

**AN ASSESSMENT OF THE GIRINKA (ONE COW PER POOR FAMILY)
PROGRAM AND POVERTY ALLEVIATION IN RWANDA
A CASE STUDY OF BUGESERA DISTRICT**

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ABSTRACT

Girinka “one cow per poor family” program has been implemented in Rwanda since 2006 for poverty and child malnutrition reduction. Every poor family receives one dairy cow and the program encourages zero-grazing to combat climate change. Bugesera District of Rwanda is characterized by long dry seasons and it was highly food insecure before the introduction of the Girinka program. However, after the initiation of the Girinka program, research showed poverty reduction in Bugesera District. This study was carried out to assess the impact of the Girinka program on its beneficiaries’ livelihoods and food security in the Bugesera District of Rwanda and its potential contribution to climate resilience. Both quantitative and qualitative research methods have been used in this study. Quantitative method was through household surveys using questionnaires and the qualitative method was through focus group discussion interviews. The study revealed that the Girinka program improved its beneficiaries’ livelihoods by providing manure as source of fertilizer, which resulted in an increase in crop production and food security. It also revealed that the money from the sale of livestock products helped the respondents to improve their livelihoods. The study also showed that child malnutrition has been eradicated in Bugesera District due to the Girinka program. Regarding climate resilience; the study showed that cow dung is used for biogas energy production, which is used as fuel for cooking and lighting and this reduces deforestation and greenhouse gases emissions in the atmosphere. Also, fodder cultivation prevents soil erosion. However, this study revealed that the use of biogas energy by the respondents is still at a low level. It is used by only 0.5% of the respondents. The study also revealed that 13% of the respondents take their cows to graze on the farm, which is prohibited by the program. The study recommends that development organizations support the Girinka program so that all poor people in Rwanda may benefit from the program. Also, it is suggested that environmentalists support research on the Girinka program as one of the climate resilience strategies. Lastly, strict program follow-up is recommended to address challenges faced by the program such inadequate veterinary services and water supply.

PREFACE

The experimental work described in this dissertation was carried out in the School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban, from February 2013 to November 2013, under the supervision of Professor Urmilla Bob.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others it is duly acknowledged in the text.

DECLARATION – PLAGIARISM

I, Vincent Kayigema declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
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Vincent Kayigema (15 March 2014)

I certify the above statement is correct.



Prof Urmilla Bob (Main supervisor) (15 March 2014)

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LIST OF ACRONYMS

ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASF	Animal Source-Food
CFMS	The Center for Financial and Management Studies
CFSVA NS	Comprehensive Food Security and Vulnerability Analysis and Nutrition Survey
CIA	Central Intelligence Agency
CO ₂	Carbonic Dioxide
CCP	Center for Civic Partnerships
DRC	Democratic Republic of Congo
EDPRS	Economic Development and Poverty Reduction Strategy
EFSA	Emergency Food Security Assessment
FAO	Food and Agriculture Organization
FEWS NET	Famine Early Warning Systems Network
FNSMS	Food Security and Nutrition Monitoring System
FSNAU	Food Security Nutrition Analysis Unit for Somalia
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GHI	Global Hunger Index
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
ICT	Information and Communication Technology
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
ISFM	Integrated Soil Fertility Management
Kg	Kilograms
LAC	Latin America and Caribbean
LDCs	Least Developed Countries
MDGs	Millennium Development Goals
MINAGRI	Ministry of Agriculture and Animal Resources
NAPAs	National Adaptation Programs of Action

N ₂ O	Nitrous Oxide
NGOs	Non-Governmental Organizations
NISR	National Institute of Statistics in Rwanda
OLPC	One Laptop per Child
PRSP	Poverty Reduction Strategy Paper
RAB	Rwanda Agriculture Board
RSSP	Rural Sector Support Project
Rwf	Rwandan Franc
SACCO	Savings and Credit Cooperatives
SLF	Sustainable Livelihoods Framework
SNV	Stichting Nederlandse Vrijwilligers (Netherlands Development Organization)
UN	United Nations
UNFCCC	United Nations Framework Conventions on Climate Change
USAID	United States Agency for International Development
VUP	Vision 2020 Umurenge (sector) Program
WFP	World Food Program
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Introduction and background

Rwanda is a land-locked small developing country located in central Africa. Any mention of Rwanda instantly brings to mind the ‘1994 Genocide of Tutsis’. This tragedy claimed up to a million lives and left two million homeless (Short, 2007). Hundreds of thousands of Hutus left the country with a legacy that seemed to have hindered sustainable development, resulting in Rwanda being among the poorest countries in the world (Short, 2007; Farmer et al., 2013). The Rwandan economy is challenged by limited natural resources and high population density (Rubagiza et al., 2011). However, through its 2020 Vision, Rwanda intends to become a middle income country by the year 2020 (Rubagiza et al., 2011). The Rwandan vision 2020 has been developed into two papers: the Poverty Reduction Strategy Paper (PRSP) published in 2002 and the Economic Development and Poverty Reduction Strategy (EDPRS) paper published in 2007 (Short, 2007). These papers helped Rwanda to move towards achieving the Millennium Development Goals (MDGs). For example, Rwanda has achieved Goal 2 of MDGs that aims to achieve universal primary education because it has a 9 years fee-free education program (Campioni and Noack, 2012).

The Government of Rwanda has implemented many strategies in agriculture to increase food security such as agro-forestry as one of the methods of controlling soil erosion by planting different types of trees that contribute as construction materials, livestock fodder and food such as fruits and nuts which improve food security (Republic of Rwanda, 2011). Also, agro-forestry provides biomass in the soil in order to improve soil fertility that increases agricultural production which results in increasing food security (Republic of Rwanda, 2011).

Girinka (the “one cow per poor family” program) is encouraged as a strategy in Rwanda to reduce poverty, specifically where resource-poor farmers get a cow aimed at developing skills and accumulating assets for livelihood improvement as well as the promotion of improved soil fertility in relation to manure use (Kim et al., 2013). Kim et al. (2013) report that more than 90% of Girinka beneficiaries use manure and attribute increased yields to enhanced soil fertility which has resulted from the program.

The Girinka program can be one of the adaptations as a climate resilience strategy for food security in Rwanda because it provides food such as milk, milk products (cheese, yoghurt, butter), meat and manure that is used to improve soil structure and rejuvenate tired land resulting in high crop production and food security (Send a Cow, 2008). Furthermore, Send a Cow (2008) asserts that animal urine and manure are used to produce natural pesticides and plant food. Cows are of considerable importance as they contribute in offering an excellent nutritious food known as milk. This is a liquid nutrient of great value rich in protein, vitamin and mineral salts (Fleming and Rae, 1994). Furthermore Fleming and Rae (1994) assert that milk contains most of dietary needs for an active and healthy life therefore it is very important for food security.

The Republic of Rwanda (2011) states that cows provide manure that is very important in agriculture. Manure is an organic fertilizer that helps to improve crop production. High crop production coincides with access to food that leads to food security. Manure is better than inorganic fertilizer as mitigation for climate change because inorganic fertilizers intensify greenhouse gas (GHG) emissions through soil nitrous oxide (N₂O) emissions and through the fertilizer manufacturing process and transportation (Republic of Rwanda, 2011).

The Food and Agricultural Organization (FAO, 2013) reveals that the management of manure from livestock is important in the reduction of the environmental impact of intensive and confined pig and dairy production systems. Nutrients recovered and energy contained in animal manure stops pollution and improves public health, recycled nutrients fertilize the soils and help as a substitute for mineral fertilizer, and fossil fuel and recovered energy reduces GHG emissions (FAO, 2013).

Henerica et al. (2011) estimate that at least two cows (depending on the size of the household) can generate valuable manure (bio-waste) to use biogas digesters that will generate sufficient biogas to supply the household cooking fuel needs. They argue that the reduction in poverty will decrease the use of biomass and related activities such as deforestation, overgrazing and over-cultivation. They further state that forests contribute to climate change adaptation through carbon sequestration as well as offering economic, environmental and socio-cultural benefits. The main opportunity of biogas energy is the reduction of carbon emissions from deforestation and degradation such as overgrazing and over-cultivation (Henerica et al., 2011).

The FAO (2006) indicates the importance of manure as a power generating (biogas) source and that it can reduce deforestation and carbonic dioxide (CO₂) emission in the atmosphere. On the other hand, the FAO (2006) also warns that there is a little doubt that livestock can produce methane gas which can cause global warming. This statement was confirmed by other researchers. Tauseef et al. (2013) reveal that ruminant animals, for example, cattle, sheep and goats produce large quantities of methane gas as a by-product of their digestive processes. Tauseef et al. (2013:188) further state that “manure-based methane has been estimated to contribute 4% of all anthropogenic methane that is presently being added up to other natural and anthropogenic sources of global warming”. In addition, Havlik et al. (2012) reveal that livestock is a major driver of land use because it accounts for 30% of global land use change. The expansion of pasture causes deforestation and it is responsible of 8% of total anthropogenic CO₂ emissions (Havlik et al., 2012). Havlik et al. (2012) suggest that future developments in the livestock sector will thus have large impacts on GHG emission levels. As indicated earlier, FAO (2006) reveals that manure-based methane has an impact on global warming, especially in relation to big commercial agriculture systems in developed countries.

1.2 Motivation for the study

This study focuses on the impacts of the Girinka program on food security in Bugesera District of Rwanda because cattle are believed to contribute to the improvement of the quality of life (Holman et al., 2005). Furthermore, Randolph et al. (2007) and Fleming and Rae (1994) state that livestock contributes to food and nutritional security by offering milk and milk products that contain most of the dietary needs for an active and healthy life, and manure that increases crop production resulting in food security. One local resident in this study highlighted during the pre-fieldwork visits that in 2000 there was a severe famine in Bugesera called Kinga umwuzukuru araje caused by drought and it persisted until 2006.

Also, according to the World Food Program (WFP, 2012: 81):

The high dependence on agriculture coupled with hilly topography and high annual precipitation rates, overexploitation of the natural environment and farming methods that are ill-adapted to steep slopes result in climate related disasters such as rainfall deficit (perceived as drought), torrential rains and floods, being the main disasters suffered by the Rwandan population.

In particular, the Republic of Rwanda (2006) states that from 2005 to 2006 prolonged droughts impacted severely on harvests which resulted in some Districts being severely food insecure, needing immediate assistance (Republic of Rwanda, 2006). One of immediate interventions was the implementation of the Girinka program in 2006 by the Rwandan Government that had poverty alleviation as its main objective (Kim et al., 2013).

After the implementation of Girinka program, research showed some improvement in food security. For example, the WFP-Rwanda (2013) reports that the results of the survey on food security carried out in 2012 shows clear improvement in food security in Rwanda compared to the previous similar surveys carried out in 2006 and 2009. Also, in May/June 2011, the Food Security and Nutrition Monitoring System (FSNMS) survey carried out around the country indicated some improvement in food security in several areas of the country including Bugesera District (Famine Early Warning Systems Network - FEWS NET, 2011). This can be mainly the result of the Girinka program because it plays a significant role in food security by providing food (milk, meat and milk products) and soil fertilizer (manure) that increases crop production (Fleming et al., 1994); (Henerica et al., 2011) and (Kim et al., 2013). Furthermore, according to Stichting Nederlandse Vrijwilligers (Netherlands Development Organization) (SNV, 2008), in Rwanda approximately 62% of pastoralists' income are derived from livestock rearing.

This study focuses on the Girinka program as a climate resilience strategy for food security using Bugesera District as a case study because Bugesera is among Districts that received many Girinka cows. It is the third District, after Gatsibo and Gicumbi, to receive many Girinka cows. From 2006 to 2010, Gatsibo received 2 094 cows, Gicumbi 2 074 cows and Bugesera 1 811 cows (Ntanyoma, 2010). Also, according to SNV (2008), the Eastern Province where Bugesera District is located has more than 49% of all the cattle population in Rwanda. According to Umworozi (2013), Bugesera District has implemented many strategies to improve the productivity of the cattle. For example there is a program of artificially

inseminating all cows in the District and, at the beginning, 2 940 cows have been inseminated. Semen to artificially inseminate cows are taken from good breeds of bulls found in the animal husbandry center of the Government of Rwanda (Umworozi, 2013). Another strategy is the initiation of a livestock insurance scheme implemented in order to acquire veterinary assistance in case of diseases which has been initiated in three sectors (Ruhuha, Nyamabuye and Ngeruka) (Umworozi, 2011). Cattle keepers are being sensitized to join livestock insurance scheme and farmers' participation to the scheme in the first three sectors is 70% (Umworozi, 2011).

Also, according to Mutimura and Everson (2011), the adoption of a zero grazing system by the Government of Rwanda in order to keep and solely feed all domestic animals in a shed in also promoted and this system is dominant in Bugesera and Nyamagabe Districts. In Bugesera 78.4% of all households raise some type of livestock and this percentage is above the national level which is 68.2% (NISR, 2011). The Republic of Rwanda (2012) states that compared to other regions of the country, Bugesera is the most affected by climate change and that it is characterized by a very hot climate with excessively prolonged droughts.

While there is general recognition of the importance of the Girinka program in improving food security among poor households, to the best of the researcher's knowledge no study has been conducted to also include a critical examination of the program's climate resilience properties from a household perspective. Thus, this empirically-based research using Bugesera District as a case study is an important contribution to assess poverty alleviation intervention in Rwanda that is aimed at improving food security levels. The results of this assessment will provide recommendations on how to improve the Girinka program in terms of both food security and climate resilience.

1.3 Research aim, objectives and questions

1.3.1 Aim

The overall aim of this research is to investigate the role of the Girinka program in poverty alleviation in the Bugesera District of Rwanda. Specifically, the aim of this study is to assess the Girinka program beneficiaries' livelihoods in Bugesera District and particularly the

impacts of the Girinka program on these livelihoods and food security, and to establish the relationship between Girinka program and climate resilience in the Bugesera District of Rwanda.

1.3.2 Objectives

- To assess the impacts of the Girinka program on increasing food nutrients (especially milk and related products), crop intensification in terms of manure use as source of fertilizer and the production of biogas energy.
- To examine the impacts of the Girinka program on livelihood strategies (including adaptation and coping strategies in relation to drought) at the household level, including income generating activities.
- To examine the perceptions and concerns of households towards the Girinka program.
- To assess the knowledge levels of households towards the benefits of having at least one cow and to examine which of these benefits are derived by beneficiary households.
- To assess the impact of the Girinka program on climate resilience.
- To forward recommendations based on findings on how to improve the Girinka program.

1.3.3 Key research questions

The primary research question is: What is the role of the of the Girinka program in poverty alleviation in the Bugesera District of Rwanda, specifically in relation to beneficiaries' livelihoods and food security, and what is the relationship between the Girinka program and climate resilience in the Bugesera District of Rwanda?

- What quantity of milk does the Girinka program cow provide to its beneficiaries per lactation period? What quantity of milk is consumed at household level and what quantity is sold? If sold, at what price the milk is sold? What milk products are consumed at household level?

- What is the quantity of manure that the Girinka program cow provides to its beneficiaries? How much of manure is used at the household level and how much is sold? Do beneficiary households use cow dung for energy purposes? If so, how much is used?
- What are the impacts of the Girinka program on livelihood strategies at the household level, including the impacts on income generating activities as well as adapting and coping with drought (that is, contributing to climate resilience)?
- What are the household perceptions regarding the advantages and the disadvantages of the Girinka program?
- How knowledgeable are households about having at least one cow and the Girinka program in particular?

1.4 Chapter outline

The second chapter gives the reader the overview of existing literature relevant to the topic under study. This includes a discussion of the Sustainable Livelihoods Framework (SLF) that guides the study. Chapter three provides the background information of the case study by giving its biogeophysical structure and socio-economic status. It also describes the methods that will be used in this study. Chapter four undertakes the data analysis. Finally, the last chapter summarizes the key findings, forwards recommendations and presents concluding comments.

1.5 Conclusion

This chapter introduced brief information on the Rwandan economy and its programs for poverty alleviation, particularly the Girinka program. The chapter has explained the motivation for this study and it presents the research aim, objectives and key questions. Additionally, the overviews of the chapters have been outlined.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides with an overview of existing literature on food security and poverty alleviation strategies including the Girinka program. It also provides an understanding of this research context, particularly cattle, and shows its importance on rural livelihoods improvement.

2.2 Definition of food security

Organizations such as the FAO (1996) and the World Health Organization (WHO, 2011) define food security as when at all times people have physical and economic access to their food preferences that contain their dietary needs for an active and healthy life. According to Rockson et al. (2013:337 cited from Dekker, 2001), “food security is defined as sustained and assured access by all social groups and individuals to food adequate in quantity and quality to meet nutritional needs to live an active and healthy life”. Bickel et al. (2000:6) also define food security as “access by all people at all times to enough food for an active and healthy life”. According to Bickel et al. (2000:6), food security includes at a minimum:

The ready availability of nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).

Cafiero (2013:4-5) also reveals that food security exists “when all people at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. However, Cafiero (2013) further reveals that the message of this definition is that food security will never be achieved in practice. According to Cafiero (2013), qualifications such as “all people at all the times” or “to meet their dietary preferences” determine the impossibility of a complete monitoring (Cafiero, 2013). Also, Maxwell et al. (2013) reveal that food security needs to be defined again. They state that the “holy grail” of food security measurement would be a single

measure that is valid and reliable, comparable over time and space, and which captures different elements of food security. Despite these debates, a useful definition of food security that frames this research is that provided by the Food Security Network (2012:2) who state that there is food security when “all people at all times have physical and economic access to adequate amounts of sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”.

Gregory et al. (2005) state that food is produced, processed, prepared, distributed and consumed through biogeophysical and human environment interactions which result in food systems that promote increased food security. Food systems include food access, food availability and food utilization (Gregory et al., 2005). They assert that food access means food affordability, allocation and preference; and that food availability includes food production, distribution and exchange while food utilization encompasses good preparation of food before its consumption. FAO (2011 cited in the International Food Policy Research Institute - IFPRI, 2012:9) defines “food deprivation or ‘undernourishment’ specifically as the consumption of fewer than about 1 800 kilocalories a day; the minimum that most people require to live a healthy and productive life”. The above discussion reveals that food security has several aspects which are complex and interrelated. This study adopts a holistic approach which attempts to examine the various components in relation to the Girinka program impacts on beneficiary households.

Climate and demographic changes, poor policies and institutions are driving natural resource scarcity in ways that threaten food production and the environment on which it depends such as water, land and energy (Grebmer et al., 2012). Some sub-Saharan and South Asian countries still have levels of hunger which are ‘extremely alarming’ or ‘alarming’, such as Burundi and Eritrea in sub-Saharan Africa which are characterized by extreme hunger (Grebmer et al., 2012). According to Grebmer et al. (2012:7), the Global Hunger Index (GHI) which is presented in Table 2.1 is a tool designed to measure and track hunger globally, by region or country and GHI, according to IFPRI (2012:7) combines three equally weighted indicators in one index:

- **Undernourishment:** the proportion of undernourished people as a percentage of the population (reflecting the share of the population with insufficient caloric intake).

- **Child underweight:** the proportion of children younger than age five who are underweight (that is, have low weight for their age, reflecting wasting, stunted growth, or both), which is one indicator of child under malnutrition.
- **Child mortality:** The mortality rate of children younger than age five (partially reflecting the synergy of inadequate caloric intake and unhealthy environment).

Table 2.1 Global Hunger Index

GHI	≤ 4.9	5.0-9.9	10.0-19.9	20.0-29.9	≥ 30.0
Indication	Low	Moderate	Serious	Alarming	Extremely Alarming

Source: Grebmer et al. (2012:8-9).

Table 2.1 shows different levels of GHI. The GHI is considered low when it is ≤ 4.9 and it is considered moderate when it is between 5 and 9.9. The GHI becomes serious when is between 10 and 19.9 and it becomes alarming when it is between 20 and 29.9. When the GHI is ≥ 30 it is considered as extremely alarming.

2.3 Global food security

The discussion in the previous section highlights the key aspects of understanding global hunger. This section provides a global overview of these components, focusing specifically on regional dynamics in developing contexts. All parts of the world are threatened by the global crisis and the number of food insecure people is projected to increase in 70 developing countries; particularly in sub-Saharan Africa where the number of food insecure people is highest (Shapouri et al., 2009). Mock et al. (2013) state that 870 million people worldwide are affected by food security and nutrition problems. They also show that food security is threatened by climate change, environmental degradation, war, energy policies and water use practices. For example, drought affecting cereals in Russia combined with energy policies in the United States could affect global cereal prices (Mock et al., 2013). According to Luan et al. (2013:395), in the last half-century Africa's capacity to meet its own population's demand for food has declined with "Africa's self-sufficiency declining from almost 1.0 in 1961 to 0.8 by 2008". Food insecurity in developing countries increased nearly 11% or by about 80 million people between 2007 and 2008 and this deterioration in food security was mainly

caused by limited purchasing power of the poor due to rising food inflation and food production shortfall (Shapouri et al., 2009). Cao and Li (2013) suggest that in the next 5 to 10 years developing countries will face greater challenges in meeting an ever increasing demand for animal protein products. They further state that livestock products impact on natural resources and climate change. Thus, research efforts should focus on technologies that enhance livestock production and also ensure environmental sustainability (Cao and Li, 2013). Agricultural development is imperative for food security and for reducing poverty and starvation to build and maintain a stable society (Cao and Li, 2013). The overview of the global food security is discussed below:

Asia: Rapid population expansion, urbanization and improvement of lifestyles for the people of Asia have resulted in more diversified dietary patterns (Cao and Li, 2013). Afghanistan and North Korea were the most vulnerable regions because of political problems (Shapouri et al., 2009). Afghanistan's agricultural sector has been influenced by political conflict that devastated the country over the years and periodic weather-related shocks, including periodic droughts, contributed to overgrazing by livestock leading to soil erosion (Shapouri et al., 2009). Forty percent of Afghanistan's cultivable land has been deteriorated because of ongoing war and lack of maintenance that caused the grain production declining by 37% (Shapouri et al., 2009). The break-up of the Soviet Bloc together with an increase in natural disasters dried up much needed financial support and resulted in the collapse of the North Korean economy in the 1990s (Shapouri et al., 2009). Between 1995-1996 and 2007-2008 the number of food insecure people doubled and the UN WFP reported in 2008 that 40% or about 9 million of North Korean people were in need of emergency food aid (Shapouri et al., 2009). Shapouri et al. (2009) assert that Bangladesh had improved its social and economic situation since the early 1990s that has seen remarkable achievements in poverty reduction. However, they indicated that the location of the country in the flood plains of three large rivers has meant that in some years up to 40% of the country was flooded and that caused severe damage to crops and infrastructure despite the government efforts to protect these areas against floods (Shapouri et al., 2009). However, both Southeast Asia and developing East Asia have lowered food insecurity in the past two decades since both regions moved from negative food security gaps to positive ones (Timmer, 2013). He also classified Asia in four categories according to food security. The first category is the "rich Asia" which contains Japan, South Korea, Taiwan, Brunei and Singapore. Although, these countries are experiencing political tensions, food security is not threatened because global food markets

remain reasonably open. Secondly, the “giant Asia” includes China and India which are major consumers and producers of rice. The third category is “emerging Asia” which comprises of Malaysia, Thailand, Indonesia, Philippines and Vietnam. Most of these countries have abundant land and are attracting large-scale investments and development in food producing sectors. The last category is “least developed Asia” which includes Myanmar, Cambodia, Laos, Papua New Guinea and Timor Leste. Food security in these countries is still a daily concern for most of the population and this leads to regional or global consequences (Timmer, 2013).

Latin America and Caribbean (LAC): The cut in commercial import capacity due to declining terms of trade increased the number of food insecure people in the LAC region and this increase was 14% between 2007 and 2008 (Shapouri et al., 2009). Haiti is the poorest country in this hemisphere due to natural disasters with food aid remaining important in this country (Shapouri et al., 2009). Additionally, it is the only low-income country in this region while Jamaica is the only upper middle income country and all other countries in this region are classified as lower middle income (Shapouri et al., 2009). In 2008, some LAC countries such as the Dominican Republic, Ecuador, Honduras, Jamaica and Nicaragua experienced a decrease in food consumption that resulted in an increase in number of their food insecure people (Shapouri et al., 2009). According to Shapouri et al. (2009), 80% of the Haitian population was estimated to consume less than nutritionally required levels for food security due to the rising rice and fuel prices. Stable export revenues, capital inflows, grain prices and adequate domestic production show little change in food security in Ecuador and Dominican republic in 2009 (Shapouri et al., 2009). According to Diaz-Bonilla et al. (2013), in the last century, agricultural and food production in LAC countries has grown faster than in developed countries and Africa, but slower than Asia. However, in 2008/2009, LAC countries faced negative impacts of both climate events and global financial crisis (Diaz-Bonilla et al., 2013). The above discussion indicates that in Latin America and LAC instances of food insecurity is increasing and is linked to global processes and changing climate.

North Africa: Despite higher food prices and consequently higher import bills, the North Africa was the most food secure region in 2009 compared to Asia, Latin America and the Caribbean, Commonwealth Independent States and sub-Saharan Africa (Shapouri et al., 2009). Food consumption in North Africa was more than 3 000 calories per person per day in 2009, which are more than nutritional target calories (Shapouri et al., 2009). However,

Libya's civil war paralyzed its economy and this affected not only the North African countries, but also has had global economic implications (Santi et al., 2011). For example, the oil prices increased considerably and this affected the price of other commodities such as gold and food as well (Santi et al., 2011). The Libyan crisis affected significantly Tunisia's economy because various Libyan-Tunisian bilateral economic relations stopped. Different joint projects had been agreed upon such as Tunisia and Libya's Ras-Jedir border development area, the construction of a new pipeline to transport gas between Libya and Tunisia and the National currency convertibility between the two currencies (Santi et al., 2011). Libya's civil war also affected the North Africa agro-processing industry (dairy products, pasta and tomato paste) because Libya was an important trading partner for the North African countries, particularly Tunisia (Santi et al., 2011). Masie (2013) expects that economic growth for the Middle East and North Africa will decrease from 4.2% to 3.7% in 2013 with political instability being a driver of the slowdown.

Sub-Saharan Africa: Sub-Saharan Africa is the most food insecure region in the World. It counts a quarter of the population of 70 developing countries and 47% of food insecure people of all those countries (Shapouri et al., 2009). In 2003, the African continent was the continent receiving most food aid and 60% of WFP's work took place in Africa (Clover, 2003). According to Clover (2003), Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) and economic policy failures are the complex and enormous crises which exacerbate challenges on the African continent. Food insecurity was "affecting 38 million people in Africa" in 2003 and it was facing the "outright risk of famine with 24 000 dying from hunger daily" (Clover, 2003:6). Africa had 25 food insecure countries among 39 worldwide in 2003 (Clover, 2003). Sub-Saharan Africa is dependent on the import of grain and it receives about four million tons of food aid in grain equivalent each year (Shapouri et al., 2009). Famine in Southern Africa is mostly caused by natural hazards and conflicts. The high variability in rainfall and temperatures interact with violent and long lasting conflicts which cause large-scale suffering and death, with the Democratic Republic of Congo (DRC) being one of the most vulnerable countries (Clover, 2003). In 2011, a severe famine in several areas of south Somalia was declared by FEWS NET and the Food Security Nutrition Analysis Unit for Somalia (FSNAU) in collaboration with UN FAO (Maxwell et al., 2012). This was mainly caused by well-recognized cycles of el Niño and la Niña effects on rainfall and it lasted the latter half of 2011 and into early 2012 (Maxwell et al., 2012). According to Ververs (2012), the year 2011 had been the driest period in the Eastern Horn of

Africa due to both natural (la Niña) and person-made conflicts. However, the 2013 GHI which reflects data from the period 2008-2012 shows that sub-Saharan Africa improved and its GHI score is now lower than south Asia (Grebmer et al., 2013). Rwanda is among top ten countries in terms of improvements in GHI scores since 1990 (Grebmer et al., 2013).

The above discussion indicates that there are variations in terms of global food insecurity regionally in relation to developing contexts. Furthermore, while some regions and specific countries are doing better, generally food insecurity is increasing. This is related to socio-economic challenges and natural disasters, including those linked to changing climates. It is important to note that Africa (especially Sub-Saharan Africa), is the most food insecure part of the world within which Rwanda is located.

2.4 Sustainable Livelihoods Framework (SLF)

After extensive discussions about definitions of livelihood among academics and development practitioners, livelihood is defined as the ways and means of making a living (Nasrin, 2013). Chambers (1988) defines livelihoods as adequate stocks and flows of food and cash to meet basic needs. Livelihood generation is defined as the bundle of activities that people undertake to get their basic needs or surpass those (Niehof and Price, 2001). According to Scoones (1998:5) *“a livelihood comprises the capabilities, assets (including material and social resources) and activities required for a means of living”*. The term ‘sustainable livelihoods’ relates to a wide set of issues which encompass much of the broader debate about the relationship between development, poverty reduction and environmental management (Scoones, 1998). A livelihood is sustainable when it can cope with and recover from stresses and shocks as well as maintain or enhance its capabilities and assets on a long-term basis (Scoones, 1998), (Chambers, 1988) and the Center for Financial and Management Studies (CFMS, 2012). Niehof and Price (2001) state that the inputs to the livelihood system are resources and assets and resources can be seen as immediate means needed for livelihood generation.

According to Niehof and Price (2001:13), several types of resources are distinguished as follows:

- *Human resources, which are needed to provide productive labor, and which consist of cognitive skills, psychomotor skills, emotional skills, social skills and physical strength.*
- *Material resources such as land, money, livestock, agricultural tools, space and facilities such as household water supply, means of communication and transport.*
- *Environmental resources divided into resources in the physical environment (both natural and person-made) and resources in the socio-institutional environment (such as markets and kinship networks).*

Assets or resources are “defined as a wide range of tangible and intangible stores of value or claims to assistance” (Swift, 1989 cited in Niehof and Price 2001:14) and are used interchangeably in this study given the above definition. They further state that sometimes assets can be converted into resources in situations of crisis or when necessary in day to day living. Experience can be an asset but also, it becomes a resource when people apply it to a new situation. Livestock is an asset when it is kept for its value and it can be converted into money when necessary and it is also a resource when it is used in agricultural and domestic production (Randolph et al., 2007) and (Niehof and Price, 2001). Biodiversity at farm level is an asset and it becomes a resource when it is purposively used in agricultural and food production (Niehof and Price, 2001). Time is an important factor in resources use and management because it can reflect some of the gender differences in various activities.

Niehof and Price (2001) state that liability is the opposite of an asset. They provide examples such as good health is an asset; bad health is a liability, while labor (for which you need good health) is a resource. They further suggest that this opposition between asset and liability might be an important perspective in rural sub-Saharan Africa where so many households are affected by the AIDS-pandemic.

According to Serrat (2008), assets or capital are conventionally divided into five categories:

- Human capital that includes skills, knowledge, experience and capabilities to accomplish different tasks.
- Natural capital that includes all natural resources such as water, land, forest, minerals, pastures, etc.
- Physical capital refers to physical tools such as food, stocks, etc.

- Social capital refers to the relationship between people.
- Financial capital refers money and money utilization (savings and credits).

However, CFMS (2012) notes that in conventional economics factors of production or assets are subdivided only into natural, physical, human and financial capital and do not have a social capital component which is also referred to as ‘institutions’. Resources are grouped according to their availability and accessibility, and according to their nature (material or immaterial) and the environmental level biodiversity is either natural or the result of human interventions (Niehof and Price, 2001). This is illustrated in table 2.2.

Table 2.2 Resources and assets in livelihood generation

	Personal level	Household level	Environmental level	
			Natural	Person-made
Material	Physical strength, health, talents	Space, income, tools, buildings, livestock	Land, soil, water, biodiversity	Infrastructure, biodiversity
Non-material	Skills, education, gender, experience, capabilities	Experience, knowledge, management, information	Kinship	Market, church, social/ political institutions, support networks

Source: Niehof and Price (2001:15)

What constitutes a household and the main challenges faced at the household level are important to consider. A household is defined as “a co-residential unit, usually family based in some way, which takes care of resources management and primary needs of its members” (Niehof and Price, 2001:19). Furthermore, Niehof and Price (2001) state that agriculture is the most important kind of livelihood in rural households. According to CFMS (2012), a household is defined as a nuclear family that lives under the same roof, manages a joint budget and pools its resources in pursuit of common goals. Resources and assets needed in farming are found in the environment and disasters such as flooding and drought destroy the environmental resources which affect rural livelihoods negatively (Niehof and Price, 2001). They also assert that epidemic disease such as HIV/AIDS and Malaria also affect rural livelihoods by killing or making weak adult people who become unable to work and provide basic household needs. In the case of insufficient assets and resources, households that avoid or resist stress and shocks are considered to have sustainable or secure livelihoods while households that cannot cope with stress and shocks without being damaged are extremely

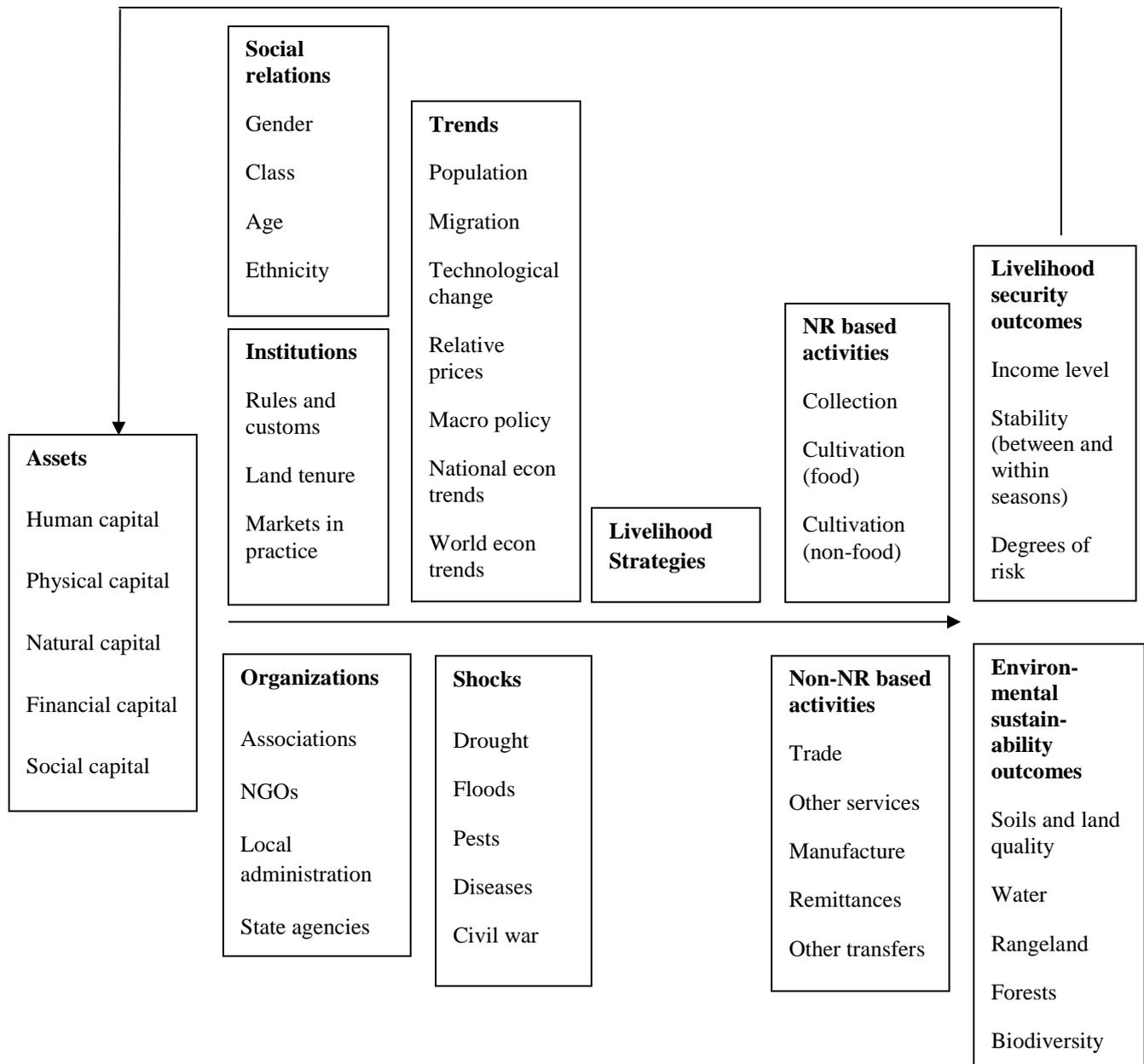
vulnerable and households that can use different strategies to cope with stress and shocks are vulnerable (Niehof and Price, 2001). In vulnerable households children are required to work and attend school less while in extremely vulnerable households, children suffer nutritionally (Niehof and Price, 2001).

The gender dimensions of household dynamics and vulnerability are also important to consider. There is great variation in the sexual division of labor in what men and women have as tasks within a household and psychological attributes of men and women are also culture bound (Niehof and Price, 2001). According to Niehof and Price (2001:21), *“in New Guinea only women plant and tend sweet potatoes and only men plant and tend yams. Women who attempt to plant a male crop are subject to physical violence while men who attempt to plant and tend a female crop are subject to social ridicule”*. CFMS (2012) indicates that women tend to be more vulnerable than men within poor households; they have access to fewer assets, adopt different strategies from men and pursue different outcomes. Women’s livelihood strategies focus on meeting the basic needs of their children and the vulnerability of women is often matched by the vulnerability of their children because they share the responsibility within the household (CFMS, 2012).

The CFMS (2012) states that the livelihoods framework attempts to unpack the dimensions of an individual’s livelihood, the strategies, outcomes and associated opportunities and constraints experienced. The conceptual components of a livelihood and the influence upon it are demonstrated in figure 2.1.

Figure 2.1 A diagram illustrating a framework for micro policy analysis of rural livelihoods

A Assets	B Access	C context	D Strategies	E activities	F outcomes
Livelihood platform	Access modified by	In changing context	Resulting in	Composed of	Leading to



Source: CFMS (2012)

Column A in figure 2.1 shows five categories of assets. Column B shows the key influences of access to assets. Social relations, institutions and organizations can affect an individual's access to assets. Columns D and E represent the complex and diverse livelihood strategies and activities. Agriculture and other natural resource-based activities are very important for

rural livelihoods (CFMS, 2012). Column C shows the vulnerability context of livelihood strategies where both livelihood and asset vulnerability can exist. Trends and shocks respectively represent gradual and sudden change that can have harmful effects on livelihood strategies. Increasing or decreasing shocks affecting people or people's livelihoods may make up trends in a community. For example, the increase of morbidity and mortality from HIV/AIDS may be a trend but the onset of HIV/AIDS is a shock to people affected by it (CFMS, 2012). Column F presents the outcomes of livelihood strategies which are divided into livelihood security and environmental sustainability outcomes. Improved access and accumulation to assets promote livelihood security and is therefore considered a critical outcome (CFMS, 2012).

According to Kent and Dorward (2012), livestock assets have diverse roles in risk management for rural households. Livestock assets play a big role in reducing vulnerability and facilitating accumulation as well as generating incomes within the household (Kent and Dorward, 2012). Thus, cows are assets and play a substantial role in poverty reduction, particularly in rural areas. The collection and sale of cow products enable poor households to accumulate assets which can result in more secure livelihood practices, such as educating children, increased investment in income generated activities and purchasing farm implements (Kent and Dorward, 2012). Cows are physical assets that interrelate with all other key livelihood capital assets which is illustrated in Figure 2.3 in this chapter. They can also become a liability when people expend more money for keeping them than the income that they derive. This study examines these aspects in relation to the Girinka program.

2.5 Role of natural resources for food security

Natural resources are central to rural household livelihoods in developing countries (Hunter et al., 2013). Some of the main natural resources that need to be considered are energy sources and water supply which is discussed in this section. Studies carried out in South African rural villages with readily available electricity demonstrated that over 90% of households use fuel wood as primary energy source because of the cost of electricity and appliances (Hunter et al., 2013). According to Rosegrant et al. (2002), water is essential for different purposes: safe drinking water is important for health (human being and livestock), it is essential for household uses and industrial production, and the water used in irrigation is

very important for food security. In 2002, about 250 million hectares were irrigated and this was nearly five times more than at the beginning of twentieth century and water consumption (domestic, industry, livestock) is projected to increase (Rosegrant et al., 2002). Water is an integral part of the natural environment because it gives life to plants and animals; and healthy rivers, lakes and oceans provide recreational opportunities and thriving wildlife (Rosegrant et al., 2002). Water consumption is a significant component of economic processes and creating built environments, especially in relation to industrial demands and providing energy (Omer, 2008). However, water supplies are under stress globally because of increasing demands, water contamination and pollution, and changing climates (Strzepek and Boehlert, 2010). They assert that this will result in increased competition for water which will affect food systems: “Although the agricultural system will need to provide more food for a growing and wealthier population in decades to come, increasing demands for water and potential impacts of climate change pose threats to food systems” (Strzepek and Boehlert, 2010:2927). Thus, protecting and securing water resources are critical for food security and livelihoods more generally. The sustainable management and use of water in agricultural practices will ensure food and environmental security (Viala, 2008).

The FAO (2013) states that forests contribute to food security and nutrition in different ways. They serve as fuel wood, especially in rural area, and agro-forestry serves as mitigation for erosion that leads to the crop yield increase. In the arid and semi-arid areas trees serve as source of fodder for livestock (FAO, 2013). According to Moroni (2013), forest management plays a big role in GHG mitigation because forests exchange large amounts of CO₂ within the atmosphere. Moroni (2013) further states that forests could be managed to slow the accumulation of CO₂ in the atmosphere which may involve reducing CO₂ emissions from forests or enhancing forest CO₂ absorption. Natural resources, particularly forests and water resources, are key assets.

2.6 Sustainable agriculture and food security

Khan et al. (2008) state that food security is strengthened by sustainable growth in agricultural productivity and improved linkages with global food suppliers. In poor and developing countries in particular, the agricultural sector is among the largest sources of income and employment and therefore plays a central role in development (Dethier and

Effenberger, 2011). According to Bread for the World (2013), the poor performance of the agricultural sector in sub-Saharan Africa has been one of the major barriers to its development. The World Bank (2008 cited in Bread for the World, 2013:1) argues that failure to include agricultural sectors in development plans, especially in vulnerable states, increases risk and instability. According to Bread for the World (2013), Rwanda is good example that demonstrates the role of the agricultural sector in rebuilding and improving socio-economic conditions, for example revenue generated from coffee exports increased from zero to \$8 million between 20001 and 2006 due to the technical and financial assistance provided by the United States Agency for International Development – USAID.

Maqsood et al. (2013:1) state:

The use of natural resources to meet people's requirements, currently and in the future, is sustainable agriculture. In order to uphold the growing rural and urban population in the developing world, considerable development in efficiency of agricultural systems is required. Intensification of current production systems via increasing cropping intensity and by increased use of external inputs is the only way to increase agricultural production.

However, soil degradation is affecting a major portion of currently cultivated land (Maqsood et al., 2013). According to Maqsood et al. (2013), soil deterioration in soil quality is due to erosion, nutrient depletion, desertification and salinization which are caused by activities such deforestation and overgrazing. Arable land has come under increasing pressure because agricultural areas became more crowded and as soils become more degraded, agricultural yields are at risk of serious decline that leads to food insecurity which put the livelihoods of millions of subsistence farmers at risk (Maqsood et al., 2013). This, as indicated by Lambin and Meyfroidt (2011), is also linked to land use changes and land scarcity. Integrated Soil Fertility Management (ISFM) is important to raise improve soil fertility, productivity levels and maintain the natural resource base (Gentile et al., 2013). Progressive and steady modification of natural resources can built up soil fertility and “the ISFM is a viable tool to rebuild degraded soils, vegetation and water by crop following, grazing, selecting crop species, deep ploughing to break the plough pan, sub soiling, organic fertilizing, transferring crop residues and fodder” (Maqsood et al., 2013:1).

2.7 Rural Development, Agriculture and Food Security

According to the European Union (2012:15), there is no universally accepted definition of a rural area because of the following main reasons:

- *The various perceptions of what is (and what is not) rural and of the elements characterizing “rurality” (natural, economic, cultural, etc.);*
- *The inherent need to have a tailor-made definition according to the “object” analyzed or the policy concerned; and*
- *The difficulties to collect relevant data at the level of basic geographical units (administrative unit, grid cell, plot, etc.).*

van der Ploeg et al. (2000: 391) indicate that it is different to conceptualize what constitutes rural development because of ‘multi-level, multi-actor and multi-faceted’ processes. According to Medina (1983), rural development is a mediating process which tackles the problems of rural areas with a will to change and the aim of a fundamental transformation in the living conditions of the local inhabitants and in the economic, political and social structures in order to enable the rural population to take a full part in the activities of national life. Rural development is regarded as one strategy of global development, of which it is an important part and its aim is summed up as equal and appropriate access for rural populations to the benefits of development (Medina, 1983).

Agricultural activities contribute to income generation and employment in rural areas and can provide food at reasonable prices in urban areas in developing countries which can lead to poverty reduction and income growth (Dethier and Effenberger, 2011). Vermeulen et al. (2012) assert that agriculture and food security are key sectors for intervention under climate change in rural areas. According to Vermeulen et al. (2012), the achievement of food security through agriculture in the context of climate change depends on two options to support farmers, particularly smallholder farmers: (1) improved adaption towards the impacts of climate change over time, and (2) more efficient management of agricultural risk brought about by increased climate variability and extreme weather events. The establishment of incentives, investment in technology and improved monitoring systems enhance the mitigatory potential of smallholder farms (Vermeulen et al., 2012). Food systems under threat due to the impacts of climate change need multi-disciplinary (Vermeulen et al., 2012).

According to Seré et al. (2006), agricultural biotechnology can be used as mitigation to climate change. Advances in agricultural biotechnology has the potential to enhance plant growth and development regimes, resistance to pests and increased tolerance of droughts as well as the development of vaccines for livestock, reducing the impact of diseases (Seré et al., 2006). Thus, biotechnological development can improve agricultural production thereby enhancing food security and promoting rural development.

A few country level case studies, discussed below, are illustrative of reforms and interventions in the agricultural sector specifically and in relation to rural development more generally. According to Christiansen (2009), in China, rapid urbanization coupled with increased production of food resulted in the loss of arable land and environmental degradation. Reforms focused on social and economic improvement to decrease the gap between urban and rural areas with the emphasis on using surplus rural labor and increasing local consumption (Christiansen, 2009). The expansion of small towns and villages led to the development of social equity and long term stability of rural livelihoods through agricultural and non-agricultural rural employment (Christiansen, 2009). In the early 2000s, China's local governments initiated basic social assistance schemes in rural areas such as provision of a basic living allowance and a simple health insurance to those who were unable to maintain an income (Christiansen, 2009). This program is similar to "Mutuelle de santé" which is the mutual health insurance scheme applicable in Rwanda. This program includes all categories of people such as the rich as well as the poor, the young as well as the old, the urban as well as the rural people and the Government of Rwanda pays for the vulnerable and the poorest people (Bulletin, 2008). Those who are better off do not directly benefit but contribute to the program to assist those in need.

Khan et al. (2008) asserted that China's food security was impacted by numerous socio-political factors such as increased population growth, rapid urbanization, water scarcity and instability within the global energy and food markets. These issues were addressing by ensuring that food security was prioritized in the political agenda (Khan et al., 2008). Khan et al. (2008: 350) suggest that:

China must also make unremitting policy responses to address the loss of its fertile land for true progress towards the goal of national food security, by investing in infrastructure such as irrigation, drainage, storage, transport, and agricultural research and institutional reforms such as tenure security and land market liberalization. The links between water and other development-related sectors such as population, energy, food, and environment, and the interactions among them require reckoning, as they together will determine future food security and poverty reduction in China. Climate change is creating new levels of uncertainty in water governance, requiring accelerated research to avoid water-related stresses.

China plans to increase crop production by 2% annually to 2030 and the achievement of this will require increased research into soil management, agronomy and the continued genetic improvement of crop varieties (Skydmore, 2012). China uses 35% of the total global chemical fertilizer consumption and 14% of the world's pesticides (Skydmore, 2012).

In Vietnam, rice is closely linked to the country's food security and rural income which is a key policy issue. This ensures that rice farmers are compensated for their produce, rice export controls implemented, storage facility improvements (Bonnin and Turner, 2012). A constant preoccupation of the central government concerns appropriate profit margins for farmers' rice, along with apprehensions over rice exports, maintaining rice storage systems, brand recognition, and ensuring food security and incomes for rural producers (Bonnin and Turner, 2012).

According to Ludi (2009), in most African economies agriculture is the backbone and contributes significantly to Gross Domestic Product (GDP), foreign exchange and allows for the generation of savings and taxes. In addition, about two-thirds of manufacturing value-added is based on agricultural raw materials (Ludi, 2009). "Improvements in agricultural performance have the potential to increase rural incomes and purchasing power for large numbers of people to lift them out of poverty" (Ludi, 2009:1). The Rwandan government implemented agricultural reforms in 2009 which targeted organisation and management of land tenure in an attempt to move the rural systems away from subsistence to commercial crop production (Pritchard, 2013).

North Africa is characterized by undependable rainfall, except Egypt where agricultural production is mostly irrigated and therefore much less variable (Shapouri et al., 2009). Farmers in Tunisia benefited from some waived import duties such as less expensive feed imports for the livestock sector as tariffs and policies to ensure food security include incentives to improve it (Shapouri et al., 2009). The Eastern Province of Rwanda is also characterized by unreliable rainfall. Like North Africa, the Government of Rwanda implemented the irrigation program since 2011 in that region. This will be discussed later in this chapter.

Dethier and Effenberger (2011) show that agriculture is gaining popularity in mainstream media due escalating food prices resulting in food insecurity and poverty and is therefore seen as essential to increase food production in developing countries. However, this requires finding viable solutions to technical, institutional and policy issues, for example, improving land markets and extension of credit access (Dethier and Effenberger, 2011).

2.8 Climate resilience strategies and food security

Climate change is a current socio-economic and environmental threat (Somorin, 2010). In Intergovernmental Panel on Climate Change (IPCC) usage, climate change is any climatic change over time due to natural or anthropogenic influences (Parry et al., 2007). The definition of climate change by UN Framework Convention on Climate Change (UNFCCC) is that climate change is in addition to natural climate variability observed over comparable time periods (Parry et al., 2007).

The opportunities to manage agricultural risk due to climate change are yet to be fully exploited (Vermeulen et al., 2012). According to Scherr (1999), reducing poverty and protecting the environment are among 2020 vision initiatives of the IFPRI. The IFPRI synergises divergent schools of thought on these issues to meet future global food requirements (Scherr, 1999). The increase of GHG concentrations in the atmosphere causes disruptions in the climate system such as changes in precipitation that leads to droughts and floods (Somorin, 2010). One third of African people live in drought-prone areas (for example, Sahel, the Horn of Africa and Southern Africa) and several millions of people in Africa suffer regularly from droughts and floods (Somorin, 2010). Gregory et al. (2005) state

that when food systems are stressed, food security diminishes and the main factor that induces food systems stressors is climate change. They further state that other factors in addition to climate change like conflict, urbanization and HIV/AIDS induce such stress. Urbanization also stresses food systems because it causes the loss of arable land for and environmental decline leading to a decrease in food production (Christiansen, 2009).

Ramirez-Villegas et al. (2011) remark that regardless of the many mitigation strategies, climate variability will persist and since agriculture is climate dependent and sensitive food security will be under threat. Temperature has increased by 0.7 °C during the last century, and globally averaged surface temperature is expected to rise by between 1.1 °C up to 6.4 °C by the last decade of the 21st century (Minaxi et al., 2011). This increase in temperature affects rainfall patterns and the availability of water resulting in weather extremes such as droughts and floods (Minaxi et al., 2011). According to Brainard et al. (2009), climate change is a global threat that is especially menacing to the world's poor. As the mean temperature of the Earth rises, the impact of climate change on sources of water and food, and on health and living standards will be greater in those regions that are already struggling (Brainard et al., 2009). Minaxi et al. (2011) state that food security systems in low latitudes face major changes due to climate change and the impact of climate change is high on smallholder and subsistence agriculture. Climate change also affects markets because of large variability in weather patterns leading to changes in the length of growing season resulting in the increase in food prices (Gregory et al., 2005). Supply chain infrastructure are also affected by climate change (for example, floods can destroy roads that help in food transportation) and changes in food systems become severe when these factors act in combination (Gregory et al., 2005).

The environment and ecosystems in Rwanda are degraded by both anthropogenic activities and climate disturbances (Republic of Rwanda, 2006). Rwanda is characterized by accented relief and consequently very sensitive to erosion and landslides that leads to climate hazards (Republic of Rwanda, 2006). Harmful effects and major disasters for Rwanda associated with climate change are floods, landslides and droughts (Republic of Rwanda, 2006). For example, during October-December 1997, Rwanda recorded largely above normal reference pluviometry, and a contrary example is an important low pluviometry registered in March-April-May 2000 and September 2005 until February 2006, followed by prolonged drought that devastated the country and caused famine in some regions such as Bugesera, Umutara,

Kibungo and Butare. Particularly, the September to December farming season did not give any harvest (Republic of Rwanda, 2006).

Mitigation and adaptation are two main strategies to address climate change (Ravindranath, 2007). Davoudi (2009) asserts that the definition of adaptation by the IPCC is the change in natural and anthropogenic systems due to climate change which can induce positive or negative impacts. Climate change impact on food security differs according to regions because the increase in temperature and precipitations that affect world agriculture vary according to regions and the ability to cope with climate change shocks is different (FAO, 2011).

According to Vermeulen et al. (2012), climate change impacts on agricultural systems depend on location and adaptive capacity. Also, Somorin (2010:907) reveal that the UNFCCC states that “climate change is expected to have adverse impacts on socio-economic development of all nations, but the degree of impacts will vary across nations”. In southern Africa, coping strategies are lower than that of other regions like Pakistan, northern Indian and northern China that have the availability and quality of ground water for irrigation (FAO, 2011). Irrigation is the best adaptation to water scarcity and variability because it provides approximately 40% of the world’s food from 20% of agricultural land or about 300 million ha worldwide (FAO, 2011). When drought has affected the agricultural and pastoral livelihoods, it is rehabilitated by seed-pack and fertilizer distribution, ploughing services and row-planting grants, expended livestock water development programs, garden projects aimed at enhancing nutrition, disbursement of general subsidies and loans, and where feasible, incentives for increased livestock sale (FAO, 2011).

Also, agro-forestry is one of the methods that improves food security through controlling soil erosion that involves planting different types of trees that contribute to construction materials, livestock fodder and human food like fruits and nuts (FAO, 2006). Agro-forestry provides biomass in the soil in order to improve soil fertility by carbon sequestration and an increase of soil carbon pool of cropland soils increase crop yield (FAO, 2006). Also, carbon sequestration has the potential to offset fossil fuel emissions by 5 to 15% of the global fossil fuel emissions (FAO, 2006).

According to IFPRI (2010), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), in which Rwanda is included, have adapted various adaptations strategies to climate change in different sectors and developed National Adaptation Programs of Action (NAPAs). NAPAs are documents prepared by Least Developed Countries (LDCs) to identify crucial and appropriate coping strategies which are represented to donors for support (IFPRI, 2010). Research in marginal areas, particularly in developing countries such as Uganda, Tanzania and Kenya, show diversification in livelihood systems to combat the impacts of climate change (Vermeulen et al., 2012). The Republic of Rwanda (2011) defines climate resilience as activities which build the ability to deal with climate variability – both today and in the future. Climate resilience building activities include many existing development investments including those in the agriculture, food security, health, land management and infrastructure sectors (Republic of Rwanda, 2011). It also defines adaptation as additional activities needed to prepare for climate change and mitigation as efforts to limit or absorb gas emissions which contribute to climate change. Rwanda's NAPAs in its PRSP are in different sectors such as crop production, livestock, forestry, health, land and water resources. In relation to livestock, Rwanda is promoting zero-grazing techniques as well as veterinary and phytosanitary services (IFPRI, 2010). This will be discussed later specifically in relation to the Girinka program.

2.9 Rural development in Rwanda

Vermeulen et al. (2012) state that South Asia and sub-Saharan Africa comprise majority of the world's population that suffer from hunger. Sub-Saharan Africa has large rural populations, widespread poverty and extensive areas of low agricultural productivity due to steadily degrading resource bases, weak markets and high climatic risks, and farmers and landless laborers dependent on rain-fed agriculture are particularly vulnerable due to high seasonal variability in rainfall and endemic poverty that forces them to avoid risks (Vermeulen et al., 2012). According to Bread for the World (2013), many of the world's conflicts are caused by inequitable access to land and resources. The leading cause of the genocide in Rwanda (in 1994) was the government's exploitation of scarce land and water resources which led to ethnic divisions in the country. Internal conflicts cause the destruction of physical assets and financial markets, and war activities results in the losses of physical, financial, social and human capital which are often substantial (Tella et al., 2010). The

internal conflicts may leave a legacy of structural poverty that is difficult to overcome as in the case of Rwanda (Tella et al., 2010).

Farmer et al. (2013:1) report:

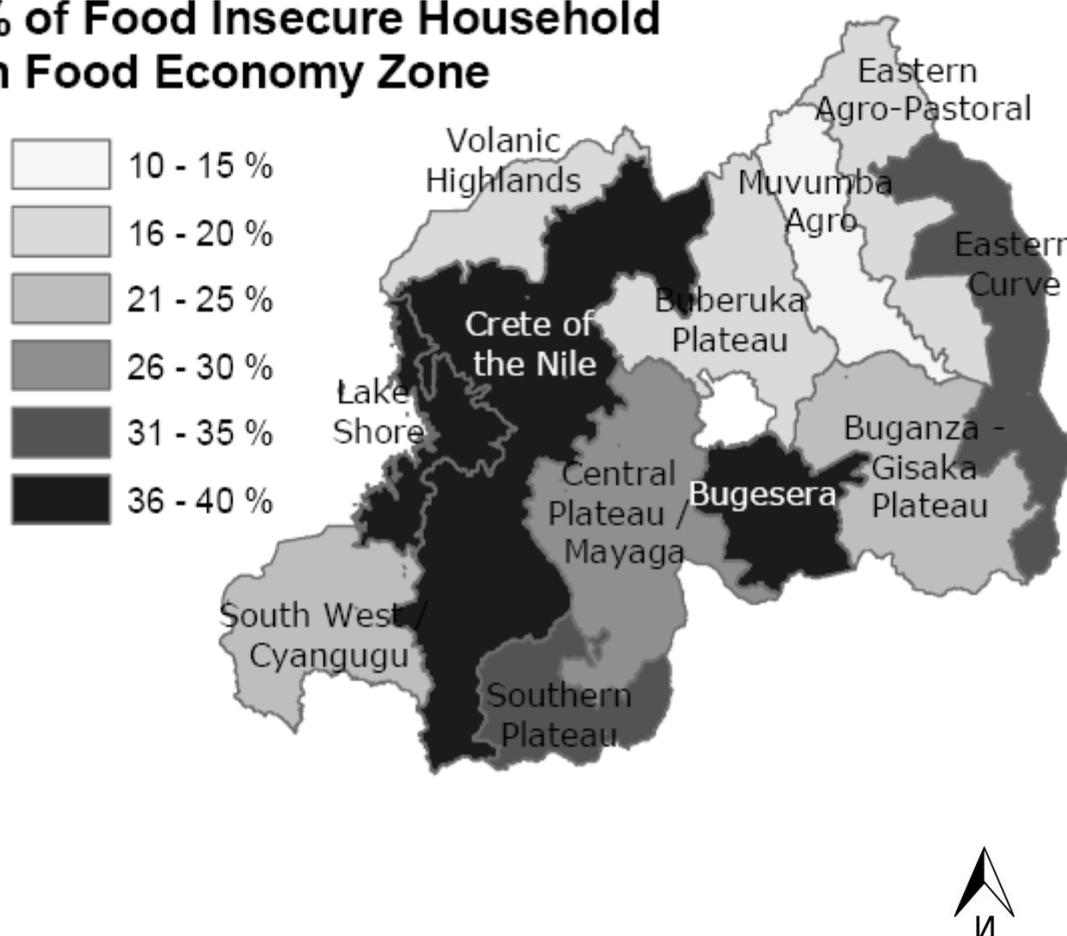
In the immediate aftermath of the 1994 genocide, which claimed up to a million lives and left two million homeless, Rwanda was among the poorest countries in the world. Health and education systems, already weak and limited in reach people before the conflict, lay in ruins; less than 5% of the population had access to clean water; the banking system had collapsed; almost no taxes were collected. Epidemics of infectious disease including AIDS, malaria, tuberculosis and waterborne infectious further thinned the population.

Diao et al. (2010) assert that Rwanda is still suffering from consequences of the 1994 genocide of Tutsis. Human and physical capital were severely destroyed which reduced considerably productivity, household income and government revenue that led to an increase in poverty (Diao et al., 2010). Despite these challenges, the country has made a remarkable transition to peace and development from 2000 to 2010 and the economic policy in this period has focused on poverty reduction and social reconstruction which resulted in GDP growth averaging 7.3% per year between 1995 and 2006 (Diao et al., 2010). According to Booth and Golooba-Mutebi (2012), economic and social development is the only feasible route to overcome the ethnic divisions and violent conflicts of the past which is the case in Rwanda. The livelihoods of 90% of Rwandans rely on agriculture (Wadhams, 2010), hence, to reduce poverty in Rwanda means to improve agricultural and livestock activities. The Rwandan vision 2020 in Rwanda was to reduce poverty and stimulate higher and sustainable economic growth which focused on agriculture and strengthening infrastructure (Diao et al., 2010). The focus on agriculture (particularly on improving agricultural productivity) and infrastructure has been further strengthened, and the distributional effect of growth is seen to matter more with growth over time (Diao et al., 2010). Similar to other countries in sub-Saharan Africa, changes in climatic variability and climatic hazards alter the risk distribution of agricultural or water system yields and prolonged drought would have the greatest impact (Downing, 1997). In 2005-2006 some Districts in Rwanda faced a severe drought that affected three consecutive harvests (Republic of Rwanda, 2006). In response to reports of a deteriorating situation, an EFSA was carried out by the WFP in collaboration with the NISR

in April 2006 in the five most affected Districts of Bugesera, Gisagara, Huye, Kayonza and Kirehe. The results of the assessment indicated that 294 000 people in these districts were severely food insecure, and required immediate assistance (Republic of Rwanda, 2006). Bugesera District is the most affected by drought and it has been characterized by drought for several years. This was confirmed by one of the respondents interviewed in this study who stated that ‘from 2000 to 2006 there was a severe famine in this District caused by drought’.

Figure 2.2 Location of food insecure zones in Rwanda in 2006

% of Food Insecure Household in Food Economy Zone



Source: Republic of Rwanda (2006)

According to Republic of Rwanda (2006), the high proportion of food insecure zones is 28% which is consistent with existing estimates of food poverty and malnutrition. Figure 2.1 presents proportions of food insecure households in food economy zones. The food insecure zone with the highest proportion is Bugesera with 40%, followed by the Crete of the Nile and

the Lake Shore with 37%. The Eastern Curve and the Southern Plateau have 34%, while the Central Plateau has 28%. Other food economy zones have proportions of less than 28% and are not highly food insecure (Republic of Rwanda, 2006).

The impacts of climate change will be felt for several generations despite abatement and adaptation measures (Downing et al., 1997). Rwanda has also implemented adaptation and mitigation strategies to combat climate change and the (Republic of Rwanda, 2011). Supported by some researchers such as Diao et al. (2009) who reveal that increasing farm size is a key for improved incomes in agriculture, Rwanda has implemented a program called “Agasozi Indatwa” or land consolidation in order to increase farm size. According to Diao et al. (2009), increasing farm size allows for mechanization and increased production and higher profitability per hectare. Agasozi Indatwa is one of Rwandan Government’s strategies implemented in agriculture to increase farm yield that consists of land consolidation and cultivation of the same crop in the specific region where that crop is well grown. For example, in Burera District they cultivate potatoes, corns and beans only. This helps to get a larger harvest that can be sold in local and international markets (Berglund, 2012). Irrigation has been prioritized by the Rwandan Government to increase food production for example irrigation schemes rehabilitated by the Rural Sector Support Project (RSSP) and funded by the World Bank, have been launched (New times, 2011).

In this region, the Rwandan Ministry of Agriculture and Animal resources (MINAGRI) also uses runoff from hillsides and valleys to construct valley dams for livestock during summer periods. Rwandan soils are so degraded so that without fertilizers the yield would automatically be poor (New times, 2011). To solve this problem, the Rwanda Agriculture Board (RAB) helps farmers to get most improved seeds, fertilizers and pesticides/fungicides (Bakwatsa, 2010). The Government of Rwanda is seeking to transform and modernize agriculture on 587.711 hectares land including marshland, hillside, ground water resources and rivers and lakes pumping domains. Fifty milliards of Rwandan Francs (Rwf) are committed to intensify and modernize agriculture to avoid dependence on rain-fed agriculture in the driest parts of the country (MINAGRI, 2011). To solve problems of growing vegetables during drought seasons, every household must have an irrigated kitchen garden on which they cultivate different kinds of vegetables that are important for their nutrition.

Ubudehe (community-based collective planning and action) is the poverty assessment in which local people identify and rank the poorest people and map the most important community and individual resources for poverty reduction (Bakwatsa, 2010). Village residents come together and identify the most pressing needs of the community, set priorities, identify resources and take action without waiting for external support. According to Rwandapedia (2013), Ubudehe is considered as a way to strengthen good governance and democracy through community involvement in decision making. The Ubudehe initiative has been boosted by the European Union support that provided 1 000 Euros (660 000Rwf) for every village through the Common Development Fund - CDF (Bakwatsa, 2010) and it won the UN Public Service Award for excellence in service delivery (Rwandapedia, 2013).

The Vision 2020 Umurenge (sector) Program (VUP) is an integrated rural development program designated to eradicate extreme poverty in Rwanda by 2020 (NISR, 2008). It is piloted in 30 of the poorest sectors (Imirenge) of the country, targeting 600 000 people. It is organized around three components identified by NISR (2008). Some Poor people are given planned public jobs to build community assets that are beneficial to the country. Other poor people receive credits to tackle extreme poverty and foster entrepreneurship and off-farm employment opportunities. The third type is direct support to improve access to social services or to provide for landless households in which no members qualify for public works or credits packages, such unconditional support seeks to expand health and education coverage and encourage the development of skills, handicrafts or social service activities (NISR, 2008).

Umurenge (sector) Savings and Credit Cooperatives (SACCO) is a cooperative program which operates in the financial system (Rwanda Focus, 2011). The Rwanda Focus explains the objectives of SACCO implementation as follows. In 2008 over half of the Rwandan population saved their income by traditional means because they had no access to formal financial institutions. The fundamental cause of this poor keeping was that financial institutions were far from villages and people found it hard to move about 50 km to them. One of the key components of EDPRS is financial sector development. The Government of Rwanda solved this problem by providing one SACCO in each sector and capacity building as well. Its main objective is to mobilize savings locally within the community and then the profits are returned to members in the form of loans. The money stays and works within membership groups in the area and this creates the culture of saving and investing. The

Rwandan Minister of Finance and Economic Planning urged all Rwandans to develop a culture of saving to attain development and added that collaboration and social cohesion was critical in this regard. (Rwanda focus, 2011). It is further understood that many people, particularly in rural households are obliged to save during certain periods in the year, such as harvesting, in order to compensate for periods when their income is dramatically reduced such as the dry season (Rwanda focus, 2011).

The Girinka program (discussed later in this chapter) is also a poverty alleviation and climate resilience strategy implemented in 2006 in Rwanda. It is the research focus of this dissertation.

Energy poverty and lack of electricity in rural areas exacerbate the poverty of developing countries (Javadi et al., 2013). They also suggest that electricity can improve human lifestyle by increasing the level of health, education, welfare and technology. In Rwanda, several private and state companies are working to improve energy provision in rural areas by establishing solar power plants and methane-based solutions (Javadi et al., 2013). The Girinka program contributes to energy poverty alleviation by providing cow dung used to generate biogas power.

According to Bizimana et al. (2012), the Government of Rwanda recognizes the central role of the agricultural sectors both in terms of economic growth and poverty reduction. Bizimana et al. (2012) also reported that Rwandan rural food production has improved significantly over the last two years because the number of cattle, goats, sheep, pigs and rabbits has increased significantly due to modernization in livestock rearing, the expansion of land area reserved for pasture and the improvement in the breeds of cattle distributed to farmers under the one cow per family program. They also indicated that milk and meat production increased significantly while the production of other animals (eggs, fish and honey) also increased, but slightly. The increase in agricultural productivity has continued to have a positive impact on food security (Bizimana et al., 2012). Despite the improved performance of the agriculture sector, export crops underperformed due to the global economic crisis which affected international commodity prices (Bizimana et al., 2012). They further state that, most importantly, Rwanda has experienced an upward trend in kcals/ person per day since 2008. However, the WHO recommendations for lipid and protein availability are yet to be

consistently met (Bizimana et al., 2012). However, as discussed next, there seems to be an upward trend in relation to other development indicators.

Diao et al. (2010:1) report:

Financed largely by foreign funds through multiple channels of international donors, public investment has picked up and reached an estimated 9.4% of GDP in 2007. Security and political stability have been restored and the business environment has improved. Significant progress has also been made in improving education and health indicators. For example, Rwanda's gross primary school enrollment ratio is higher today than that observed in other sub-Saharan countries of similar income level, and the number of students in secondary school has almost tripled since 1996.

Diao et al. (2010) state that in terms of key health indicators, the infant mortality rate after increasing from 85 to 137‰ between 1998-92 and 1992-94, it receded to 104‰ in 1998-2000 and further reduced to 97.5‰ in 2006. Farmer et al. (2013) assert that today Rwanda has been transformed remarkably. No more violence within the country's borders and its GDP has more than tripled over the past decade. They further assert that more than one million Rwandans progressed out of poverty between 2005 and 2010. According to Farmer et al. (2013), Rwanda is the only country in sub-Saharan Africa on track to meet most of the MDGs by 2015.

In 2011, the Rwandan total population was 10 942 950 and the population living in rural areas was 81.2% of the total population while the population below age 15 years was 42.8% of the total population (Farmer et al., 2013). The same researchers also report that the parliamentary seats held by women are 56.3% and the net enrolment in primary education is 98.7% and the total health spending per capita was \$55.51 in 2010. They also report that the average annual GDP growth over the past decade (2002-2011) was 7.6% and was \$582.59 per capita in 2011 (Farmer et al., 2013). Some have characterized Rwanda's rebirth as good fortune or as a "black box" case with few lessons for others (Farmer et al., 2013). According to the Legatum Institute (2013), Rwanda ranks 9th in Africa in the Prosperity Index 2012-2013. Rwanda ranks first in Africa in combating corruption and it is among four first countries in Africa that show a real improvement in doing business (Legatum Institute, 2013).

Despite the successes, the UN WFP (2013) report indicates poor food consumption in Rwanda that represents an extremely insufficient and unbalanced diet. The Comprehensive Food Security and Vulnerability Analysis and Nutrition Survey (CFCVA NS) carried out in 2012 by WFP in partnership with the Rwandan MINAGRI and NISR, indicates that one out of five Rwandan households have unacceptable food consumption and could be considered food insecure which show clear improvements compared to the last two surveys carried out in 2006 and 2009 (WFP, 2013). The report indicates the improvement in food security and nutrition over the last seven years but the levels of food insecurity and malnutrition remain high. The report also reveals that 61% of farmers in Rwanda cultivate less than half a hectare, and 50% have even less than 0.2 hectare on which they grow their crops. This is very limiting to households whose livelihoods rely solely on agriculture (WFP, 2013).

Based on Rwanda's limited natural resources, high population density and land-locked position; its main potential source for economic growth is seen to be its human resources (Hayman, 2007). In the early post-genocide years, the Government of Rwanda has placed considerable emphasis on expanding tertiary education and the justification for this was the need to replace professionals who had died or fled as a consequence of events. To increase resources, the Government of Rwanda is promoting primary and lower secondary education. The basic education program is intended to equip children with knowledge and skills to lead productive lives and thus addressing poverty reduction (Hayman, 2007).

Rwanda's 9 year education program achieves Goal 2 of the MDGs that aim to achieve universal primary education (Campioni and Noack, 2012). The Government of Rwanda considers Information and Communication Technology (ICT) as a key tool for transforming the economy because it plays an important role in developing the necessary human resources (Rubagiza et al., 2011). Since 2000, the Government of Rwanda started to introduce computers into schools and integrate ICT into the education curriculum through a range of initiatives (Rubagiza et al., 2011). In collaboration with the One Laptop per Child (OLPC) association, a non-profit United States-based organization for the creation of educational tools for use in the developing countries, the Government of Rwanda has initiated a project to deploy "*low-cost, low-power connected laptops with content and software designed for collaborative, joyful, self-empowered learning*" in primary schools around Rwanda (Anderson and Nonmalm, 2010:1).

2.10 Girinka program for poverty alleviation

The role of cattle in poverty alleviation is indicated by different researchers. For example, Holman et al. (2005) in their study about the role of cattle in alleviating poverty in Colombia reveals that cattle are perceived by smallholder farmers as a contribution to the improvement in the quality of life. The poorest of the poor do not have cows, but if they get animals, they can start a pathway out of poverty (Randolph et al., 2007). The Girinka “one cow per poor family” program aims to improve the livelihoods of poor households by managing dairy cow which for increased milk, meat and fertilizer production (Rwandapedia, 2013). This will not only improve nutrition, but also increase the earnings of beneficiaries from milk, milk products, meat and sale of manure (Rwandapedia, 2013). This program has been approved by the Rwandan cabinet on 12 April 2006 as one the 2020 vision implementation measures designed to move Rwanda to a middle income nation by the year 2020 (Rwandapedia, 2013). The target was initially to reach 257 000 beneficiaries by 2015, but this target was revised upwards to 350 000 beneficiaries by 2017 and since its implementation in 2006 more than 148 238 cows have been given all over the country, among which 8 457 cows were given to Bugesera District. This is illustrated in table 2.3 (Rwandapedia, 2013).

Table 2.3 Distribution of Girinka cows per year per District

Province	District	Number of cows								Total
		2006	2007	2008	2009	2010	2011	2012	2013	
NORTH	BURERA	216	197	1847	1766	315	1469	632	328	6770
	GAKENKE	0	132	255	493	254	434	204	139	1911
	GICUMBI	216	478	942	800	7984	256	585	142	11403
	MUSANZE	216	252	93	696	139	381	345	161	2283
	RULINDO	0	325	430	2802	270	498	441	135	4901
	S/Total	648	1384	3567	6557	8962	3038	2207	905	27268
EAST	BUGESERA	0	218	4574	556	137	712	1798	462	8457
	GATSIBO	0	1074	2425	1743	1303	349	2169	31	9094
	KAYONZA	0	344	871	928	696	446	359	17	3661
	KIREHE	0	1006	470	545	560	765	1123	317	4786
	NGOMA	0	545	1660	82	546	354	1078	56	4321
	NYAGATARE	0	591	701	1780	59	657	621	173	4582
	RWAMAGANA	102	413	1488	460	284	283	1111	224	4365
S/Total	102	4191	12189	6094	3585	3566	8259	1280	39266	
WEST	KARONGI	0	710	443	2304	154	689	1432	56	5788
	NGORORERO	0	645	885	6459	261	568	1773	153	10744
	NYABIHU	231	173	420	668	296	265	444		2497
	NYAMASHEKE	0	65	142	2213	2040	1150	1306	699	7615
	RUBAVU	232	333	307	842	104	431	516	110	2875
	RUSIZI	0	319	618	825	538	790	1845	85	5020
	RUTSIRO	0	760	737	2825	229	457	1399	252	6659
S/Total	463	3005	3552	16136	3622	4350	8715	1355	41198	
SOUTH	GISAGARA	223	818	1332	4016	376	385	316	5	7471
	HUYE	223	942	1102	424	305	275	452	164	3887
	KAMONYI	223	676	1119	892	679	1114	965	379	6047
	MUHANGA	223	528	1042	468	252	214	544	116	3387
	NYAMAGABE	223	664	1101	1407	235	1213	422	87	5352
	NYANZA	223	308	750	449	191	465	307		2693
	NYARUGURU	223	881	1991	2030	463	412	560	55	6615
	RUHANGO	0	211	487	93	491	492	202	215	2191
S/Total	1561	5028	8924	9779	2992	4570	3768	1021	37643	
KIGALI CITY	GASABO	78	217	233	81	33	242	242	130	1224
	KICUKIRO	79	100	114	122	78	142	142	79	867
	NYARUGENGE	79	14	120	172	55	130	130	70	772
	S/Total	236	331	467	375	166	514	514	279	2863
GRAND TOTAL		3010	13939	28699	38941	19327	23463	23463	4840	148238

Source: Rwandapedia (2013)

Table 2.3 presents how the Girinka program cows have been distributed from 2006 to June 2013. The first column presents four Provinces (Intara) of Rwanda (North, East, West and South) and the second last column is Kigali city. The second column presents the thirty Districts of Rwanda per Province. The third to the eighth columns show the number of cows distributed per year in each District and the sub-total per year per Province. The last column presents the sum of cows distributed per District and per Province.

According to Rwandapedia (2013), the Girinka program was initiated in response to the high level of poverty and child malnutrition in Rwanda in 2006. The Demographic Health Survey carried out in 2005 showed that up to 40% of households were food insecure in some regions of Rwanda, Bugesera District included. That survey also showed that 19% of children under five years old had severe malnutrition while 45% had moderate malnutrition (Rwandapedia, 2013). The aim of the Girinka program was mainly to solve those problems discussed above and had the following objectives:

- Reduce poverty through the money from the sale of cow products
- Increase crop production by providing manure used as fertilizers
- Soil protection because beneficiaries are encouraged to plant grasses for animal fodder on terraces to reduce soil erosion
- Promote social cohesion by passing on the first calf to another household
- Reduce malnutrition through milk consumption as child malnutrition is an eminent concern

The Girinka program is under RAB responsibilities and it is in charge of selection, certification, distribution of cows and their follow-up. RAB is also in charge of the management of both centralized budget and donations (Rwandapedia, 2013). Cows provided must be between 18 and 24 months old and weigh at least 250kg. They must also be free from contagious bovine pleura-pneumonia and brucellosis (Rwandapedia, 2013). The Girinka program is implemented in two ways such as “Girinka y’ingabirano” or donation and “Girinka y’inguzanyo” or loan. For Girinka y’ingabirano, the poor family receives a pregnant heifer and when it calves, the first calf is given to the neighbor’s poor family who keeps it and gives the next calf to the next poor neighbor and so on. This calf giving is called “Kwitura” (MINAGRI, 2006). However, in Kamonyi District, Southern Province, the first beneficiary retains the first calf and gives the mother to the next poor neighbor and so on. This process is called “Inka y’akaguru”. The Inka y’akaguru process is faster than Kwitura but it does not last longer like Kwitura because it stops when the first cow gets old and dies (Rwandapedia, 2013). For the Girinka y’inguzanyo, beneficiaries receive cows as loans from the Rwanda National Bank without a mortgage. Girinka y’inguzanyo beneficiaries must have a cow shed, sufficient land for fodder cultivation and they must be able to care for the cow. Because Girinka y’ingabirano beneficiaries sometimes are not able to care for the cow, the

RAB provides them drugs, spray pumps and mineral salts to help them to care for the cow until it calves (Rwandapedia, 2013). Beneficiaries are selected under principles of the Ubudehe program where people in the village meeting decide themselves how their problems can be solved. For Girinka beneficiaries' selection, the meeting of all Village members facilitated by the Village leader makes a list of poor households that should receive a cow and that list is given to the Cell and Sector leaders and when Girinka cows get available, the person number one on the list is the first to receive the cow (Rwandapedia, 2013). The program has the following criteria of beneficiary selection:

- The beneficiary must not already own a cow.
- The beneficiary must be an Inyangamugayo (person of integrity) in the community.
- The beneficiary must be considered as poor by their community and have less or no other source of income.
- The beneficiary must have at least 0.25 – 0.75 hectares, and those who have less than 0.25 hectares must join to form common cow shed (Igikumba) for their cows.
- The selected beneficiary must construct the cow shed before he/she receives the cow.

Selected beneficiaries are trained about cow practices before getting the cow. The training, monitoring and evaluation are given by the RAB in partnership with local government institutions such as Sector, Cell and Village committees (Rwandapedia, 2013). The program encourages zero-grazing system because cows are supposed to be fed by cut and carried fodder and to be sheltered under roofed houses. This system has the potential to minimize disease transmission through open grazing and also to maximize manure collection (Ntanyoma, 2010). The mixed farming (crop-livestock) is suitable for smallholder farmers in rural areas who have small pasture land (Ntanyoma, 2010). Livestock is of social importance in many traditional societies because it strengthens social bonds including the use of livestock as dowry or bride price (Randolph et al., 2007). For example, traditionally a cow in Rwanda is a symbol of wealth (milk and manure), unity and solidarity; it was the currency of socio-economic transactions before colonization and was also used as dowry price (Eussi, 2012). In Rwandan culture, the gifting of a cow is a sign of appreciation or expression of gratitude and creates special relationships between not only the giver and the receiver but also between their families hence Rwandese say that a cow is given by a family to another family (Rwandapedia, 2013).

The Girinka program is funded by Government of Rwanda and its partners such as Line Ministries, local Non-Governmental Organizations (NGOs) and international organizations (Heifer International, Send a Cow, World Vision, etc.). Calculations show that the Eastern Province keeps more cattle in Rwanda where the predominant breed is the Ankole type which makes up 84% of the cattle population in Rwanda (SNV, 2008). The Girinka program provides local breeds (Ankole), cross breeds, Jersey and Friesian breeds (Ntanyoma, 2010).

2.11 The value of cows for food security in rural communities

According to Holman et al. (2005) and Randolph et al. (2007), livestock (cows in this context) contribute to food and nutritional security; provides draught power, transport and manure; and serves traditional social functions. Cows have nutritional and health benefits because it produces a regular supply of nutrient-rich food known as ‘Animal Source-Food’ (ASF) that provides a supplement and diversity to staple plant-based diets (Randolph et al., 2007). Cow products such as milk can help mitigate the effects of large seasonal variations in food availability. Poor people’s diets are largely based on starchy foods that fail to meet all their nutritional needs that can lead to protein-energy malnutrition, iron-deficiency anemia and vitamin A deficiency (Smith et al., 2013). This can be prevented if sufficient ASF are included in their diets because ASF are nutritionally dense sources of energy, protein and various essential micronutrients (Smith et al., 2013). For example, milk and meat provide around 13% of the energy and 28% of the protein and even small amounts of ASF in diets can ensure dietary adequacy; prevent under-nutrition; have positive impacts on growth, cognitive function, physical activity and reduces illness (Smith et al., 2013). Millar and Photakoun (2008) and Smith et al. (2013) state that cows play a key role in the lives of poor rural people in developing countries because of its contribution to improving crop production for food and income. They also assert that cows in poor countries provide income from the sale of animal products or services that can be used to purchase staple food. Smith et al. (2013:9) reveal that “it is estimated that cow production and marketing are currently essential to the livelihoods of more than one billion poor people in Africa and Asia. For example, dairy supports 124 million people in South Asia and 24 million in East Africa”. They further state that mixed farming systems contribute to staple food production by providing fertilizer (manure) and cash to buy planting materials or inorganic fertilizer to mix with manure. The

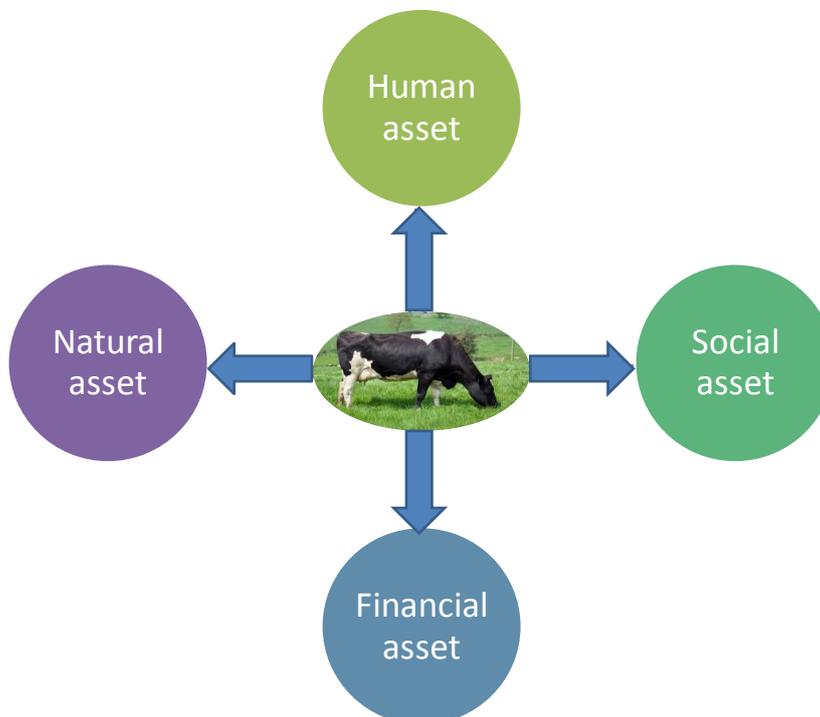
money from cows can also contribute to hire labor for planting, weeding, harvesting or increase the area of land cultivated (Smith et al., 2013).

Agricultural productivity constitutes a pillar for food security in developing countries. The MFS in developing countries is very important because cows provides manure for soil fertility and hence contributes to increased agriculture; it is also a cheaper source of fertilizers compared to chemical fertilizers for rural poor households (Ntanyoma, 2010). Skills relating to manure application are important because in case of low and erratic rainfall, if manure is not well applied it can burn crops. The literature indicates that the combination of both organic and inorganic fertilizers seems to be more productive and the efficient combination of these fertilizers needs some technical skills (Ntanyoma, 2010). According to Randolph et al. (2007:2790):

In the Sustainable Livelihoods Framework (SLF), cows are a critical physical asset that can improve the stock or quality of each of the key livelihood assets, reducing vulnerability, broadening livelihood alternatives, and improving outcomes.

Cows and key capital assets are obviously interrelated and the interrelationship between the cow (physical asset) and other key livelihood capital assets are illustrated in Figure 2.3.

Figure 2.3 The relationship between cows and key livelihood assets



The figure inside the diagram on figure 2.3 is a cow. The diagram shows how the cow interacts with the key capital assets. Cow ownership can enhance social capital by strengthening social bonds, including the use of cows as dowry and the use of manure as a soil fertility increases natural capital (Randolph et al., 2007). They also reveal that a larger cow herd constitutes an increase in physical capital and better nutrition and health derived from cows improve human capital. Cows serve as living savings accounts for the poor who do not have access to standard financial markets, including banks and they can be sold and transformed into cash when needed (Randolph et al., 2007).

Officials have estimated in monetary terms the benefits of the Girinka program. They estimate that households whose cow produces 10 liters of milk, 7 liters are sold and valued at Rwf 200 and 3 liters are consumed at the household level (Ntanyoma, 2010). The estimated value of the milk during the lactation period is Rwf 378 000 (\$582), manure is estimated for 20 tons per year equivalent to Rwf 200 000 (\$357), and the estimated cost of drugs for a cow per year is Rwf 55 000 (\$98) (Ntanyoma, 2010). He further states that local breeds or Ankole and cross breeds produce less quantities of milk compared to improved breeds like Friesian, Jersey and Pure Sang, which can negatively affect the results expected by the program. He further states that in the short and long run, aggregate results show that the Girinka program has a positive effect on households' income, without including medication, cow shed and water costs.

The dairy industry in Rwanda is emerging and produces young and produces a quarter of East Africa's raw milk (SNV, 2008). In 2007, Rwanda produced about 160 000 000 liters of fresh milk from a cattle population estimated at 1 148 000 cows (SNV, 2008). Local farm consumption was approximately 62 million liters and about 35% of the raw milk is wasted due to spoilage (SNV, 2008). SNV (2008) also reveals that most of the milk (48%) is produced in traditional or extensive grazing systems in the Eastern Province (SNV, 2008).

However, cattle can affect household's livelihoods negatively when they are not kept properly (Randolph et al., 2007). Milk is a good microbial culture media and microbes can spoil the milk when it not kept aseptically. Livestock can cause zoonotic diseases or food-borne diseases (Randolph et al., 2007). Consumption of raw milk and direct utilization of milk can cause human illnesses because unpasteurized milk is capable of acting as a vehicle for transmitting pathogens or spoilage responsible of human diseases (Fleming et al., 1994).

According to Smith et al. (2013), the ability of people to produce food and earn an income to purchase food is impacted by zoonotic diseases and ASF-borne diseases especially amongst the poor and middle income populations. (Smith et al., 2013). They further suggest that prevention, detection and treatment of both zoonotic and ASF-borne diseases demand the collaboration between veterinary and public health researchers and officials (Smith et al., 2013).

2.12 Conclusion

According to the literature reviewed, it is clear that food systems are stressed by climate change that leads to poverty and food insecurity. Food security and poverty reduction strategies were discussed in the above literature review. The literature shows that poverty can be alleviated when some strategies are developed by different Governments and organizations against it. Providing livestock to poor people is one of the strategies against poverty reduction in poor rural communities. The objective of goal one of the MDGs is to reduce hunger and malnutrition by 2015 (UN Development Program, 2008). To achieve this goal, different strategies and policies must be developed to adapt and mitigate against climate change. The Girinka program can be an adaptation or climate resilience strategy. Additionally, as the chapter shows, there are strong links with the SLF which is the theoretical approach adopted in this study.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter is composed of the general background information on the study area and the research methods that have been used in this study. The study area is Bugesera District of Rwanda and the background information of Bugesera as well as Rwanda in general is provided in this chapter. Also, the research design and different methods that have been used in data collection are discussed in this chapter.

3.2 Background information of Rwanda

Rwanda is a small country in the East Africa, sometimes known as the “land of a thousand hills” and it is the 154th smallest country in the world at 26 338km² (Short, 2007). It has a high population density (384 persons per km² in 2008) which is comparable to Japan and Belgium (Short, 2007). Rwanda is about 120km south of the equator, 1 270km west of the Indian Ocean and 2 000km east of the Atlantic, ‘literally in the heart of Africa’. It is completely landlocked by its neighbors: Uganda, Tanzania, DRC and Burundi (Short, 2007). Verwimp (2010) asserts that Rwanda witnessed a genocide that swiftly took the lives of some 800 000 Rwandans in 1994 and in just 3 months, more than 10% of the general population and approximately 75% of the Tutsi ethnic minority population was killed. According to Short (2007), the 1994 genocide took the lives of about million Rwandans. Easterly and Freschi (2010) reveal that Rwanda’s speciality coffee commands some of the highest prices in the world and revenues are still increasing despite the global recession with the major beneficiaries being the rural poor. The International Fertilizer Development Center (IFDC, 2012) states that the Rwandan primary agricultural export is coffee and tea. According to Easterly and Freschi (2010), the coffee industry has reduced ethnic conflict between the Hutus and Tutsis who now work together in the coffee industry.

The Central Intelligence Agency (CIA, 2012) states that Rwanda is a landlocked country located in central Africa and its geographic coordinates are: 2 00 S, 30, 00 E. Its surface land and water are 24 668 km² and 1 670 km², respectively. Its total land boundaries are 893 km.

The climate of Rwanda is temperate with two rainy seasons (February to April and November to January) and mild in the mountains with frost and snow possible (CIA, 2012). Its terrain is grassy uplands and hills with relief that is mountainous and with altitude declining from west to east; the lowest point is Rusizi River with 950 m and the highest point is volcano Karisimbi with 4 519 m (CIA, 2012). Rwanda's natural resources are gold, cassiterite (tin ore), wolframite (tungsten ore), methane, hydro-power and arable land while its natural hazards are periodic droughts and volcanism (CIA, 2012). Rwanda's current environmental issues include deforestation, overgrazing, soil degradation exhaustion and widespread poaching (CIA, 2012).

Figure 3.1 presents the Provinces of Rwanda and Kigali city as well as shows the location of Bugesera District. Rwanda is divided into four Provinces (North, South, East and West) and the City of Kigali in the middle. Figure 3.1 also illustrates the Districts of Rwanda. Rwanda has 30 Districts including Bugesera District indicated by the circle. Bugesera District is located in the Eastern Province. Rwanyiziri and Rugema (2013: 35) state, "the analysis of rainfall on past trends show that, since 1992, Bugesera District has been characterized by a declining trend with a remarkable variability in rainfall frequencies and intensity which resulted into serious floods in 1997-1998 and a prolonged drought in 1999-2000".

Figure 3.1 Provinces of Rwanda and location of Bugesera District



Source: Rwandan Environmental Management Agency (2011:11)

3.2.1 Background information of Bugesera District

Bugesera is one of the 7 Districts of the Eastern Province of Rwanda, located to the south west of the Province (Figure 3.2), between Longitude $30^{\circ}10'$ East and Latitude $2^{\circ}13'$ South and it covers a surface of $1\,337\text{km}^2$. It is divided into 15 Sectors; From the District there is a Sector (Umurenge) in Rwandan administrative entity, then Cell and Village respectively (Republic of Rwanda, 2012).

The Republic of Rwanda (2012) describes the relief of Bugesera District as the succession of trays in the heights subsided and whose altitude varies between 1 300m and 1 667m. This District is also characterized by a set of curlings of Hills to the soft and middle slopes. The low trays that overhang some mounts includes Mount Juru (1 667m) which is the highest in

the District, mount Nemba (1 625m) and the Maranyundo mountain that has an altitude of 1 614m. The relief is also constituted of succession of low plateaus with old mountains, hills, dry valleys and by swampy places due to the downfall tectonic (Republic of Rwanda, 2012). Bugesera is characterized by a very hot climate resulting from the absence of mountains due to relatively low altitude, of the rarity of rains and the periods of drought excessively prolonged (Republic of Rwanda, 2012). The climate of the Bugesera is tropical where the temperature is in the order of 20 to 30 °C. From 1997 to 2006, Bugesera recorded several irregularities in climatic Unclear. The seasons are marked by an alternation of rains and drought. The four seasons are differentiated according to the length and the intensity of rains and drought: the dry season called “urugaryi” goes from January to the mid-March and it is followed by the season of rain called “itumba” that starts from mid-March to June. The season of drought “impeshyi” covers the mid-June to the mid-October and it is followed by the season of rains “umuhindo” that starts mid-October and finishes the December (Republic of Rwanda, 2012).

The main sources of water in this district are its three rivers (Akanyaru, Nyabarongo and Akagera) and its nine lakes (Lake Rweru -1857 hectares, Lake Cyohoha North and Cyohoha South - 630 hectares, Lake Gashanga - 232hectares, Lake Kidogo - 220 hectares, Lake Rumira - 280 hectares, Lake Mirayi - 230 hectares, Lake Kirimbi - 230 hectares and Lake Gaharwa 230 hectares). Except lakes Rweru and Cyohoha, others were formed themselves following the flooding of the rises in the water level of the river Akagera that continues to nourish them. A large part of northern Cyohoha was dried following the prolonged drought in these last years. Bugesera is also characterized by grassy savanna and shrubby savanna (Republic of Rwanda, 2012). The main sources of food in this District are its fertile valleys, but sometimes due to flooding the valleys are water-logged and this destroys crops, which leads to hunger (Republic of Rwanda, 2012).

3.3 Research methodology

Research methodology is defined as a process of investigation which a researcher uses to address the research objectives through the research questions posed (Kumar, 2005). According to Kumar (2005), the research methodology can take the structured approach that constitutes quantitative research and the unstructured approach that constitutes qualitative research. The quantitative research strategy emphasizes on quantification and analysis in data collection and all forms of the research process such as the objectives, design, sample and the questions to ask in this approach are predetermined, while the qualitative research strategy emphasizes words in the collection and analysis of data (Bryman, 2008) and (Kumar, 2005). Contrary to the quantitative approach where a researcher goes to the field with predetermined variables, in qualitative approach the researcher arrives in the field with an open mind and without preconceived variables which avoid influencing the existing predetermined variables (Pomuti, 2008). Therefore, both quantitative and qualitative approaches are important in research depending on the aim of inquiry which can be exploration, confirmation or quantification and the use of results (Pomuti, 2008). The qualitative approach is appropriate in exploring the nature of the issue while the quantitative approach is more appropriate in determining the extent of the phenomenon or problem (Rubin and Babbie, 2005) and (Kumar, 2005). Bryman (2008) states that quantitative and qualitative approaches represent different research orientations. He furthermore states that the difference between the two is thin in studies which have a broader characteristic where one research may have characteristics of the other. The two approaches can be combined in one research project as mixed methods research which is one of the types of triangulation where results of a study using one method are cross-checked against the results of the same study using another method (Bryman, 2008). According to the Center for Civic Partnerships (CCP, 2007), quantitative data are numbers while qualitative data are words and may include photos, videos, audio recordings and other non-text data. Quantitative data are credible and scientific and explains the how and why of a program, while qualitative data best explains the what, who and when (CCP, 2007). This does not mean that that qualitative research is not credible but that there are different approaches to examine issues. Most researchers reveal that the combination of quantitative and qualitative techniques provides a richer and more comprehensive project (CCP, 2007).

3.4 Research design

Qualitative and quantitative data collection methods have been used in this research project. This study has been conducted using two theoretical orientations, positivism and interpretivism. According to Pomuti (2008), positivism and interpretivism are among orientations that posit claims with regard to reality and knowledge. Positivism advocates the application of natural science methods to the study of social reality and states that reality can only be understood through scientific methods and that valid knowledge is acquired from measurement and direct observation (Bryman, 2008) and (Pomuti, 2008). Interpretivism states that reality is understood through language and acquired through discovery (Pomuti, 2008). According to Bryman (2008), quantitative methods' roots are founded on positivism and qualitative methods' roots are founded upon interpretivism.

The survey method via a questionnaire was used in this study to understand the impact of the Girinka program on poor family livelihoods and its climate resilience properties. The questionnaire was used to assess the poor family income generating activities provided by the Girinka program and the usage of cow products such as milk, manure and cow dung. Focus group discussions were also used in order to gain depth understanding of the Girinka program's impacts on poverty alleviation and climate change adaptation and mitigation.

3.5 Data collection strategy

Kothari (2004) shows that there are a variety of data collection techniques and this is dependent on the availability of time and finances by the researcher. In every data collection, the researcher should mention two types of data (primary and secondary data) collection approached. Primary data are those collected for the first time and secondary data are those which have been already collected by someone else (Kothari, 2004). Secondary data can be accessed, for example, from government publications, journal articles, magazines, etc. (Kumar, 2005). Kothari (2004) states that they are different methods of collecting primary data. The collection of primary data can be through experiment or through survey; if primary data are collected through experiment, the researcher observes some quantitative measurements, while in the case of a survey, data can be collected through observation, personal interviews, telephonic interviews, mailing of questionnaires and schedules (Kothari, 2004). All these data collection methods listed above are discussed below as outlined by

Kothari (2004). In the observation method, the information is collected by way of investigator's own observation without interviewing the respondents, it provides very limited information, it is not suitable for large samples and it is expensive. The personal interview method is the rigid procedure of seeking answers to a set of pre-conceived questions through personal interviews. Telephonic interviews are important surveys when the researcher has limited time. The mailing of questionnaire method is used in various economic and business surveys. The schedule method requires enumerators which are given training and provided with schedules containing relevant questions and the information is collected by completing the schedules.

Table 3.1 Techniques used to collect and analyze quantitative and qualitative data

Quantitative Techniques	Qualitative Techniques
Surveys/ questionnaires	Observations
Pre/ post tests	Interviews
Existing databases	Focus groups
Statistical analysis	Non-statistical analysis (methods vary)

Source: CCP (2007)

3.5.1 Construction of questionnaire

According to Marshall (2005), the most common research data collection instrument is the questionnaire. Questions developed in the questionnaire must be made based on finding answers to the research questions posed and these should be considered as the questionnaire is constructed (Bryman, 2008). Also, Bryman (2008) states that questions should be clear to the respondents so that they can get right answers and the researcher should show how questions must be answered. Thus, for example, questions can be open-ended or closed-ended. An open-ended question is a question that provides freedom to the respondents to answer it as they feel without restriction, while a closed-ended question suggests a set of possible answers from which respondents should select the suitable answer (Bryman, 2008; Rubin and Babbie, 2005). Open-ended questions are time-consuming because firstly, the interviewer should record verbatim what respondents say and they may talk for longer times. Second, questions have to be coded in order to be processed by computer programs for analysis which is also a time-consuming activity (Bryman, 2008; Rubin and Babbie, 2005).

Closed-ended questions are easier to ask, to respond to, to code and they minimize the chances of misinterpreting the responses (Bryman, 2008). However, in closed-ended questions respondents may bring a response which is not included in the list of possible responses. Thus, Rubin and Babbie (2005) suggest that the list of responses should be exhaustive and that to avoid any loss of responses not covered, the list of response options should include “other, please specify”.

In this study the questionnaire was developed following the points discussed above. As closed-ended questions are focused and less-time consuming, most of the questions in this research questionnaire were closed-ended and few of them were open-ended. The questionnaire was divided into four sections:

- Demographic profile of the respondents
- Household economics and sustainable livelihoods
- Cow practices
- Girinka program services

3.6 Sampling

A sample is a subset of a population (Fink, 2003). The same author states that the population is the universe to be sampled, like all Rwandans; all Tutsis killed during the 1994 Genocide, or all people owning the Girinka program cow in Bugesera District. According to Fink (2003:1), “a good sample is a miniature version of the population of which it is a part - just like it, only smaller”. Fink (2003) further states that the responses from survey samples represent the views of the target population and the importance of a sample lies in the quality with which it represents the institutions, persons, problems and systems to which or to whom the survey’s findings are to be applied. But no sample is perfect; every sample should have some errors and the researcher should decide how many errors to allow (Fink, 2003). Smith (2013) reveals that a larger sample can yield more accurate results. According to Smith (2013), there are important aspects in determining the sample size:

- Population size
- Margin of error
- Confidence level

- Standard deviation

This research was based on structured surveys administered to households in Bugesera District, Rwanda. As indicated earlier, Bugesera District has 15 Sectors from which four Sectors were purposively chosen to participate in the study. The chosen Sectors are those most impacted by drought. Within each of the 4 Sectors, 100 surveys were conducted providing a total of 400 households which is deemed to be statistically significant at a 95% confidence level. Only beneficiaries of the program before 2011 were selected in order to receive sufficient information on milk and manure use. In each Sector the households were selected using the random method. The lists of households were acquired from the Sectors' offices. The lists were used to randomly select 100 households in each Sector.

The quantitative survey was complemented with focus group discussions to clarify issues that emerge from the analysis of the quantitative survey results. The focus group discussion is defined as a qualitative method of group interviewing which allows the researcher to pose questions to many individuals at the same time (Rubin and Babbie, 2005). The CCP (2007) states that focus group discussion is useful in defining problems in project implementation, generating ideas and strategies. For focus group discussions, participants are selected non-randomly, they should share some characteristics or experience relevant to the assessment, do not know each other and respond to questions from a group facilitator (CCP, 2007). A focus group composed of 10 persons was conducted in each Sector. Thus, 4 focus group discussions were held. The participants were chosen from among those who participated in the survey component of the study. Purposive sampling was used to ensure that different types of beneficiaries were included such as males and females, those with one cow and those with more than one cow, those with multiple livelihood strategies and those whose main activity is agriculture. Observation was also used in this study.

The above approach of using multiple methods shows that triangulation was used in this study using both quantitative (survey – Appendix A) and qualitative (focus group discussions – Appendix B) methods. Only the head of household or another adult household member was interviewed in each selected household. A visit prior to data collection was made to the District office area in order to inform the District authorities about the research and ask them the permission to conduct the study in chosen Sectors. Before entering the villages, the

researcher passed by the Sector office to introduce the authorities to the aim of this study and seek permission from the District so that they provided the lists of Girinka beneficiaries. The information about Sectors most affected by drought in the last decade was attained from District's authorities and selected Sectors were Gashora, Rweru, Mayange and Ntarama. Gashora received 518 cows, Rweru 417, Mayange 418 and Ntarama received 780 cows. The data collection started on 19 June 2013 and ended on 15 August 2013.

3.7 Data analysis

Fitz-Gibbon and Morris (1987) states that statistics is a part of mathematics that makes order out of collections of diverse data and it help to crunch large amounts of information into summary numbers that can be understood in a single glance and used as a basis for making decisions, forming opinions or developing theories. Data from the survey in this research was analyzed using the Statistical Packages for the Social Sciences (SPSS) version 21 for the quantitative results. The qualitative data was analyzed thematically and the results have been integrated thematically in the relevant sections of the discussion.

3.8 Limitation of the data collection process

Gashora Sector is divided into 5 cells, Rweru 6, Mayange 5 and Ntarama into 3 cells. All cells should have been visited but, two cells (Mazane and Sharita) located in Rweru Lake island in the Rweru Sector, were not visited because of inaccessibility to that island. The only way to reach the island is by traditional boats made of wood. These boats are overloaded and do not have life jackets. Girinka cows reach to that island by being bound to those boats and they are pulled by the boats in the lake as indicated by one of the Rweru resident respondents. The researcher decided to exclude those two cells because of insecure accessibility to that island.

3.9 Conclusion

This chapter discussed the methods that were used to conduct this study. As mentioned, primary data were collected through quantitative and qualitative methods. The quantitative method used was in the form of a household questionnaire while the qualitative method used involved focus group discussions guided by an interview schedule. Secondary sources of data were also used to study the policy issues with regard to the Girinka program in Rwanda. Furthermore, the challenges faced during this study were discussed in this chapter.

CHAPTER FOUR DATA ANALYSIS

4.1 Introduction

This chapter presents the results of this study. The analysis and discussion of the results are also provided in this chapter. The quantitative results are discussed with the incorporation of the findings from the qualitative data obtained from focus group discussions and this incorporation gives a better understanding of the results. The answers to the research questions are presented in this chapter and the relationship between the literature discussed in chapter two and the findings of this study is also presented in this chapter.

4.2 Demographic Profile of Respondents

The demographic profile of the respondents is discussed in terms of age, marital status, educational level of respondents and gender distribution in the household. As discussed in the literature review, social relations such as age, gender and class are the key influences of access to assets (CFMS, 2012). The demographic profile indicates who the respondents are and their influence in decision making in their communities (Kotile and Martin, 2000).

Table 4.1 Gender of the respondents (n=400)

Gender	%
Male	66.75
Female	33.25

Table 4.1 presents the gender of the respondents. The number of males interviewed is 66.75% of the respondents while the number of females is 33.25% of the respondents. The number of males is almost double that of females. This is because the targeted respondents were the heads of households or their alternates and in Rwanda, males are generally heads of households. According to CFMS (2012), women tend to be more vulnerable than men within poor households; they have access to fewer assets, adopt different strategies from men and pursue different outcomes.

Table 4.2 Age of the respondents (n=400)

Age	%
20 – 24	1.75
25 – 29	4.75
30 – 34	7.75
35 – 39	8.25
40 – 44	10.25
45 – 49	11.25
50 – 54	17.25
55 – 59	13
60 – 64	10.75
65 – 69	5.75
70 ⁺	10.5

Table 4.2 shows the age of respondents. The age of respondents ranged from 20 to over 70 years old. Slightly more than half of the respondents (51.75%) were 40-59 years old. The average age of respondents is 50.73 years, which is found in the age interval of 50-54 years which represents 17.35% of the respondents. This is the age interval that has the largest number of respondents, followed by the 55-59 age interval which represents 13% of the respondents. After this interval were 45-49, 60-64, 70⁺, 40-44, 35-39, 30-34, 65-69, 25-29, and 20-24 intervals which have 11.25%, 10.65%, 10.5%, 10.25%, 8.35%, 7.65%, 4.65% and 1.75%, respectively. According to Niehof and Price (2001), physical strength, which is a human resource is needed to provide productive labor in relation to rural livelihoods. However, the results of this study show that a large number of the respondents have an advanced age and therefore cannot contribute substantially to productive labor. But those vulnerable people are those targeted by the Girinka program to improve their livelihoods.

Table 4.3 Marital status of respondents (n=400)

Marital status	%
Married	64.5
Single	3.5
Divorce	6.5
Widow	25.5

The marital status of the respondents in this study is presented in table 4.3. These results show that the largest number of respondents (64.5%) are married, followed by widows (25.5%). Divorced respondents count for 6.5% while single respondents count for 3.5% of the respondents. The large number of widows is the consequence of 1994 Rwandan Genocide of Tutsis and this is confirmed by Diao et al. (2010) who state that Rwanda is still suffering from consequences of the 1994 Genocide of Tutsis because human and physical capital were severely destroyed which reduced considerably productivity, household income and government revenue that led to an increase in poverty. Women's livelihood strategies focus on meeting the basic needs of their children and the vulnerability of women is often matched by the vulnerability of their children because they share the responsibility within the household (CFMS, 2012). Most of these widows have children to look after and, according to CFMS (2012), this large number of widows can be a handicap to livelihoods' improvement. The single respondents are orphans and most of them are 1994 Genocide Tutsis survivors.

Table 4.4 Educational level of respondents (n=400)

Educational level	%
None	29.25
Grade 1-3	14.75
Grade 4-6	41.25
Grade 7-9	12.5
Grade 10-12	2
University	0.25

As discussed in chapter two, Niehof and Price (2001) reveal that human resources such as skills and education are needed to provide productive labor. They further reveal that farmers with higher education are more likely to adopt new technologies in agriculture than less

educated or uneducated farmers. However, in this study as shown in table 4.4; a large number of respondents (41.25%) have grade 4-6, followed by respondents who have no formal education (29.25%). Grade 1-3, Grade 7-9, Grade 10-12 and university education are represented by 14.75%, 12.5%, 2% and 0.25% of the respondents, respectively. It is important to note that 34% of the respondents can be considered to be functional illiterate since they have a formal education below Grade 4.

Table 4.5 Gender distribution in the household and the household size (n=400)

Gender Distribution in the household			
Number of males		Number of females	
	%		%
0-2	53.25	0-2	52.75
3-5	41.75	3-5	42.25
6-8	5	6-8	5
Household size		%	
1 – 5		56.75	
6 – 10		41.25	
11 – 15		2	

As presented in table 4.5 of gender distribution, there is almost no difference between the distribution of males and females in households interviewed. Households that had less than 3 members who are males is 53.25% and 52.75% for females. Household members ranging between 3 and 5 who are males is 41.75% and 42.25% for females, while household members ranging between 6 and 8 who are males and females are 5% each. This study shows that the average household size in the case study communities is 5.3 and this average is found in the interval that represents 41.35% of respondents. The average household size for male-headed households were slightly higher (5.5) than female-headed households (5.2). Many households (56.75%) encompass between 1 and 5 household members and 41.25% encompass between 6 and 10 household members, while 2% of the respondents encompass between 11 and 15 household members.

Table 4.6 Number of years residing in the village (n=400)

Number	%
>10	26.55
10 – 19	44.5
20 – 29	8
30 – 39	13.85
40 – 49	5.75
50 ⁺	2.75

Table 4.6 shows the number years the respondents had stayed in their respective villages. According to Kotile and Martin (2000), the number of years in farming has a role in influencing the adoption of sustainable agricultural practices. The average number of years respondents resided in their villages is 18.6. A large number of the respondents (44.5%) stayed in their villages for between 10 and 19 years and the average year is found in this interval. This interval is followed by the intervals >10, 30-39, 20-29, 40-49, and 50⁺ that represents 26.55%, 13.85%, 8%, 5.75% and 2.75% of the respondents, respectively.

The results provided by the demographic profile of respondents are positive since it generally correlates with the objectives of the Girinka program which targets vulnerable households. The literature indicates that in many cases vulnerable households are those who are dominated by females, advanced (the elderly) or very young (children) age, unskilled and uneducated people, and, the demographic profile of respondents shows that the respondents are some or all of these vulnerable groups.

4.3 Household economics and sustainable livelihoods

Table 4.7 Area of land cultivated before and after getting the cow (n=400)

	Hectares	%
Quantity of land cultivated before getting the cow (in Hectares)	0 -1	61.25
	1 – 3	38.5
	3 ⁺	0.25
Quantity of land cultivated after getting the cow (in Hectares)	0 -1	48
	1 – 3	51.25
	3 ⁺	0.75

Table 4.7 shows the area of land cultivated by the respondents before and after getting the cow. Before getting the cow, 61.25% of the respondents cultivated between zero and 1 hectares and after getting the cow, this number diminished to 48% of the respondents. The area ranging in the interval of 1-3 hectares had been cultivated by 38.5% of the respondents before getting the cow and 51.25% after. More than 3 hectares were cultivated by 0.25% of the respondents before getting the cow and 0.75% after. The average area cultivated before getting the cow is 1.39 hectares and 1.53 hectares after getting the cow. According to Smith et al. (2013), suggestion discussed in chapter two, the money from cow products or cow sale can also contribute to hiring labor for planting, weeding, harvesting or increasing the area of land cultivated. These results show that the respondents increased the area of land cultivated after getting the cow and this indicates that objective one of this study in terms of crop intensification may be evident.

Table 4.8 Percentage of land cultivated and reasons for not cultivating all land

	% of land cultivated	% of respondents
Total land for agricultural production compared to total available land (n=400)	21-40%	0.5
	41-60%	2.5
	61-80%	2.25
	81-99%	0.75
	100%	94
	Did not cultivate	6
Reasons for not cultivate all land (n=24, multiple responses)	Inadequate labor	50
	Land for grazing	37.5
	Land to fallow	12.5
	Poor and uncultivable land	4.2

Most of respondents (94%) cultivated the total land they accessed, but some (6%) respondents did not cultivate the total they accessed because of diverse reasons. Those who did not cultivate all the land, cultivated 41-40% (2.5%), 61-80% (2.25%), 81-99% (0.75%) and 21-40% (0.25%) of the total land. The main reason for not cultivating the total available land is inadequate labor (50%), followed by leaving the land for grazing purposes (37.5%). Inadequate labor is mainly due to the advanced age of some the respondents. Another reason for not cultivating the total available land is leaving the land to fallow (12.5%). A small number of respondents (4.2%) also do not cultivate their total available land because a part of their land is poor quality.

Despite the fact that most of respondents have poor human capital, their productive labor is good because only 3% of all respondents are those who do not cultivate all their land because of inadequate labor. During the focus group discussion, respondents stated that those with poor human capital sometimes use the money derived from cow products (milk and manure) to hire labor for weeding and harvesting. This indicates that the Girinka program contributes to improving livelihood strategies. The literature indicates that agricultural production is one of the main survival strategies in rural communities in Rwanda and the specific case studies in this research endeavor. The finding therefore is a positive response to the second objective of this study which focuses on the impacts of the Girinka program on livelihood strategies. However, the land to fallow is a worrying result and is perhaps insufficient because only 0.75% of the respondents are not cultivating the entire land available to allow for fallow farming practice while 94% of all respondents cultivate all their land every season which may result in reduced soil fertility. This is against the ISFM discussed in the literature review (Maqsood et al., 2013:1) and may have longer term environmental and food security implications.

Table 4.9 Extension of land for cultivation and reasons for extension (n=400)

		%
Extension of land for cultivation	Yes	47
	No	53
Reasons for extension of land for cultivation	Increase crop production	46.5
	Acquire land for grazing	0.5

The results presented in table 4.9 show that 53% of the respondents did not extend the land for cultivation while 47% had extended it. The main reason of increasing the land for cultivation is to increase crop production that represents 46.5% of the respondents. Only 0.5% of respondents extended the land to acquire land for grazing. According to the findings from the focus group discussions, the extension of land for cultivation is due to the money derived from the sale of milk and male calves. This could also be the reason for increased cultivation in land after receiving the cow as indicated in table 4.7.

Table 4.10 Crops grown before and after getting the cow (n=400)

Crop	% before	% after
Maize	92	94
Cassava	92.75	93.25
Groundnuts	45.25	45.25
Rice	2	3
Sweet potato	76.75	77.25
Irish potato	9.25	9.75
Tobacco	1.25	1.5
Beans	98	98
Sorghum	33.75	33.75
Banana plantation	61	61.25
Cabbage	0.25	0.25

Table 4.10 shows percentages of crops cultivated before and after the introduction of the Girinka program. These results show that types of crops cultivated before getting the cow are generally the same when compared to crops cultivated after getting the cow. Respondents who cultivated maize, rice, cassava, sweet potato, Irish potato, tobacco and banana plantations before getting the cow increased slightly after getting the cow. Those who cultivated beans, groundnuts, sorghum and cabbage did not change before and after getting the cow. These results show that the main crops grown in Bugesera were beans (98%), maize (94%), cassava (93.25%), sweet potato (77.25%) and banana plantations (61.25%). The crops that were least grown in Bugesera were rice (3%), tobacco (1.5%) and cabbage (0.25%).

The literature indicates that money from cow products and cow sale can help to increase crop production by extending cultivation land (Smith et al. 2013). Respondents said that the cow helped them to increase considerably crop production by providing manure as source of fertilizer and money for cultivation land extension. This is also confirmed by the findings from all focus group discussions. This again is also a positive response to the objective one of this study in terms of crop intensification.

Table 4.11 Sources of income in the household (n=400)

Source	%
Sale of livestock	65.25
Sale of rain-fed crops	99.75
Piecework	0.75
Gifts from relatives	2.25
Full-time paid employment	3
Part-time paid employment	0.25
Own business	0.5
Trading	0.75
Crafts	0.75
Beer brewing	0.25
Carpentry	0.25
Ingoboka (the money provided by the Rwandan Genocide Survivors' Fund)	0.75
Masonry	0.75
Pisciculture	0.25

Percentages of all sources of incomes of the Girinka program beneficiaries interviewed are presented in table 4.11. The results show that the respondents' main sources of incomes are sale of rain-fed crops and sale of livestock products (99.75% and 65.25%, respectively). This relates to the literature which indicates that incomes and employment in rural areas are generated by agricultural/ farming activities that also provide food at reasonable prices in urban areas in developing countries which leads to poverty reduction and income growth (Dethier and Effenberger, 2011). These results suggest that the respondents' main sources of activities may have been supported by Girinka program because it is known that cows provide manure that serves as organic fertilizer that increase rain-fed crops. Also the sale of livestock is probably the sale of cow calves or other livestock acquired from the money from the sale of cow products. This is also confirmed by the data from all focus group discussions. These results confirm that the Girinka program has a positive impact on its beneficiaries' livelihoods, which is also a positive result of the aim of this study. This will be discussed in greater detail in the final chapter of this study.

Other sources of income for the respondents are full-time paid employment and gifts from relatives (3% and 2.25%, respectively). Trading, masonry, crafts, piecework and Ingoboka (the money provided by the Rwandan Genocide Survivors' Fund - FARG) are also sources of income for a few of the respondents and count 0.75% each. The respondents that own

businesses are 0.5% while those who are involved in part-time paid employment, beer brewing, carpentry and pisciculture are 0.25% each.

Table 4.12 Coping mechanisms in times of drought with changes in water (n=400)

Coping mechanism with water	%
Lakes	65.35
Rivers	11.25
Water pumps	7
Water from marshes	7
Water from flood plains	7.75
Saving water in huge tanks	0.25
Do not need to cope	1.5

It is known that Bugesera District is characterized by long dry seasons that sometimes lead to drought (Republic of Rwanda, 2012). This lack of water is a major challenge for the respondents because they need enough water for their cows. The Republic of Rwanda (2012) also states that Bugesera main sources of water are its lakes and rivers, which is confirmed by the results of this study presented in table 4.12. Those who stay near lakes and rivers draw water for their cows from these sources, while those who stay far from lakes and rivers struggle to find water for their cows during drought periods. These results show that lakes are used by 65.35% of the respondents during drought period, followed by rivers which are used by 11.25% of the respondents. Only respondents from three Sectors (Rweru, Gashora and Mayange) use lakes as main source of water during drought periods, and this is also confirmed by the data from focus group discussions in those Sectors. Respondents from Ntarama Sector use Rivers as the main source of water during drought periods and this is also confirmed by the data from focus group discussion in that Sector. Some respondents (7.75%) find water from flood plains, while marshes and water pumps also serve as sources of water during drought periods (7% each). Marshes and flood plains are formed themselves following the flooding of the rises in the water level of the Akagera and Nyabarongo rivers that continue to nourish them. Also, one respondent saves water in huge tanks and use that water during drought periods. However, the results of this study show that 1.5% of the respondents do not need to cope with water because they have their own taps.

Table 4.13 Coping mechanisms in times of drought with changes in vegetation (400)

Coping mechanism with vegetation	%
Marshes	14.5
Flood plains	14.5
Do not need to cope	72

Table 4.13 presents the coping mechanisms in times of drought with changes in vegetation. Marshes and flood plains were found to be the only coping mechanisms with changes in vegetation in this study (14.5% each) because respondents cultivate in these areas during drought periods. However, 72% of the respondents do not need to cope with changes in vegetation in times of drought because they save enough food that they eat or sell crops and save money that they will use during drought periods. This is also confirmed by the findings from focus group discussions.

Table 4.14 Coping mechanisms in times of drought with changes in pasture (400)

Coping mechanism with pasture	%
Lakesides	5.55
Banana plant stalks	0.75
Flood plains	9
Marshes	18
Forests	0.75
Do not need to cope	53.75

The results presented in the table 4.14 show the different sources of fodder during drought periods. Marshes, flood plains and lakesides are the main sources of fodder during drought period for respondents who do not have enough pasture. They were used by the respondents at the rates of 18.1%, 9% and 5.6%, respectively. A large number of respondents (53.75%) do not need to cope with pasture because they have enough pasture so that they can save fodder for drought periods. Other respondents cope with pasture through banana plant stalks and forests at the rate of 0.75% each.

Respondents who do not need to cope with pasture and vegetation changes are mainly those who possess a large area of land for crop and fodder cultivation (53.75%). Agro-forestry is encouraged by the Government of Rwanda particularly in Bugesera District to combat drought, and fodder cultivation also helps to avoid soil erosion. The Girinka program

increased considerably fodder cultivation and supported agro-forestry by providing manure as fertilizer as indicated in the literature and supported by participants during the focus group discussions. This is also a positive response in relation to the second objective of this study in terms of livelihood strategies such as adaptation and coping strategies in relation to drought at the household level. These livelihood strategies discussed above, also respond positively to the fifth objective linked to impacts of the Girinka program on climate resilience. Agro-forestry and fodder cultivation are linked to mitigation which is one of the types of climate resilience strategies. In relation to the role of the Girinka program on climate resilience strategies such as agro-forestry and fodder cultivation, it is clear that the Girinka program has a positive impact on climate resilience.

Table 4.15 Coping strategies for food during drought periods before getting the cow (n=400)

Coping strategy	%
Buy cheap food that they do not like	77.75
Reduce number of meals per day	74
Reduce the quantity of the food per meal	76.25
Casual labor	4.25
Work for food	1
Seasonal off-farm labor	20
The entire family relocation	1.75
Food aid from different NGOs in collaboration with Rwandan Government	0.75

The literature says that in the case of insufficient assets and resources, households that avoid or resist stress and shocks are considered to have sustainable or secure livelihoods while households that cannot cope with stress and shocks without being damaged are extremely vulnerable and households that can use different strategies to cope with stress and shocks are vulnerable (Niehof and Price, 2001). The table above shows the rates of different coping strategies for food during drought periods before getting the cow. In terms of Niehof and Price's (2001) assertion, it is clear that most of households interviewed were vulnerable because they had high rates of different coping strategies. The coping strategies for food during drought periods mostly used were buying cheap food that they do not like, reducing the quantity of meals per day, reducing number of meals per day and seasonal off-farming labor which were identified by 77.75%, 76.25%, 74% and 20% of the respondents, respectively. Other coping strategies for food used by the respondents before getting the cow

were casual labor, relocation of the entire family, work for food and food aid which were identified by 4.25%, 1.75%, 1% and 0.75% of the respondents, respectively.

Table 4.16 Sources of energy for cooking (n=400)

Source of energy for cooking	%
Charcoal	0.75
Firewood	99.75
Cow dung	0.5

Table 4.16 presents different sources of energy for cooking currently (that is, after households received a cow) that were used by the households interviewed. Most of the respondents (99.8%) use firewood as source of energy for cooking. The findings from focus group discussions also show that firewood is mostly used by the respondents as a source of energy for cooking. Charcoal and cow dung are used by 0.75% and 0.5% of the respondents, respectively. This indicates that cow dung usage as a source of fuel for cooking is still at a very low level while the literature suggests that at least two cows can generate valuable manure (bio-waste) to use biogas digesters that will generate sufficient biogas to supply the household cooking fuel needs (Henerica et al. 2011). They add that the reduction in poverty will decrease the use of biomass and related activities such as deforestation, overgrazing and over-cultivation. These results from this study indicate that the generation of biogas maybe an untapped potential that could reduce the reliance on firewood in Bugesera.

Table 4.17 Sources of energy for lighting (n=400)

Source of energy for lighting	%
Firewood	0.5
Electricity	25.75
Solar power	1.75
Candle	14
Paraffin	24.75
Cow dung	0.5
Torch	39.25

Table 4.17 presents different sources of energy for lighting used by the respondents. The torch is mostly used as source of lighting by the respondents, followed by electricity and paraffin. They are used by 39.25%, 25.75% and 24.75% of the respondents, respectively. Other sources of energy for lighting are candles followed by solar power, cow dung and firewood, which are used by 14%, 1.75%, 0.5% and 0.5% of the respondents, respectively. These results show that the Girinka program is improving considerably among its beneficiaries the ability to access electricity as source of energy because 25.75% of the households interviewed can afford the cost of electricity. The target of the Rwandan government is to electrify 35% of the population by 2020 by developing micro-hydro, solar, and methane-based solutions (Javadi et al., 2013). They also suggest that electricity can improve the quality of life of humans by increasing the level of health, education, welfare and technology. Studies carried out in South African rural villages with readily available electricity demonstrated that over 90% of households use firewood as primary energy source because of the cost of electricity and appliances (Hunter et al., 2013). This shows that poor rural communities are hybrid users of energy (that is, they use multiple sources of energy), even when electricity is readily available. This is also the case in Rwanda where multiple sources of energy is being used in Bugesera. In Bugesera, compared to South Africa, some households mainly use electricity as source of energy for lighting. Electricity is not the main source of energy and this was also confirmed during the focus group discussions with only a quarter of the participants stating that electricity is a main source of energy for lighting.

In relation to the objectives of this study regarding biogas energy production using manure and Girinka program impacts on climate resilience, it is important to note that only two households interviewed stated that they used cow dung (tables 4.16 and 4.17). The use of manure in production of biogas energy by Girinka beneficiaries is still at a very low, almost non-existent, level and this is caused by the price of purchasing the biogas power generator which is expensive for Girinka program beneficiaries. Thus, it is possible that initial start-up costs prevent the use of biogas in Bugesera. These results regarding the sources of energy show a step towards climate resilience by reducing the GHG emissions with the use among a few of alternate, renewable sources such as solar energy and addresses the fifth objective of this study. However, the use of paraffin and candles as sources of energy for lighting and the almost total reliance on firewood for cooking are still at a high level as presented above and they increase the GHG emissions to the atmosphere.

4. 4 Cow practices

Table 4.18 Cow dung practices (n=400)

		%
Use of cow dung before receiving the cow	Yes	6
	No	94
Source of cow dung used before receiving the Girinka cow	From cows held for safe keeping	1
	Purchased	2
	Free from neighbors	3.25
Reason for not using cow dung as fuel source after receiving the cow	Not know how to use it	75.25
	Not needing it	20.25
	Biogas generator installation is expensive	7
	Not have enough cow dung for both fertilization and energy source	2

Table 4.18 presents results in relation to whether Girinka beneficiaries used cow dung before getting the cow and the reasons for not using cow dung as source of energy or fertilizer after getting the cow. Maqsood et al. (2013:1) state that increased use of external inputs is the only way to increase agricultural production. Before the initiation of the Girinka program, only 6% of the respondents used cow dung as source of energy or fertilizer which is the cheapest external inputs on their farms, while 94% did not use cow dung as source of energy and fertilizer. The cow dung used before getting the cow was free from neighbors (3.25%), purchased (2%) and one respondent stated from cows held for safe keeping. The results of this study show that 75.25% of the respondents did not know how to use cow dung as fuel source and 20.25% do not need to use cow dung as fuel source. Some of the respondents (7%) said that they don't use biogas energy because its generator installation is expensive. Also, 2% of the respondents do not have enough cow dung for both fertilization and energy source. These findings are important to note since the majority of the respondents would likely use cow dung if they knew how to use it and if there was sufficient cow dung available. The literature indicates that manure serves as a power generating (biogas) source and that it reduces deforestation and GHG emissions in the atmosphere (FAO, 2006). The results suggest that the Girinka program may have been a missed about to educate beneficiaries about the multiple use of the cow and cow by-products.

The researcher observed that those who used electricity as an energy source are those who do not need to use cow dung as an energy source and those who do not know how to use cow dung as a fuel source are uneducated respondents. Also, the direct use of dry cow dung as fuel for cooking is not known by the respondents.

Table 4.19 Ownership of livestock before and after getting the cow (n=400)

Livestock		%			
	Number	% before	Total % before	% after	Total % after
Cattle	1 – 3	-	-	98	100
	4 – 6	-		1.75	
	7 ⁺	-		0.25	
Sheep	1 – 3	-	0.25	1.55	1.85
	4 – 6	-		-	
	7 ⁺	0.25		0.25	
Goats	1 – 3	12.75	17.5	29.55	40.5
	4 – 6	3.35		6.75	
	7 – 9	0.75		2.25	
	10 ⁺	0.5		1.85	
Pigs	1 – 3	2	2	9.75	10.65
	4 – 6	-		-	
	7 ⁺	-		0.85	
Rabbits	1 – 3	1	2.15	2.25	4.5
	4 – 6	0.75		1.55	
	7 ⁺	0.25		0.55	
Poultry	1 - 3	3.25	10.55	9	16.65
	4 – 6	3.25		4.35	
	7 – 9	1.25		1	
	10 ⁺	2.65		2	

Table 4.19 presents all livestock owned before and after getting the cow. This study shows that Girinka beneficiaries had no cattle at the time of receiving the cow as planned by the program and the results show that all other livestock increased after getting the cow. This is supported by research conducted by Kent and Dorward (2012) who found that the collection and sale of cow products by poor households assisted in the accumulation of assets and livelihood security. By personal communication, this statement was confirmed by

respondents who told the researcher that they bought other livestock by the money from cow products. Also, *Rwandapedia* (2013) states that the Girinka program increased the earnings of beneficiaries from sale of milk, milk products, meat and manure. The findings from focus group discussions also confirm that the Girinka program helped the respondents to buy other livestock. The results presented in the table 4.19 shows that all respondents have a cow from the Girinka program and at the time of data collection they had cows ranging from 1 to 7 per respondent. The respondents whose cows increased from 1 to 7 indicate great livelihood improvement with almost all households (98%) interviewed having 1-3 cows. Goats, pigs and poultry increased considerably compared to other livestock even if all types of livestock increased. Before the program only 17.5% of respondents owned at least one goat, while after the program 40.5% of respondents owned at least goat. Goats increased because they are drought tolerant and this is indicative of yet another climate resilience strategy being adopted by some households in Bugesera. Pigs had been owned by only 2% of the respondents before the program and were owned by 10.65% after the program. Pigs increased because they are omnivorous and eat different types of food and therefore it is easy to feed them. Respondents who own poultry increased from 10.55% to 16.65%. Rabbits and sheep also increased from 2.15% and 0.25% to 4.5% and 1.85%, respectively. This increase of livestock shows the improvement of livelihoods in terms of increased income generating activities, and this addresses the second objective because the Girinka program is viewed as being the cause of livestock increase which was also highlighted during the focus group discussions. Livestock are physical assets and play a significant role in rural livelihoods.

Table 4.20 Average number of livestock owned before and after getting the cow (n=400)

Number of livestock before	Average number	Number of livestock after	Average number
Number of cattle possessed before getting the cow	0	Number of cattle possessed after getting the cow	1.41
Number of sheep possessed before getting the cow	0.03	Number of sheep possessed after getting the cow	0.04
Number of goats possessed before getting the Girinka cow	0.51	Number of goats possessed after getting the cow	1.25
Number of pigs possessed before getting the Girinka cow	0.03	Number of pigs possessed after getting the cow	0.20
Number of rabbits possessed before getting the Girinka cow	0.09	Number of rabbits possessed after getting the cow	0.16
Number of poultry possessed before getting the Girinka cow	0.62	Number of poultry possessed after getting the cow	0.67

Even if there is an increase of livestock among the respondents as discussed in table 4.19, the average number of livestock owned presented in the table 4.20 is still small because some respondents did not yet have livestock other than cow and households in general did not have many livestock. Before that Girinka program, goats had the largest average number (0.51), followed by poultry, rabbits, pigs and sheep with average numbers 0.62, 0.09, 0.03 and 0.03, respectively. The average number of cows was zero before the program because no respondent owned a cow before the program. After the program, the results of this study show that the average number of cows (1.41) increased significantly and was the highest compared to other livestock owned. This was followed by goats, poultry, pigs, rabbits and sheep with average numbers of 1.25, 0.67, 0.20, 0.16 and 0.04, respectively. The results suggest that the Girinka program may be increasing the asset base of households which resonates with the literature.

Table 4.21 Adequacy of land for grazing and cultivation (n=400)

		%
Accessibility to land for grazing	Yes	13
	No	87
Type of land for grazing	Communal land	4
	Private land	9
	Both	0.5
Adequacy of land for grazing	Poor	4.75
	Satisfactory	4.25
	Good	4.5
	Excellent	0.5
Adequacy of land for cultivation	Poor	0.5
	Satisfactory	11
	Good	39
	Excellent	49.25

Table 4.21 presents the results regarding land for grazing and cultivation. These results show that 13% of the respondents have access to land for grazing, and 87% of the respondents do not have access to land for grazing. The grazing farming practice among some of the respondents is against the policy regarding the Girinka program because the literature states that the Girinka program encourages a zero-grazing farming system (Rwandapedia, 2013). The grazing farming system is also a negative response to the fifth objective of this study regarding climate resilience because overgrazing increases drought. During personal

communication with the researcher, the respondents that used the grazing system said that they do it only during drought periods because it is very hard to find fodder for cows. This is also confirmed by the findings from all the focus group discussions. This suggests that the inability to have options to deal with stress during drought forces households to engage in practices that worsens environmental conditions in the long-term. The land for grazing was found to be private, communal and sometimes both at the rates of 9%, 4% and 0.5%, respectively. The quality of land for grazing was rated as poor (4.75%), satisfactory (4.25%), good (4.5%) and excellent (0.5%), while the quality of land for cultivation was rated as excellent (49.25%), good (39%), satisfactory (11%) and only 0.5% indicated poor. This adequacy of land for cultivation can be due to the use of manure from the cow as a source of fertilizer and this is confirmed by the data from all focus group discussions.

Table 4.22 Training and regulations regarding livestock (n=400)

		%
Possession of training about cow practices	-	100
Adequacy of training	-	100
Trainers about cow practices	Government of Rwanda	99.75
	NGOs	4.25
Possession of regulations regarding livestock	-	100
Types of regulations	Feeding cows in cow shades only	100
	Wash the cow with anti-parasites medications at least twice a week	100

The literature says that the Girinka program encourages the zero-grazing system and cows are supposed to be fed by cut and carried fodder and to be sheltered under roofed houses because this system has the potential to minimize disease transmission through open grazing and also to maximize manure collection (Ntanyoma, 2010). According to the literature, the training is supposed to be provided by the RAB in collaboration with local government (Rwandapedia, 2013). The results of this study show that the respondents have been trained about cow practices and the training is deemed to adequate by all the respondents as presented in table 4.22. Almost all the respondents (99.75%) stated that trainers are from the Government of Rwanda through RAB and 4.25% stated that NGOs are the trainers. Some respondents received training from both the Government of Rwanda and NGOs. Also, all the respondents

stated that they were in possession of two regulations regarding livestock. The first regulation is to feed cows in cow sheds only and the second is to wash the cow with anti-cow pest agents medications at least twice a week. The results presented in table 4.22 address the third objective of this study, that is, to examine the perceptions and concerns of households towards the Girinka program.

Table 4.23 Farming practices (n=400)

Farming practices	%
Conservation agriculture	47.3
Improved fallow	13.5
Crop rotations	99
Agro-forestry	91.8
Green (organic) manure	96.3
Windbreaks	39.8
Irrigation	0.3
Use of organic manure from the cow	96.3

All farming practices used by the respondents are presented in the table 4.23. The literature states that progressive and steady modification of the natural resources can built up soil fertility and “the ISFM is a viable tool to rebuild degraded soils, vegetation and water by crop fallowing, selecting crop species, organic fertilizing, transferring crop residues and fodder” (Maqsood et al., 2013:1). In this study, the respondents use mostly crop rotations, green manure (organic fertilizer) and agro-forestry farming practices at the rates of 99%, 96.25% and 91.75%, respectively. All green manure (96.25%) used by Girinka program beneficiaries is from the cow as presented in table 4.23. They also use conservation agriculture, windbreaks, improved fallow and irrigation farming practices at the rates of 47.25%, 39.75%, 13.5% and 0.25%, respectively. These farming practices are needed to combat climate change. Thus, it is clear that the Girinka program contributes to and has the potential to contribute to a greater extent to climate resilience strategies by providing organic fertilizer through manure. According to the FAO (2011), irrigation is the best adaptation to water scarcity and variability because it provides approximately 40% of the world’s food from 20% of agricultural land or about 300 million hectares worldwide. Irrigation has been prioritized by the Rwandan Government as a means to achieve sustainable food security in the face of climate change (New times, 2011). However, the level of irrigation among the respondents is almost non-existent with only one respondent stated that they were involved in irrigation

practices. The participants during the focus group discussions stated that this is because most of their farms are located far from rivers and lakes. FAO (2006) states that agro-forestry provides biomass in the soil in order to improve soil fertility by carbon sequestration and an increase of soil carbon pool of cropland soils increase crop yield. The respondents' use of agro-forestry farming practice is successful because 91.8% of them use it, and this correlates to the FAO statement and to the fifth objective of this study as well. The Girinka program supports agro-forestry by providing manure as inorganic fertilizer.

4.5 Girinka Program Services

Table 4.24 General information on Girinka program cows (n=400)

		%
Reception year of the Girinka cow	2007	10.25
	2008	15.75
	2009	11.5
	2010	23
	2011	39.5
Type of cow received	Local	39.25
	Cross	32.5
	Frisian	25.5
	Jersey	2.8
Cows ever calved	Yes	64.5
	No	35.5
Number of calves from receiving first cow	1 – 2	45
	3 – 4	18.25
	5 – 6	1
Calves kept		31.5
Number of calves kept	1 – 2	30.75
	3 – 4	0.75
Calves given away	-	55.5
Number of calves given away	1	55.5
	2	0.25
Calves sold	-	20.5
Number of calves sold	1	16.5
	2	3.75
	3	0.25
Calves given to neighbor for safe keeping	-	1.25
Calves died	-	8.25
Number of calves died	1	9
	2	0.25
Number of cows possessed at time of data collection	1 – 3	98.85
	4 – 6	1
	7 ⁺	0.25

This study planned to interview only beneficiaries that received the cow from 2006 to 2011 and the literature shows how cows were distributed in Bugesera District during that period. According to Rwandapedia (2013), 218 cows were distributed in 2007, 4 574 in 2008, 556 in 2009, 137 in 2010 and 712 cows were distributed in 2011 in Bugesera District. The Girinka program started in 2006 in some Districts of Rwanda but it commenced in 2007 in Bugesera District. The results of this study presented in table 4.24 show that respondents received cows

at the rates of 10.25% in 2007, 15.75% in 2008, 11.5% in 2009, 23% in 2010 and 39.5% in 2011, and it is clear that a large number of cows was distributed in 2011 followed by 2010. Four types of the cows have been received at the rates of 39.3% local, 32.5% cross breed, 25.5% Friesian and 2.8% Jersey. Local breeds are mostly distributed, followed by cross breeds and Friesian while Jersey cows are less distributed. The literature states that local breeds and cross breeds produce less milk compared to improved breeds like Friesian, Jersey and Pure Sang (Ntanyoma, 2010). He further reveals that the program tried to increase improved breeds in order to increase milk production.

The results of this study show a big improvement because, according to the Rwandan Patriotic Front (2008) report, local breeds distributed from 2006 to 2008 were 73.4% of all cows distributed. But now, the results of this study show that local breeds are 39.25%. This is due to the encouragement of cross breeding mating system and distribution of improved breeds by RAB. Only 64.5% of respondents said that their cows calved at least once and 35.5% of the cows have not yet calved. This is because some respondents (1.25%) have young heifers (one year old) from neighbor beneficiaries of the program. Also, as discussed in the focus groups, in some villages, if the first calf is male, the next poor candidate gets it; when it becomes mature; it is sold and the money is used to buy a heifer. This process takes a long time to get milk from the Girinka program cow, but it is also important because the manure from the bull is helpful in livelihood improvement. The average number of calves per cow is 1.25 with the number of calves ranging from 1 to 6. This average is small because some cows have not yet calved as presented in the table 4.24. Forty five percent of the cows have 1 to 2 calves and 18.25% have 3 to 4 calves, while only 1% has 5 to 6 calves. As targeted by the program, 55.5% of the calves have been given away, 31.5% of calves are kept and 20.5% of calves have been sold, while 8.25% of calves died. Also 1.25% of calves were given to neighbors for safe keeping. At the time of data collection, 98.85% of respondents had 1 to 3 cows in total and 1.25% had 4 to 6 cows. The average number of cows in total is 1.38 and 98.85% of the respondents possess at least the average number of cows in total.

Table 4.25 Milk production and its utilization (n=400)

		%
Lactation length (in months)	1-5	18
	6-10	42.25
	11 ⁺	5
Quantity of milk produced during lactation period (in liters)	< 1000	47.75
	1000 – 1999	13.5
	2000 – 2999	2.85
	3000 – 3999	1.35
	4000 – 4999	1
	5000 ⁺	0.5
Price of the milk per liter (in Rwf)	150	4
	180	0.75
	200	58.25
	250	1.75
Quantity of milk consumed (in liters)	>500	45.5
	500 – 999	16.25
	1000 – 1499	3.75
	1500 ⁺	1.25
Quantity of milk sold (in liters)	>500	20.75
	500 – 999	12.75
	1000 – 1499	5.75
	1500 ⁺	4.75
Soured milk made at household level	-	48.5
Soured milk used at the household level	-	48.5
Soured milk sold at the household level	-	1.75

There is no fixed lactation length and milk production per Girinka cow because the cows given are varied by types and also the production of same type of cows vary according to coping mechanisms with pasture. According to the literature, the program estimates the average of 10 liters per cow per day and it also estimates that 7 liters are sold while 3 liters are consumed at the household level (Ntanyoma, 2010). The estimated value of the milk per lactation period is 378 000Rwf and the price per liter is estimated to be 200Rwf (Ntanyoma, 2010). According to the estimations above, it is clear that the estimated lactation period would be 9 months and the total milk produced per lactation period would be 2 700 liters, 1 890 liters sold and 810 liters consumed at the household level. The results of this study show that 42.25% of all cows that calved have lactation lengths ranging between 6 and 10 months which relate to what the literature says, 17.75% have lactation lengths ranging between 1 to 5 months, while only 5% have more than 10 months. The average milk per lactation period per cow is 559.24 liters and 47.75% of the respondents produced at least the average milk per

lactation length. This average is smaller than that estimated by the program because 35.5% of the cows in this study had not yet calved. Also this average could be small due to the fact that most of the respondents (39.25%) received local breeds and these produce less milk compared to other breeds. The program estimates 2 700 liters per lactation period per cow but the results of this study show that 47.75% of all cows that calved produce less than 1 000 liters per lactation period. The results presented in table 4.25 show that 13.5% produce between 1 000 and 1 999 liters, 2.75% produce between 2 000 and 2 999 liters, 1.25% produce between 3 000 and 3 999 liters, 1% produce between 4 000 and 4 999 liters, and 0.5% produce 5 000 liters or more per lactation period. These results also show that 58.25% of the respondents said that the price of one liter of milk is 200Rwf as suggested by the literature review.

However, 4% of the respondents said that the price of milk per liter is 150Rwf, 1.75% said 250Rwf and 0.75% said 180Rwf. These results also show that 45.5% of the respondents consumed less than 500 liters of milk per lactation period, 16.25% consumed between 500 and 999 liters, 3.75% consumed between 1 000 and 1 499 liters and 1.25% consumed 1 500 liters or more per lactation period; while 20.75% of the respondents sell less than 500 liters of milk per lactation period, 12.75% sell between 500 and 999 liters, 5.75% sell between 1 000 and 1 499 liters and 4.75% sell 1 500 liters and more. The average milk consumed is 270.98 liters per lactation length, while the average milk sold per lactation length is 291.54 liters. These results show that 45.5% of the respondents consumed at least the average milk consumed per lactation length, and 20.75% of the respondents sold at least the average of milk sold per lactation length. Close to half of the respondents (48.5%) produce and consume soured milk at the household level, while only 1.75% of the respondents sell soured milk. This consumption of milk and milk products addresses the first objective of this study regarding the increase of food nutrients (milk and related products) by the Girinka program. Specifically, according to the literature discussed in chapter two, this milk consumption relates to the objective Girinka program of reducing child malnutrition through milk consumption. However, it is important to note that this study does not examine intra-household dynamics in relation to who within the household uses the milk. There is therefore the need for future research in this area.

Table 4.26 Cow feeding, medicating and watering (n=400)

		%
Cow shed cost (in Rwf)	>20 000	52.25
	20 000 – 39 999	20.75
	40 000 ⁺	10.25
Respondents who did not spend money on cow shed	-	19
Feed the cow in cattle sheds	-	100
Feed the cow by taking it to the farm for grazing	-	11.25
Feed the cow by fodder from their own farm	-	100
Buy fodder for the cow	-	43.75
Cost of the fodder for previous 6 months starting from data collection date (in Rwf)	>10 000	27
	10 000 – 19 999	14.5
	20 000 ⁺	7.75
Respondents who did not spend money on fodder	-	51.5
Cost of cow medication for previous 6 months starting from data collection date (in Rwf)	>5 000	53.25
	5 000 - 9999	15.25
	10 000 – 14 999	6.75
	15 000 ⁺	7.25
Respondents who did not spend money on cow medication	-	19.5
Quantity of water that the cow takes per day (in liters)	>20	3.5
	20 – 39	55.25
	40 – 59	29.75
	60 ⁺	11.75
Cost of water for the cow for previous 6 months starting from data collection date (in Rwf)	>10 000	37.25
	10 000 – 19 999	11.75
	20 000 ⁺	6.5
Respondents who did not spend money on water	-	45.5

Table 4.26 presents the results on cow feeding, medicating and watering. The literature does not talk about the cost of cow sheds for this program. All respondents stated that Girinka program cows are kept in cow sheds during rain periods, but in drought season some cows are sometimes taken to graze on the farms. These results show that 52.25% of the respondents spent less than 20 000Rwf on cow sheds, 20.85% spent between 20 000 and 39 999Rwf and 10.25% spent 40 000Rwf or more for cow sheds. The cost of cow sheds varies according to the materials used, and these results show that the average cost of Girinka cow shed is 15807.5Rwf which is in the interval of less than 20 000Rwf and indicates that 52.25% of the respondents spent close to average cost of cow shed. However, 19% of the respondents

did not spend money on cow sheds. It was noted that they build it themselves with wood and ropes.

According to the literature, the estimated cost of cow medication per year is 55 000Rwf, but this study shows that 53.15% of the respondents used less than 5 000Rwf per 6 months, 15.15% used between 5 000 and 9 999Rwf per 6 months, 6.75% used between 10 000 and 14 999Rwf per 6 months and only 7.35% used 15 000Rwf or more per 6 months for cow medication. The average medication cost is 5008.45Rwf. However, 19.5% of respondents did not spend money for cow medication. They received cow medication as gifts from NGOs. These results show that Girinka cows are fed by fodder from their own farm among all households interviewed, 43.75% bought fodder and 11.25% took the cow to the farm for grazing. However, despite the zero-grazing policy of this program, as indicated earlier, this study shows that some respondents take their cows to graze in the farm and also, the findings from focus group discussions estimate that during drought periods 5% of the Girinka program cows are taken to graze on the farms.

These results also showed that 27% of respondents spent less than 10 000Rwf on fodder for the cow per 6 months, 14.5% spent between 10 000 and 19 999Rwf and only 7.75% spent 20 000Rwf or more. The average fodder cost per 6 months is 5448.25Rwf. However 51.5% of the respondents did not spend money on fodder; they find fodder from their own farms only.

The literature does not talk about the quantity of water used by the Girinka program cow and its costs. These results show that 3.5% of the cows consumed less than 20 liters per day; 55.25% consumed between 20 and 39 liters per day, 29.75% consumed between 40 and 59 liters per day and 11.75% consumed 60 liters and more. The average quantity of water consumed by the Girinka program cow per day is 33.15 liters. The respondents also spent money on water for the cow and 37.15% of the respondents spent less than 10 000Rwf per 6 months, 11.85% spent between 10 000 and 19 999Rwf while 3.15% spent 30 000Rwf and more on water for the cow per 6 months. The average cost of water for the cow is 5326.93Rwf. However, 45.5% did not spend money on water for the cow because they draw water from lakes, rivers and marshes. The respondents located far from lakes and rivers are those who buy water for their cows.

Table 4.27 Manure production and management (n=400)

		%
Quantity of manure provided by the cow in the previous cultivation season (in kg)	< 5 000	27.25
	5 000 – 9 999	45.75
	10 000 ⁺	27.75
Quantity of manure used in their farm (in kg)	< 5 000	30
	5 000 – 9 999	41.25
	10 000 ⁺	25.75
Respondents who did not use manure in their farms	-	3.75
Quantity of manure sold (in kg)	< 5 000	5.75
	5 000 – 9 999	4.75
	10 000 ⁺	3.75
The money got from selling manure (in Rwf)	< 10 000	6.75
	10 000 – 19 999	4.75
	20 000 ⁺	3
Respondents who did not sell the manure	-	85.75
Use of chemical fertilizer in the previous cultivation season	Yes	8
	No	92
Sources of chemical fertilizer	GoR	3.25
	NGOs	1.25
	Bought	6
The money spent for chemical fertilizer (in Rwf)	< 20 000	2.75
	20 000 – 39 999	2.75
	40 000 ⁺	1.25

The literature estimates that one Girinka cow can produce 20 000 kg of manure per year equivalent to 200 000Rwf (Ntanyoma, 2010). The results of this study presented in table 4.27 show that 27.25% of the Girinka cows produced less than 5 000 kg per year, 45.85% produced between 5 000 and 9 999 kg, and 27.65% produced 10 000 kg or more. The quantity of manure produced by a cow depends on the quantity of grasses for the cow to sleep on. During the rain periods, the quantity of cow beddings increase and the quantity of manure increases as well. The average quantity of manure per cultivation season is 8 004 kg and 45.85% of the cows produced about the average manure per cultivation season. Thirty percent of Girinka beneficiaries used less than 5 000 kg of manure on their farms per cultivation season, 41.15% used between 5 000 and 9 999 kg and 25.65% used 10 000 g or more manure on their farms per cultivation season. The average quantity of manure used by the respondents on their farms is 6 692.75 kg and 41.15% of the respondents used about the

average quantity of manure on their farms. However, 3.75% of the respondents do not use manure from cows on their farms due to the following reasons:

- Some said that their farms are very fertile and do not need manure for fertilization; they added that when they put manure it destroys crops.
- Others stay with their cows in townships far from their farms and they said that they are unable to rent cars for manure transportation.
- Very old people who are unable to keep the cow sometimes give their cows to their relatives for safe keeping. If neighbors keep the cows they share both manure and milk.

As discussed in chapter two, the use of organic manure in farms is one of the types of climate resilience strategies and addresses the fifth objective of this study. Most of the respondents (85.75%) in Bugesera District do not sell the manure; they use all of it on their farms. But 5.85% of the respondents sold less than 5 000 kg, 4.85% sold between 5 000 and 9 999 kg and 3.85% sold 10 000 kg or more per cultivation season. These results show that 6.65% of the respondents sold the manure at less than 10 000Rwf, 4.65% sold it at between 10 000 and 19 999Rwf while 3% of the respondents sold it at 20 000Rwf or more per cultivation season. The average money from manure per cultivation season is 1663.75Rwf. Only 8% of the respondents used chemical fertilizer in the previous cultivation season, while 92% of the respondents did not use it. The results of this study show that 6% of the chemical fertilizer was purchased, 3.25% was provided for free by the Government of Rwanda while 1.25% was provided by NGOs. The literature says that the combination of both organic and inorganic fertilizers seems to be more productive and the efficient combination of these fertilizers needs some technical skills (Ntanyoma, 2010). Only 2.75% of the respondents spent less than 20 000Rwf on chemical fertilizer, 2.75% spent between 20 000 and 39 999Rwf and 1.25% of the respondents spent 40 000Rwf and more. The average cost of chemical fertilizer is 21 754Rwf per cultivation season.

Table 4.28 Advantages of the Girinka program (n=400)

	%
Livelihoods improved by Girinka program	97
Crop production increase	96
Child malnutrition eradication	95.5
Savings increase	88
Milk	100
Manure	100
Dung as source of fuel for cooking and lighting	7.25
Creation of friendship between neighbors by sharing milk and manure	1
Meat	2
Dowry	0.5
Confidence and dignity of having a cow	1.25

Ntanyoma (2010) states that in the short and long run, the Girinka program has a positive effect on households' income without including medication, cow shed and water costs. The results of this study presented in table 4.28 show that 97% of the respondents stated that the program improved their livelihoods. This improvement is also linked to other responses which include perceived benefits as being an increase in crop production (96%), eradication of child malnutrition (95.5%) and the increase of savings (88%) identified by the majority of the respondents. These results discussed above are also confirmed by the data from focus group discussions. Additionally, the findings from focus group discussions show that eradication of child malnutrition is confirmed by the fact that since 2009 there are no more Nutritional Centers in Bugesera District. Those Centers were in charge of providing food to children that suffered from malnutrition-related diseases in the region but two years after Girinka program has been implemented in Bugesera District they closed because there were no more child malnutrition in the region. All respondents stated that the main benefits of the program are manure that rejuvenated their farms and the milk produced. The literature estimates that at least two cows can generate valuable manure (bio-waste) to use biogas digesters that will generate sufficient biogas to supply the household cooking fuel needs (Henerica et al., 2011). As indicated earlier in this study, only 7.25% of respondents are aware that cow dung is used as source of fuel for cooking and lighting. Also the literature suggests that according to Rwandan culture, the Girinka program will create friendship between neighbors, improve unity and reconciliation, increase meat production and be used as dowry payment. The focus group discussions also indicated that the Girinka program helped them to buy other household assets such bicycles, cell phones and some of them built

better houses. The results of this study show that meat, friendship and dowry as benefits from the Girinka program are 2%, 1% and 0.5%, respectively, while the findings from focus group discussions show that the Girinka program improved considerably friendship, unity and reconciliation in the community. These results discussed above show that Girinka program has a positive impact on its beneficiaries' livelihoods and indicate food security for its beneficiaries because of the eradication of malnutrition. Also, the respondents generally have a good knowledge of the benefits of having at least one cow. This is a positive response to the fourth objective of this study regarding households' knowledge towards the benefits of the Girinka program. The results on the aim of this study will be discussed in greater detail in the final chapter.

Table 4.29 Disadvantages of the Girinka program (n=400)

	%
None	90.5
Insufficient veterinarians	3.75
Corruption of Ubudehe committee which is in charge of beneficiaries selection	1.5
Insufficiency or absence of land for fodder cultivation	1.75
Fodder stealing from neighbors	0.75
Inadequate artificial insemination	0.75
Inadequate labor for cow keeping for old people	1

Table 4.29 presents the disadvantages of the Girinka program. These results show that 90.5% of the respondents said that there is no advantages of the Girinka program. However, 3.75% of the respondents said that veterinarians are insufficient and focus group discussions in Rweru, Mayange and Ntarama Sectors also said confirmed that they need veterinarians at cell level because there is only one veterinarian at Sector level. The findings from the focus group discussion in Gashora sector did not identify insufficiency of veterinarians as a concern. Another disadvantage of the program is the corruption of the Ubudehe committee who is in charge of conducting the selection of first calves' beneficiaries, which sometimes does not respect the selection regulations and this was confirmed by 1.5% of the respondents. However, the findings from the focus group discussions did not identify as a challenge or disadvantage of the Girinka program. Other disadvantages are insufficiency or absence of land for fodder cultivation (1.75%) that leads to fodder stealing from neighbors (0.75%).

Inadequate artificial insemination (0.75%) is also a disadvantage of the program and the inadequate labor for keeping the cow by old beneficiaries (1%). Gashora Sector's livestock veterinarian interviewed by the researcher said that inadequate artificial insemination is caused by poor cow feeding particularly during drought periods.

Table 4.30 Income generating activities before and after the Girinka program (n=400)

Activity before	%	Activity after	%
Permanent employment	1.5	Permanent employment	1.5
Part-time paid employment	1.25	Part-time paid employment	1.5
Agricultural/ farming activities	99.75	Agricultural/ farming activities	99.75
-	-	Sale of manure	9.75
Trading	0.75	Trading	2.5
Crafts	0.5	Crafts	1.5
Beer brewing	1	Beer brewing	1.25
Carpentry	0.25	Carpentry	0.25
Masonry	2	Masonry	1.75
Casual labor	4.5	-	-
Work for food	1	-	-
Pisciculture	0.25	Pisciculture	0.25

Table 4.30 presents the income generating activities of the households interviewed before and after getting the cow. The income generating activities of the Girinka program after getting the cow were discussed in the table 4.11 (page 9). The comparison between income generating activities before and after the Girinka program shows that most of Girinka beneficiaries did not change their income generating activities, except sale of manure which was introduced after the program by 9.75% of the respondents. Casual labor and work for food stopped completely after the program. These results address the second objective of this study regarding income generating activities. It is clear that there is no creation of new activities except for the sale of manure. The eradication of casual labor and work for food indicates the improvement of the respondents' livelihoods. This will also be detailed in the final chapter.

4.6 Conclusion

This chapter presented and discussed the results of the study. The findings of this study were examined in relation to the literature reviewed. The relationship between the results and the research objectives was also discussed. The demographic profile of the respondents, household economics and sustainable livelihoods were discussed in this chapter. Cow practices, cow feeding and Girinka program services were also discussed in this chapter.

CHAPTER FIVE

CONCLUSION

5.1 Introduction

This chapter presents the summary of the research findings and forwards the recommendations. It shows different livelihoods associated with Girinka program beneficiaries before and after the program and indicates the role played by the Girinka program in relation to those livelihoods. The research findings are discussed in accordance with the research objectives. Recommendations are provided to both the Government of Rwanda and Girinka program beneficiaries for the improvement of the program.

5.2 Girinka program beneficiaries' livelihoods before and after the program

The results of this study show that Girinka beneficiaries had poor livelihoods before getting the cow; which is the first condition to benefit from the Girinka program. Therefore, the findings of this research show that the beneficiaries of this program are those targeted by the program. The results of this study also show that after getting the Girinka program cow, its beneficiaries improved their livelihoods. Those livelihoods are discussed in terms of the five key livelihoods assets discussed in chapter two in relation to the SLF adopted.

5.2.1 Human Capital

Human capital includes skills, knowledge, experience and capabilities to accomplish different tasks. For this point, the households interviewed had an average of 5.3 persons per household and the average age of the respondents was 50.7 years. Also, a large number of the respondents have an education level ranging from grade 4 to 6 which the literature indicates is sufficient for a good understanding of new farming practices. However, some respondents do not know how to read and write, which may reflect lack of skills and knowledge. The largest number of respondents was married which increases the number of adult people who can provide productive labor at the household level. However, some respondents were widows, while a few respondents were single or divorced. The average number of years the respondents stayed in their villages was 18.6 years. Many respondents stayed in their villages

for more than 10 years, while few respondents stayed in their villages for less than 10 years. This indicates that many respondents have experience in their region's livelihoods and are capable of choosing the appropriate farming practices in the region. The Girinka program contributes to human capital by providing to its beneficiaries rain-fed crops and livestock products such as milk that gives them a healthy and productive body. Moreover the eradication of child malnutrition results in healthy adults enabling them to reach their full potential and earn higher incomes to support their families.

5.2.2 Natural Capital

Different types of natural resources such as water, land and pasture were studied in this research. Water availability in Bugesera District depends on the seasons and on the regions. In the rain seasons water is available abundantly, but during dry seasons which are often severe in Bugesera; water becomes irregular for both human-beings and livestock. However, the regions close to the lakes and rivers have more reliable access from these sources. These sources help households during drought periods, particularly for their livestock. The results of this study show that during drought periods, a large number of the respondents use water from lakes and rivers. This is due to the fact that Bugesera District has 9 lakes (as discussed in chapter three) and 2 of the largest rivers in Rwanda (Akagera and Nyabarongo) which cross this District. The respondents who stay far from lakes and rivers, however, face severe problems during drought periods to find water for their cows. The findings of this study show that a large number of the respondents spent money on water for their cows and the average cost of the water for each cow is 5326.93Rwf for 6 months.

The findings of this study show that the land for cultivation accessed by the respondents before getting the cow increased after getting the cow. The average land accessed per household before the Girinka program was 1.39 hectares and became 1.53 hectares after getting the cow. Additionally, the land was poor and infertile before the Girinka program, but after getting the cow it became more fertile. Respondents confirmed that the extension of the land for cultivation and its fertility are the results of the Girinka program. The money from the milk and the sale of livestock helped them to extend their land for cultivation and the manure provided by the cow increased soil fertility. The findings also show that most of the respondents have land for fodder cultivation and they feed their cows by cutting and carrying

the fodder to the cow shed. However, a few of the respondents have private land for grazing and they take their cows to graze on the farm themselves during drought period which is prohibited by the program. They use both private and communal land for grazing.

5.2.3 Physical capital

It is obvious that Girinka program beneficiaries' livestock increased after the program because they had no cows before the program was initiated. Also, their other livestock such as goats, pigs and poultry increased due to the benefits of the Girinka program. The findings of this study show that the money derived from the Girinka program helped the respondents to increase their goats by 23%, while pigs increased by 8.65% and poultry increased by 6.1%. Respondents also have other capital assets such as bicycles, cell phones and some of them improved their houses with the money derived from Girinka program cow. Bugesera District has good public roads and markets and Girinka program beneficiaries also benefit from them. Ntarama, Mayange and Gashora Sectors have access to electricity, but there is no electricity in Rweru Sector. Some respondents use only solar power which is a key physical and renewable resource. However, compared to what the literature reveals about the use electricity in Rwanda, the findings of this study show that a significant number of the respondents have access to electricity.

5.2.4 Financial capital

The main sources of income for the Girinka program in Bugesera District are the sale of rain-fed crops and the sale of livestock and livestock products such as milk. The sale of rain-fed crops was identified as a source of income by 99.75% of the respondents, while the sale of livestock products was identified by 65.25% of the respondents. This means that some respondents were involved in both the sale of rain-fed crops and sale of livestock products. They have also other smaller sources of income such as part-time paid employment, own business, trading, beer brewing and crafts. The results show that there has been an increase in the sale of cow products in some of the household which is improving financial capital.

5.2.5 Social or institutional capital

As discussed in chapter two, the Government of Rwanda has implemented various homegrown practices such as Ubudehe, VUP, Land Consolidation and the Girinka program as well. Girinka program beneficiaries are also involved in the other programs. The findings of this study show that Girinka program has improved the unity and reconciliation by giving first calves to neighbors. The Government of Rwanda also adopted a program of encouraging people to stay together in appropriate places (Imidugudu) in order to provide them with different public institutions such as schools and hospitals. The Girinka program beneficiaries also benefit from those institutions. They also benefit from the free 9 year basic education program implemented by the Government of Rwanda and the implementation of the free 12 year basic education is under process. Girinka program beneficiaries are also involved in the Umuganda (community service) program that happens once a month all around the country. Umuganda is volunteer community work in which all able bodied persons above the age of 18 years and below 65 years are expected to participate. This study found that the Girinka program contributed to several livelihoods assets at the household level.

5.2.6 Summary in relation to the research objectives

Objective one 1: To assess the impacts of the Girinka program on increasing food nutrients (especially milk and related products), crop intensification in terms of manure use as source of fertilizer and the production of biogas energy

The first objective of this study was to assess the impact of Girinka program on food security. The results of this study show that the Girinka program increased food security and eradicated completely child malnutrition in Bugesera District. It provided milk which is a nutritious food of great value rich in protein, vitamin and mineral salts. It also provided milk products such as soured milk. The manure used as source of fertilizer provided by cows increased soil fertility and crop production as well. The findings of this study show that the Girinka program helped a few of the respondents to use cow dung and urine for production of biogas energy. However, the results show that currently biogas is used by very few respondents. As indicated earlier, this may be a missed opportunity to improve energy

security in these communities. The under-use could be linked to lack of knowledge among the beneficiaries.

Objective 2: To examine the impacts of the Girinka program on livelihood strategies (including adaptation and coping strategies in relation to drought) at the household level, including income generating activities

This objective was to examine the impact of the Girinka program on its beneficiaries' livelihoods. The findings of this study show that the main Girinka program beneficiaries' income generating activities are the sale of rain-fed crops and the sale of livestock products. The rain-fed crops are challenged by drought which is persistent in Bugesera District. The milk provided by the Girinka program cows serves as a coping strategy for food when crops had been destroyed by drought. The results of this study also show that the money from the sale of milk helps to buy other household tools. It has also been found that the money from the sale of calves help to buy drought tolerant livestock such as goats and pigs. Also the money from the cow helped to extend land for cultivation and the manure helped to increase crop production so that Girinka program beneficiaries can save food for drought periods. However, before the cow calves; the inadequate labor of older beneficiaries is found to be a challenge to their livelihoods because they spend all their time taking care of their cows and do not get time to accomplish other household livelihoods. But, after the cow calves the money from the sale of milk helps them to invest capital on activities that can generate additional income. The results show that the Girinka program is and has the potential to improve livelihood strategies.

Objective 3: To examine the perceptions and concerns of households towards the Girinka program

The third objective was to examine the perceptions and concerns of respondents towards the Girinka program. The findings of this study show that all respondents are interested in the program. They have been trained on cow practices and they perceived the training to be adequate. Also, there are regulations regarding cows such as feeding them in cow sheds only and washing cows with anti-cow pest agent medications at least twice a week. The results show that all respondents feed their cows in cow sheds during rain periods, but during

drought periods a few of the respondents take their cows to farms for grazing. All respondents wash their cows with anti-cow pest medication at least twice a week.

Objective 4: To assess the knowledge levels of households towards the benefits of having at least one cow, and to examine which of these benefits are derived by beneficiary households

The fourth objective of this study was to assess the knowledge of respondents towards the benefits of having at least one cow and to examine whether households experience these benefits. The results of this study show that all respondents appreciated the benefits of having at least one cow. They highlighted the importance of the Girinka program on poverty alleviation and social bond improvement. The findings of this study show that benefits of the Girinka program are the increase in crop production because of the use of manure as a source of fertilizer, child malnutrition eradication, increase in savings, milk, dung as a source of fuel for cooking and lighting, creation of friendship between neighbors by sharing milk and manure, meat, dowry payment, and confidence or dignity of having a cow.

Objective 5: To assess the impact of the Girinka program on climate resilience

The fifth objective of this research was to assess the impact of the Girinka program on climate resilience in Rwanda as an adaptation for food security. Building the ability to deal with climate variability both today and in the future is one of Rwandan Government climate resilience strategies (Republic of Rwanda, 2011). It particularly deals with additional activities to prepare for climate change and make efforts to limit or absorb gas emissions, which contribute to climate change. Rwandan Government climate resilience building activities include development investments in the agriculture, food security, health, land management and infrastructure sectors (Republic of Rwanda, 2011). The findings of this study show that Girinka program cows provide manure used as both sources of fertilizer and energy. Manure is used to improve soil structure and rejuvenate tired land resulting in high crop production and food security simultaneously. Animal urine and manure are used to produce natural pesticides and plant food (Send a Cow, 2008). Manure is also used to produce biogas energy and this reduces deforestation and CO₂ emission in the atmosphere. However, there is consensus that livestock can produce methane gas which can cause global warming (FAO, 2006). Agro-forestry is one of the methods of controlling soil erosion by

planting different types of trees that contribute as construction materials, livestock fodder and food like fruits and nuts which improves food security. The findings of this study show that most of the respondents use agro-forestry as the one of the farming practices and this practice is promoted by the use of manure as a source of fertilizer provided by Girinka program cows. For this objective, it is clear that the Girinka program is one of the key climate resilience strategies for adaptation aimed at improving food security in Rwanda.

5.3 Recommendations

This study revealed that cows are of considerable importance as they contribute to poverty alleviation and climate resilience strategies. However, the findings of this study show that the use of biogas energy is still at a low level and a significant number of respondents are not aware of biogas energy use. Some respondents do not need it because they use electricity and others cannot afford its generator installation costs. Therefore, the Government of Rwanda and NGOs that deal with climate resilience are recommended to teach Girinka program beneficiaries about the role of biogas energy use and support financially those who cannot afford its start-up costs.

Randolph et al. (2007) state that the poorest of the poor do not have cows, but if they get them they can start a pathway out of poverty. Thus, the Government of Rwanda, NGOs and donors are recommended to increase their financial support to the Girinka program in order to provide cows to all poor people because they contribute to poverty reduction. Also, the findings of this study show that marshes and flood plains are used as sources of water for livestock. However, the inappropriate usage of marshes is against environmental policy. Thus, the Government of Rwanda is recommended to provide enough water in Bugesera District so that the usage of marshes and flood plains can stop.

The Girinka program encourages zero-grazing farming practices as one of the climate resilience strategies. But, it has been found that some Girinka program beneficiaries are still taking their cows to graze on the farms. Therefore, the Girinka program coordination by local government agencies is recommended to follow-up and address this issue. Furthermore, mechanisms need to be put in place to monitor and evaluate impacts of the Girinka program. Also, the insufficiency of veterinarians and inadequate artificial insemination has been noted

in this study. Girinka program coordination is also recommended to deal with this problem regarding veterinarians and artificial insemination. One veterinarian per each cell can be helpful.

According to Smith et al. (2013), the impact of livestock on food security at household, national and global levels demands innovative research, development and policy approaches. Thus, the impact of the Girinka program on food security at its beneficiaries, national and global levels also demands innovative research, development and policy approaches. Randolph et al. (2007) state that malnutrition can be combated by the use of animal-resource foods and that livestock can utilize some of the domestic wastes generated by the household. Thus, research about domestic animals must be encouraged and funded. In the case of the Girinka program in Bugesera District, the results show eradication of child malnutrition and the manure provided by the Girinka program cows were used to rejuvenate the land for cultivation and increased soil fertility. Therefore, research on the Girinka program all around the country is recommended in order to reveal benefits and challenges of the program according to different regions.

Reports from environment specialists state that deforestation, soil erosion, reduced soil fertility, overgrazing and GHG emissions in the atmosphere are among recognized environmental problems all around the world (Ehui et al., 1998). However, according to the findings of this study, the Girinka program can assist to address these problems. Thus, climate change funding is recommended to support the Girinka program as one climate resilience strategy by funding the Girinka program, particularly research on the program.

The key limitation of the study is examining one District when there is significant climate variability in Rwanda across Districts and Sectors. It is therefore imperative that future studies include more case study areas that will permit a detailed comparative analysis. Additionally, as highlighted in the discussion and recommendations, there is a need for more research in relation to specific thematic areas such as dung and biogas, intra-household dynamics, nutritional and income generating impacts, and soil fertility assessments.

5.4 Concluding remarks

This study revealed the impact of the Girinka program on poverty reduction and food security. Milk as nutrient food and manure as a source of fertilizer have been noted as benefits of this study. It was found that the Girinka program also plays a notable role in relation to climate resilience. This program has provided manure that promoted agro-forestry which is mitigation to climate change, and also cow dung is used for production of biogas energy. Benefits and challenges of this program have been highlighted in this study. The Girinka program has notably improved its beneficiaries' livelihoods. Regarding the 1994 Genocide of Tutsis, this program has promoted unity and reconciliation in Rwanda. Various benefits of the Girinka program are demonstrated in this study such as crop intensification, eradication of child malnutrition, increase of milk and meat, dowry payment and the confidence or dignity of having a cow which is imperative in Rwandan culture. Challenges of the program have also been highlighted such as insufficiency of veterinarians, insufficiency of land for fodder cultivation and inadequate artificial insemination. Lastly, recommendations have been provided in this study. Different development organizations such as local NGOs and international organizations (Heifer International, Send a Cow, World Vision, etc.) are recommended to support the Girinka program because it has a notable role to play in poverty reduction.

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APPENDICES

Appendix A: Household questionnaire

**University of KwaZulu-Natal, School of Agriculture, Earth and Environmental Sciences
Household questionnaire**

Section A: Demographic profile of respondents

A1. Gender (Note, do not ask):

1. Male	2. Female
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A2. Age (in years) _____

A3. Marital status (**mark the best answer**)

1. Married	2. Single	3. Divorced	4. Widowed	5. Other (specify)
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A4. What is the highest level of education attained or completed? (**Mark the best answer**)

1. None	2. Grade[1-3]	3. Grade[4-6]	4. Grade[7-9]	5. Grade[10-12]
6. University		7. Other (specify)		

A5. How many are you in your household?

Male:	Female:
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A6. How long have you lived in this village? (In years, record **00** if < 1yr, **88** don't know)
.....Years.

Section B: Household economics and sustainable livelihoods

B1. How much agricultural land did you cultivate before getting the cow?

1. [0-1]ha	2.]1-3] ha	3.]3-5]ha	4. >5ha
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B2. How much agricultural land did you cultivate after getting a cow?

1. 0.5-1.0 ha	2. 1.5-3 ha	3. 3.5-5ha	4. >5ha
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B3. How much of the total land available to the household for agricultural production did this make up?

1. 1-20%	2. 21-40%	3. 41-60%	4. 61-80%	5. 81-99%	6. 100%
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B4. (**If not cultivated all land**) What were the reasons for not cultivating?

1. Inadequate labor	2. Lack of fertilizer	3. Poor rainfall	4. Lack of seed
5. Other (specify)			

B5. Did you extend the land or open new land for cultivation? (**If no, skip to B6**)

Yes 1	No 2
------------	-------------

B6. If yes, what were reasons for opening up or extending land for cultivation?

Reason	Yes	No
1. Increasing crop production		
2. Acquiring land to fallow		
3. Other (specify)		

B7. Did you grow the following crops last year? (Multiple responses)

Crop	Yield	
	Before	After
1. Maize		
2. Cassava		
3. Groundnuts		
4. Rice		
5. Sweet-Potato		
6. Irish Potato		
7. Tobacco		
8. Beans		
9. Other (specify)		

B8. What are your sources of income in your household?

1. Sale of Livestock	2. Sale of rain-fed crops	3. Piecework
4. Charcoal burning	5. Gardening	6. Gifts from relatives
7. Full-time paid employment	8. Part-time paid employment	9. Own a business
10. Trading	11. Crafts	12. Other (specify)

B9. How do you cope with changes in water/vegetation/pasture in times of drought?

Resource Type	Coping Mechanism in times of drought
1. Water	
2. Vegetation	
3. Pastures	

B10. What did you do in relation to food specifically during drought periods before getting the cow?

Coping strategy	Yes	No
1. Buying cheap food that you don't like		
2. Reduce number of meals per day		
3. Reduce the quantity of the food per meal		
4. Other (specify)		

B11. What are your sources of fuel for cooking?

1. Charcoal	2. Firewood	3. Electricity	4. Solar power	5. Gas
6. Generator	7. Cow dung	7. Other (Specify)		

B12. What are your sources of fuel for lighting?

1. Charcoal	2. Firewood	3. Electricity	4. Solar power	5. Gas
6. Generator	7. Candle	8. Paraffin	9. Other (Specify)	

B13. What are your sources of fuels for heating the house? **(NB: All never heat the house)**

1. Firewood	2. Charcoal	3. Electricity	Solar power
4. Cow dung	5. Other (specify)		

NB: All respondents said that they never heat their houses because Bugesera is often hot.

B14. Did you use cow dung before you received the cow?

Yes	1	No	2
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B14.1. **If yes**, from where did you get the cow dung?

1. From cows we already possessed	2. Purchased	3. Free from neighbors
4. Other (Specify)		

B15. If not using cow dung, what is preventing you from using cow dung as a fuel source?

	Yes	No
1. We don't know to use it		
2. We don't have cow dung storage		
3. We don't like its odor		
4. We don't need it		
5. Other (specify)		

B16. How many of the following livestock did you own before getting the cow and how many do you own now?

Livestock	Quantity	
	Before	After
1. Cattle		
2. Sheep		
3. Goats		
4. Pigs		
5. Rabbits		
6. Poultry		
7. Other (specify)		

B17. Does your household have access to land for grazing?

Yes	1	No	2
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B18. Does your livestock graze in communal land, private (own land) land or both?

1. Communal land	2. Private land	3. Both
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B19. How would you rate the adequacy of land for grazing and cultivation?

(Codes 1 = excellent; 2 = good; 3 = satisfactory; 0 = poor)

1. Grazing		2. Cultivation	
------------	--	----------------	--

B20. Do you have communal or other regulations regarding livestock grazing?

Yes	1	No	2
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B21. If yes to the above, what are regulations you are familiar with?

	Yes	No
1. Graze only		
2. Feeding cows in cow shades only		
3. Other (specify)		

Section C: Cow Practices

C1. Do you engage in any of these farming practices? **(Mark all possible answers)**

1. Conservation agriculture	2. Improved fallow	3. Crop rotations	4. Agro-forestry
5. Green(organic) manure	6. Windbreaks	7. Ploughing	8. Irrigation
7. Other (specify)			

C2. If you use the organic manure, is it from the cow?

Yes	1	No	2
-----	---	----	---

C3. If you use ploughing, do you use the cow?

Yes	1	No	2
-----	---	----	---

C4. Have you ever received training about cow practices?

Yes	1	No	2
-----	---	----	---

C5. If yes, who provided the training? **(Multiple answer)**

1. GoR
2. NGOs
3. Friend/ neighbor
4. Other (specify)

C6. Is the training you received adequate?

Yes	1	No	2
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C7. If no, do you need more training?

Yes	1	No	2
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C7.1. If yes, what type of training do you need?

Section D: Girinka Program services**D1. General information on Girinka program cow**

D1.1. Have you had a cow before 2006?

Yes	1	No	2
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D1.2. When did you receive the cow from Girinka program? (Year)

D1.3. What type of cow did you receive?

L : Local	C : Cross	J : Jersey	F : Frisone
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D1.4. Did it ever calve?

Yes	1	No	2
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D1.5. If yes, how many calves does the cow have? **calves**

D1.6. What did you do with the calves?

Calves	Yes	No
1. Kept		
2. Given away		
3. Sold		
4. Given to neighbor for keeping (<i>kuyiragiza</i>)		
5. Died		
6. Other (specify)		

D1.7. How many cows do you have now?**cows****D.2. Milk production**D2.1. What is the lactation length of the Girinka cow?**months**D2.2. How much milk does your cow produce during lactation period?**liters**D2.3. What is the price of the milk per liter?**Rwf**D2.4. How much milk did you consume?**liters**D2.5. How much milk did you sell?**liters**

D2.6. Do you make any products from the milk?

Yes	1	No	2
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D2.7. If yes, please indicate the products made/used at the household level?

Product	Made		Used at the household level		Sold by the household	
	Yes	No	Yes	No	Yes	No
1. Soured milk						
2. Yoghurt						
3. Cheese						
4. Other (specify)						

D3. Cow feeding

D3.1. How much did your cattle shed cost?**Rwf**

D3.2. How do you feed your cow?

1. We find and bring it grasses in the cattle shed	2. It grazes itself in the farm
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D3.3. Where do you find the grasses for your cow?

1. We buy them	2. From our own farm
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D3.4. If you buy grasses how much money did you spend for them last 6 months?**Rwf**

D3.5. How much money did you spend for cow medication in last 6 months?**Rwf**

D3.6. How much water does your cow get per day?**liters**

D3.7. How much money did you spend for water for your cow in last 6 months?**Rwf**

D4. Manure production and management

D4.1. How much manure did your cow provide you in last cultivation season?**Kgs**

D4.2. How much manure did you use in your farm?**Kgs**

D4.3. How much manure did you sell?**Kgs**

D4.4. How much money did you get from selling manure?**Rwf**

D4.5. Did you use chemical fertilizers last cultivation season?

Yes	1	No	2
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D4.6. If yes, how did you get it?

1. From GoR	2. From NGOs	3. We bought it
-------------	--------------	-----------------

D4.7. If you bought chemical fertilizers how much did you spend for it?**Rwf**

D4.8. Has the Girinka program improved your livelihood?

Yes	1	No	2
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D4.9. If yes, how?

	Yes	No
1. Increased crop production		
2. Eradicated child malnutrition		
3. Increased savings		
4. Other (specify)		

D5. What are the benefits of Girinka program?

	Yes	No
1. Providing milk		
2. Providing manure as fertilizer		
3. Providing dung as source of fuel for cooking & lighting		
4. Serves as ploughing power		
5. Other (specify)		

D6. What are disadvantages of Girinka program?

D7. What are your income generating activities before and after Girinka program?

Income generating activity	Before	After
1. Permanent employment		
2. Par-time paid employment		
3. Agricultural/farming activities		
4. Sale of manure		
5. Sale of dung		
6. Trading		
7. Bricklaying		
8. Charcoal burning		
9. Crafts		
10. Beer brewing		
11. Carpentry		
12. Masonry		
13. Other (specify)		

MURAKOZE/THANK YOU

Appendix B: Focus group discussion guiding questions

University of KwaZulu-Natal, School of Agriculture, Earth and Environmental Sciences

Focus group discussion schedule

A. Background information

1. Number of participants (specify number of males and number of females)
2. Number of cattle each participant has
3. Establish other demographic information such as age, number of years resided in the village

B. Household livelihoods

1. What are households' main sources of energy and water?
2. What types of livelihoods do households in the village have? What are the main sources of income for most households in the area?
3. What are the key challenges experienced at the household level in terms of livelihoods?
4. What are the main coping mechanisms used during times of drought?

C. Use of cows and cow products

1. How are cows used in the community? What is the value of cows in the community?
2. What are the benefits of having a cow?
3. What are the challenges of having cows?

D. Girinka program

1. What are the knowledge levels regarding the Girinka program?
2. What have been the impacts of introducing the Girinka program in the community?
3. What are the advantages and disadvantages of the Girinka program?
4. How can the Girinka program be improved in the future?

Appendix C: Consent letter

Human Subjects Research Consent Letter

University of KwaZulu-Natal

Date: 03 May 2013

I, Mr Vincent Kayigema (Reg. No. 212562520) am a Masters student registered at the University of KwaZulu-Natal. I am conducting research on an assessment of the Girinka ('one cow per poor family') Program and poverty alleviation in Rwanda: A case study of Bugesera District, Rwanda. The information collected will be used solely for the purposes of completing my thesis and future papers, journal articles and books that will be written by the researcher.

Since the validity of the results of the study depends on a high response rate, your participation is crucial to the success of this study. The interview will take approximately forty minutes. Your co-operation will contribute to the growing body of knowledge aimed at understanding and improving the Girinka program and how they would utilize it in the future. Please be assured that your responses will be held as strictly confidential and no identity will be used in the results of the study. Your anonymity and confidentiality will be preserved at all times. Your personal details are not required for this study and in under no circumstances will your personal details be disclosed or referenced. Furthermore, your participation is entirely voluntary and you may withdraw your permission to participate in this study without explanation at any time.

I thank you for your time in completing this questionnaire. Do not hesitate to contact me or my supervisor if you have any questions or concerns about the questionnaire or any aspect of this study. My contact details are +250788549114 (cell) or vincentkayigema@gmail.com (email). My supervisor is Professor Urmilla Bob and her contact details are 0731330147 (cell) or bobu@ukzn.ac.za (email).

Yours sincerely,

Vincent Kayigema

I have understood the information about the project and I agree to participate in the study.

Signature: _____

Date: _____