	0.014	0.4639*	0.5839*	1						
Spend money on meat/poultry/fish in the last 30 days	0.029	0.3726*	0.6431*	0.4695*	1					
Spend money on egg in the last 30 days	0.018	0.3852*	0.4577*	0.4312*	0.6168*	1				
Spend money on milk and other dairy products in the last 30 days	0.030	0.4184*	0.4949*	0.5254*	0.4426*	0.3801*	1			
Spend money on fresh fruits in the last 30 days	-0.015	0.2251*	0.3855*	0.4103*	0.3268*	0.4916*	0.3145*	1		
Spend money on vegetables in the last 30 days	0.002	0.3792*	0.3175*	0.3361*	0.2976*	0.3997*	0.3355*	0.3685*	1	
Spend money on sugar and sweets in the last 30 days	0.030	0.3251*	0.2364*	0.3164*	0.4024*	0.3308*	0.2683*	0.1671*	0.2599*	1

Appendix 7.5: List of Anthropometry Team

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Appendix 7.6: List of Survey Supervisors

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Kwesiga Steven	Supervisor/Nyagatare
Ndanyuzwe Michel	Supervisor/Nyagatare
Inyange Sylvie	Supervisor/Nyamagabe
Musore Daniel	Supervisor/Nyamagabe
Habinshuti Patrice	Supervisor/Kirehe
Umugwaneza Germaine	Supervisor/Kirehe
Rwendeye Herve	Supervisor/Nyaruguru
Musonera Noella	Supervisor/Nyaruguru
Ntambara Faustin	Supervisor/Rubavu
Umurerwa Anabelle Clementine	Supervisor/Rubavu
Safari Alexis	Supervisor/Ngororero
Umubyeyi Antoinette	Supervisor/Ngororero
Gisore Moise	Supervisor/Gakenke
Uwera Agnes	Supervisor/Gakenke
24 Hour Recall Team	
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