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Integrated Farming: A Strategy for Socio-Economic Development of Farmers in Sectors of Nyagatare and Gatunda of Nyagatare District

Dissertation submitted in partial fulfilment of the requirements for Master's Degree of Social Science in Local Governance Studies by:

Fred ATUHE SABITI

Supervisor:Dr. GISARO Ca -MADEBERI Ya- BITITI

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DECLARATION

I Fred Sabiti Atuhe, do declare that to the best of my knowledge this dissertation is my own original work and has not been submitted to any other institution or university for academic awards

Fred Sabiti Atuhe

Reg. Number: 216367875

Signature: …….

Date: …….

DEDICATION

To the Almighty God who gave me life and blessed me abundantly;

To my beloved, wife, sons and daughter, brothers, sisters and all relatives;

To my friends whose care, love, appreciation, encouragement and players are the secret to my success.

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May God bless you all.

Fred Sabiti Atuhe

ABBREVIATIONS AND ACRONYMS

% : Percentage
Kg : Kilogram
Km : Kilometer
Km^2 : Square Kilometer
N : Number
7YGP : Seven Years Government Program
CFS **:** Crop Farming system
DDP : District Development Plan
DDS : District Development Strategy
EDPRS : Economic Development and Poverty Reduction Strategy
EICV4 : Enquête Intégrale des Conditions de Vie
FAO : Food Agriculture Organization
GDP : Growth Domestic Product
GNP : Growth National Product
GoR : Government of Rwanda
HH : Household
ICLF : Integrated Crop-Livestock Farming
IFS : Integrated Farming System
MINAGRI: Ministry of Agriculture
MINECOFIN : Ministry of Finance and Economic Planning
NAEB : National Agriculture Export Board.
NGO : Non- Governmental Organization
NISR : National Institute of Statistics of Rwanda
NPK : Nitrogen, Phosphorus and Potassium
RAB : Rwanda Agriculture Board
RDHS : Rwanda Demographic Health Survey
RwF : Rwandan Franc
SACCO : Saving and Credit Cooperatives
SPSS : Scientific Package for Social Sciences
SSA : Sub- Saharan Africa
SWOT : Strengths Weaknesses Opportunities and Threats
TK : TAKA(Currency in Bangladesh)
UNDP : United Nations Development Program
UR : University of Rwanda
WB : World Bank
WBG : World Bank Group

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ABSTRACT

This study was undertaken to evaluate and determine the impact of integrated farming system on livestock and crop production, as socio-economic development of farmers in Nyagatare district, specifically in the sectors of Gatunda and Nyagatare. The main purpose of this study was due to current dominance of subsistence farming being practiced on the limited land resources with rapid growing of population which does not match with the economic development of Rwanda, this leads to food security crisis and low social economic development of the Rwandan farmers. The general objective was to determine the contribution of integrated farming system to social economic development of farmers in Nyagatare district of Eastern province. It was conducted in two case studies of Nyagatare and Gatunda sectors. Five cells of Nyagatare sector and four cells of Gatunda sector were selected. The method used to select the sample was purposive sampling, whereby forty one (41) respondents were selected for questionnaires and five (5) administrative staff responsible for agriculture and livestock related activities from local (sector, district and province) to central government level were purposively selected for interviews. The findings of this study revealed that, IFS has to some extent a positive social and economic impact. This initiative has allowed some households to shift from a lower level of poorer to a relatively poor class. The participants in this research declared that IFS has increased their livelihood due to selling surplus milk and increased agricultural production due to manure use.

Findings in tables 7-14 showed that through IFS, farmers increased their income from agriculture and livestock. This was due to the increase of crop production and livestock production (milk). Because of income increase, the findings showed that farmers increased their expenditures on food, education and clothing. Also, the quantity of food taken has improved. Though IFS contributed to the welfare of farmers, it was revealed in the figures 6-11 that IFS is not 100% well-practiced by the farmers. Some gaps exist and were identified in the figure 12. The farmers face some challenges in practicing IFS, such as insufficient knowledge and skills due to lack of or inadequate training in Gatunda sector especially, lack of or insufficient water in Gatunda animal and crop diseases, drought in both sectors, to mention but a few. Some strategies to address the challenges were proposed, namely regular training of farmers; increase the number of famers field school facilitators and farmer promoters, and assist the farmers in cow breeding and use of manure.

Keywords:*Farm, Integrated Farming and Socio-Economic Development*

CHAPTER ONE: GENERAL INTRODUCTION

In the next 7 Years Government Program: National Strategy for Transformation (NST 1/ 2017-2024) the Government of Rwanda seeks to modernize and increase production and productivity of agriculture and livestock. Therefore, integrated farming system is considered as one of strategic instruments to increase agriculture and livestock production and productivity and thus, to up-lift the socio-economic conditions of farmers. This study was undertaken to evaluate and determine the impact of integrated farming system on socio-economic development of farmers in Nyagatare district, specifically in the sectors of Gatunda and Nyagatare. This chapter highly ghtsthe background of the study, problem statement, research questions, research hypotheses, research objectives, scope and limitation of the study, rationale of the study, and organization of the study.

1.1 Background to the study

Worldwide, the importance of agriculture and livestock in the socio-economic development of countries has long been recognized. Mixed crop-livestock systems are the dominant source of livelihood supporting more than 80% of people living in the developing world and producing 50% of world cereals, around 34% of the global beef production and about 30% of global milk production(Ajuruchukwu, 2013:2). However, mixed systems are coming under increasing pressure with human population predicted to increase from 1,099 million in 2000 to 1,670 million people in 2030 and their cattle population to increase from 230 million to 317 million from 2000 to 2030(UNDP Report, 2013:2).

Recent figures show that Agriculture provides 60% of all employment in Africa and about 70 to 80% of the total population depend on agriculture for their income (Ugwumba, 2013:2.). In spite the fact that agriculture farming is widely recognized as an engine for social economic development in Africa, it is under-developed and has not contributed significantly to poverty alleviation and economic growth. It is estimated that 70% of Africa's extreme poor and undernourished are farmers in rural areas(Ajuruchukwu, 2013:4).

Efforts to raise agricultural and livestock productivity are ever more needed in order to meet the rapidly increasing demand for food in Africa. To meet food demand of an ever expanding human population, production from crop agriculture must expand by 4% annually while the production of livestock must expand by more than 3% annually, by the year 2025(UNDP ,

2013:7). The most sustainable means of increasing land productivity is the intensification of agriculture through greater integration of mixed crop-livestock farming (UNDP Report,2013:2).

Integrated Farming System (IFS)is a commonly and broadly used concept and has been found as an appropriate approach to maximize food production. In this context, livestock makes a positive contribution to raising productivity of the entire farming system. Livestock manure contributes to the nutrient needs of the crops and help to maintain soil organic matter and beneficial physical properties, such as water and nutrient retention capacities (Ajuruchukwu, 2013:6).Integrated farming has been confirmed to reduce cost of production and thus increase farmer's productivity, income and nutrition. It improves personal savings and provides employment opportunities for excess labour force. This type of farming can remove all the farming constraints, such as shortage and high cost of inputs and environmental pollution. It provides opportunity for effective recycling of waste material, therefore applying this type of farming in not an option but imperative (Rahman, 2018:3).

Like other countries in Sub-Saharan Africa, agriculture is crucial and backbone for Rwanda's social economic growth and reduction of poverty. Agriculture sector contributes to 39% of Growth Domestic Products (GDP), 80% of employment, 63% of foreign exchange and 90% of the country's food needs (World Bank group report, 2013: 6). However, this sector is challenged by land constraints due to the population pressure. Rwanda with its estimated population of 11.4 million in 2013/14, surface Area of 26,338 Km^2, 1400 Km^2 is covered by water and has an average of 467 persons per square Km, and it is the most densely populated nation in the continent(NISR, 2015:8). About 36 % of the households own only 6% of the farm lands, with an average of 0.11 Ha (Nuwamanya, 2016:2.). In addition, 39.1% of Rwandans are under poverty line and 16.3% are under extreme poverty(NISR,2014:39).

The Rwandan Vision 2020 targets to reduce poverty from 39.1% to 20% and the improvement in agricultural and livestock production and productivity was set as an option among other options to achieve that target. In fact, modernize and increase productivity of agriculture and livestock is one of the priorities of 7 Years Government Program 2017-2024, and Integrated Farming System was viewed as one of strategic instruments to increase agriculture and livestock production and productivity(MINECOFIN, 2017:5).However, it was observed by the researcher that integrated farming is not effectively practiced, as the Girinka program which was believed to be a strategy to promote integrated farming is faced and is still facing some challenges. Consequently, subsistence nature of farming still persists. This

study was undertaken to determine the impact of integrated farming system on socio-economic development of farmers and challenges linked to it.

1.2Problem statement

Rwanda has a strong pressure on limited land resources due to rapid growing of population which does not match with the economic development. This commonly leads to subsistence agriculture, to food security crisis and low socio- economic development of the Rwandan farmers (MINECOFIN,2014:5.). Domination of the traditional farming (subsistence agriculture) put more pressure on land resource and results to low production and productivity of the available land due constant losses of soil due to erosion(Mudahar*et al*.,2015:1).

As per case study, the poverty incidence in Nyagatare district stands at 44.1 %, while extreme poverty incidence stands at 19.5%. In other words, 44.1 % of Nyagatare population is identified as poor and 19.5 % are identified as extremely poor. This rate of extreme poverty is higher compared to that of national level which is 16.3% (NISR (EICV4), 2014:21). The prevalence of stunted children was 38%, Wasting (too thin for height) was 2%, while 9% were underweight (NISR (RDHS, 2014-2015),2014: 7).Furthermore, more than 70% of the population of Nyagatare depends on subsistence agriculture and livestock.

To deal with the problem of malnutrition and to reduce poverty, one cow per poor household program [Girinka program] was introduced in 2006. The rationale behind this program was that a cow produces milk and therefore handles the alarming high rate of childhood malnutrition; generates income for a family by selling milk; and provides manure to increase agricultural production (Gumira& al., 2017). In addition, Girinka program was introduced as a strategy to promote integrated farming (Nyagatare District Report, 2018:6). However, Girinka program faced and is still facing challenges which affect envisioned outcomes. The identified challenges include among others: (i)Some Girinka beneficiaries do not have convenient cowsheds and they continue taking care of their cows in precarious way and consequently the production of milk and manure decreases considerably; (ii) cows received were not always from good species and those assumed to be good species generally from abroad are vulnerable to tropical weather(long dry seasons caused by unfavorable climate change) and poor living conditions. This caused the deaths of many cows given in Girinka program. (iii) No consultation with beneficiaries in choosing suitable milk cows before distribution. This led to disengagement and lack of ownership of beneficiaries. This reveals

also the unprofessionalism prevailing in the process of selecting people who may be given cows in the line of Girinka program. (iv) Rare visits and assistance from Veterinary technicians and agronomists; (v) lack of or Insufficiency of trainings of cattle breeding to potential Girinka beneficiaries;(vi) Lack or inadequate training on manure management and use; (vii) the effects of water shortage and quasi-permanent drought in the region; and (viii) insufficient land to grow fodder (Gumira and Kalinganire, 2017).

These challenges affected and are affecting integrated crop-livestock farming which is at the heart of the battle against poverty, food insecurity and malnutrition. If nothing is done to promote integrated farming through well implemented Girinka program, the battle against poverty, food insecurity and malnutrition in Nyagatare, specifically in Nyagatare and Gatunda sectors will always be a challenge.

1.3 Research questions

The main question for the study is: Does integrated farming system improve the socio-economic development of farmers in Nyagatare district?

From this main question, the following sub-questions emerged:

- How do the farmers in Nyagatare district practice integrated farming and what are the impacts?
- What are the challenges the farmers face in practicing integrated farming system and what are the strategies to overcome those challenges?

1.4 Hypotheses

The general hypothesis that the study intends to verify is: Integrated farming improved the socio-economic conditions of farmers in the sectors of Nyagatare and Gatunda of Nyagatare district.

To respond to the research questions, the study intends to verify other two hypotheses:

- Integrated farming is effectively practiced by the farmers in Nyagatare district.
- Farmers encounter some challenges in practicing integrated farming.

1.5Objectives of the study

The General objective is to determine the contribution of integrated farming system on social economic welfare of farmers in Nyagatare district.

Two specific objectives emerged from the main objective:

- To determine the extent to which integrated farming is practiced and the extent to which integrated farming has impacted the socio-economic welfare of farmers in Gatunda and Nyagatare sectors of Nyagatare district.
- To determine the challenges that the farmers face when practicing the integrated farming system and propose the strategies to overcome them.

1.6 Significance of the study

There is lack of information on the benefits of integrated farming system in Nyagatare district. This is evidenced by the subsistence nature of farming and monoculture which is still practiced by the majority of the population. This study was undertaken to determine the advantages of integrated farming system and its impact on farmers' cash income, nutrition and general welfare of farmers in the area of study. The findings of the study will inspire other farmers and will be motivated to practice integrated farming. The findings of this study will inform policy makers at national and district level and NGOs on programs that will promote integrated farming in order to drastically reduce poverty and increase the standards of living of farmers. Last but not least, information generated and contained in this study will enrich existing literature on IFS.

1.7 Scope and limitation of the study

Three dimensions were considered

1.7.1 Scope in time

The data for this study was from 2013 to 2018. In other words, the research is limited to five-year period (2013–2018). This scope in time was determined, because the researcher assumed that this period of 5 years is enough for someone (farmer) to appreciate the impact of integrated crop-livestock farming. Again, data were easily available in this interval period.

1.7.2 Scope in space

This study was undertaken to analyze and determine the contribution of integrated crop-livestock farming on the socio-economic welfare of farmers in the sectors of Nyagatare and and Gatunda.These two sectors were chosen, because one is semi-urban and another one rural. Again, they were chosen, because integrated farming is promoted compared to other sectors of Nyagatare district.

1.7.3 Scope in domain

The study focused on socio-economic welfare of farmers as a result of integrated crop-livestock farming in Nyagatare district. It is in social-economic development domain.

1.7.4 Limitation of the study

The data collection process (field work) was conducted during the preparations of parliamentary elections. Consequently, local authorities were so busy and not available for interviews. Appointments were postponed several times. But, the researcher patiently waited and interviews were successfully conducted. As for the respondents to the questionnaire (selected farmers) the researcher encountered the problem of roads in poor conditions and long distance to walk to reach them. As a result, data collection process took more days than expected.

Last but not least, it is worth to indicate that the findings of this study cannot be generalized for the whole district. Therefore, the findings are specific and only applicable for the selected sectors of Nyagatare and Gatunda.

1.8 Overview of research methodology

This research was of descriptive design andcritical analysis design. To achieve the objectives of the study, both quantitative and qualitative data were collected through questionnaire, interviews and documentary techniques (triangulation). The target population was the households which fulfilled the following criteria: (a) Households who had at least three (3) cows; (b) households who had at least 0.5 ha of land; and (c) households with at least three (3) family members. Therefore, 200 households fulfilled these criteria in Nyagatare and Gatunda sectors.

Randomly, 20 households were selected in Gatunda sector and 21 in Nyagatare sector. In total, 41 households were selected and 41 questionnaires were self-administered and all completed and returned. In addition, 5 administrative staff in charge of agriculture were purposively selected for interviews (2 at sector level, 1 at the district level, 1 at provincial level and 1 at Rwanda Agriculture Board (RAB).

The entry and analysis of data were done using Scientific Package for Social Sciences (SPSS) and Microsoft Excel program. The SPSS was used to generate tables and histograms. The mean and percentages were calculated and interpreted as descriptive statistics. During the survey, the researcher observed the ethical considerations in the research, namely confidentiality, anonymity and voluntary participation in the research.

1.9 Organization of the study

This study is composed of 5 chapters. Chapter one is the General Introduction where background of the study, problem statement, research questions, research objectives, are clarified. Chapter two is Literature review where by theoretical framework, empirical review and conceptual framework were presented. Chapter three is the research methodology. It comprises the presentation of the case study and research methodology followed in this study. Chapter four is findings, data analysis and interpretation. In this chapter findings were presented and discussed. Finally, chapter five is general conclusion and recommendations.

Summary

The chapter one dealt with background of the study. In the background, it was revealed that Integrated farming system is an innovation which guarantees increased production and productivity of agriculture and livestock. However, this system is not utilized effectively and this results to low crop harvest and low livestock production which lead to low household income, food insecurity and environment degradation. If well-practiced integrated farming system could improve the socio-economic conditions of farmers in Nyagatare district. It is in this regard that the research was undertaken to determine to what extent integrated farming is practiced and to what extent has impacted on socio-economic development of farmers in Gatunda and Nyagatare sectors of Nyagatare district.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Integrated-crop livestock farming (ICLF) is an ideal way to satisfy the grown demand for food, decrease the environmental degradation, enhance the nutritional supply and increase the productivity (Nizamuddin, Khan& Kumar, 2018: 36). This chapter presents necessary literature related to the integrated farming system and socio-economic development of farmers. It is composed of introduction to the chapter, definition of key concepts, theoretical review, conceptual framework, empirical review, and finally the summary of the chapter.

2.2 Definition of key concepts

In this study, key concepts such as Farm, Farming, integrated farming, impact, socio-economic development are defined.

2.2.1 Farm

Farm is an area of land and its buildings which is used for growing crops and rearing animals. It is devoted primarily to agricultural processes with the primary objective of producing food and other crops. The people who own and work on the farm are called farmers. A farm usually has buildings where equipment such as tractors and supplies are stored. Some farms also have buildings where livestock are housed (Basudev Sharma, 2018:1).

Furthermore, FAO distinguishes six basic farm types: Type 1. *Small subsistence-oriented family farms*; Type 2. *Small semi-subsistence or part-commercial family farms*, usually of one half to two hectares; Type 3. *Small independent specialized family farms*; Type 4. *Small dependent specialized family farms*- often with the family as tenants; Type 5. *Large commercial family farms*- usually specialized and operated along modified estate lines; and Type 6. *Commercial estates*-usually mono-crop and with hired management and absentee ownership (FAO,2014:3).Considering the above 6 types of farms, the farmers who participated in the study had farms of type 2 and 3.

2.2.2 System

A system is a set of inter-related, interacting and interdependent elements acting together for a common purpose and capable of reacting as a whole to external stimuli. It is unaffected by its own output and it has external boundaries based on all significant feed backs (Basudev Sharma, 2018:2)

2.2.3 Farming system

Farming system is an integrated set of activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis. The farming system takes into account the components of soil, water, crops, livestock, labor, capital, energy and other resources, with the farm family at the center managing agriculture and related activities (Kareem, 2015:2).

2.2.4 Integrated farming

The word "Integrated" is derived from the Latin verb "*Integrate*" which means to make whole, to complete by addition of parts, or to combine parts into a whole. The crop, livestock, Hens, Pigs and fish subsystems may function independently in certain farming systems, and their products are only additive. However, in an integrated farming system, an output from one subsystem which otherwise may have been wasted becomes an input to another subsystem resulting in a greater efficiency of output of desired products. There is synergism in integrated farming since the working together of the subsystems has a greater total effect than the sum of their individual effects (Eduard, Pullin and Gartner, 2013: 5).

Types of Integrated Farming System are distinguished: (i) Crop-Livestock Farming System; (ii) Crop-Livestock-Fishery Farming System; (iii) Crop-Poultry-Fishery-Mushroom Farming System; (iii) Crop-Fishery-Duckery Farming System; (iv) Crop-Livestock-Fishery-Vermi composting Farming System; (v) Crop-Livestock-Forestry Farming System; (vi)Agri-Silvi-Apiary (beekeeping) Farming System; and (vii) Agri-Horti-Silvi-Pastoral Farming System (FAO, 2014: 4).In this study, integrated farming is considered as a farming system with simultaneous activities which involve crops and domestic animals, especially cows .This study focuses on integrated crop-livestock farming system and its impact on socio- economic welfare of farmers in Nyagatare District

2.2.5 Social economic Development

Socio-economic development is the activity involving both social and economic factors which result in the growth of the economy and societal progress and is measureable in both economic and social terms, for instance growth in the number of jobs created and increase in life expectancy(Todaro and Smith, 2011:23).Development had mainly been measured in pure economic terms of increases of about 5% to 7% or more in the Gross National Product (GNP) or the Gross Domestic Product (GDP) of national economies (Op cit, p24). However, experience has however shown that the economies of many developing nations experienced economic growth but without a corresponding improvement in the living standards of the

majority of their people. The GNP per capita model was found inadequate in addressing the developmental needs of the masses of the developing nations. A case in point is the often cited Brazil's "growth without development" between 1960s and 1980s (UNDP ,2014:25).

One can extend the "growth without development" phenomenon to many developing countries today. For instance, Sub-Saharan African countries such as Nigeria and Ghana are currently rated high in terms of fast paced economic growth. Unfortunately, these high rates of growth in GDP terms have not translated into improved quality of life for the majority of their citizenry(Kalisa and Brimble, 2018:14).

With the growing realization that economic growth *per se* did not necessarily translate into the well-being of society, the United Nations Development Program (2014:27) advocates that, the questions to ask about a country's development are therefore: What has been happening to poverty? What has been happening to unemployment? What has been happening to inequality? If all three have declined from high levels, then beyond doubt this has been a period of development for the country. If one or two of these central indicators have been growing worse, especially if all three have increased , it would be strange to call the result "development" even if per capita income doubled (Todaro and Smith, 2011:29).

2.3 Theoretical review

This section describes the role of agriculture and livestock for human development. Also, it presents the integrated crop-livestock cycle as well as the advantages of integrated farming system.

2.3.1 Agriculture at the center of human development

Agriculture is the supplier of that basic human need (food). It affects our daily life in many ways, both directly and indirectly. Humans expect agriculture to supply sufficient nutrients, economically and culturally valued foods, fibers and other products (UNDP-Technical report for the post-2015 development agenda, 2013: 9).Human race depends more on farm products for their existence than anything else since food and clothing – the prime necessaries are products of farming. Even for industrial prosperity, farming forms the basic raw material (Rana and Chopra, 2016:7). They further state that the prosperity of any country depends upon the prosperity of its people. For instance, prosperity of India would depend upon the prosperity of its farmers, as the majority of about 70% of Indian population is engaged in farming.

In Rwanda, agriculture is crucial and backbone for the country's social economic growth and reduction of poverty. Agriculture sector contributes to 39% of Growth Domestic Products (GDP), 80% of employment, 63% of foreign exchange and 90% of the country's food needs (World Bank report, 2013: 12). However, for agriculture to be at the center of sustainable human development will depends upon the adoption of improved technology and judicious allocation of resources (land, labor, capital, machinery etc.).

2.3.2 Role of livestock in human development

The role of livestock in human development is enormous. Protein from livestock is needed for physical and intellectual development as well as for developing immunity against disease (Mwabonimana&. Habimana, 2015:2). Livestock production is also an instrument to socio-economic change to improved income and quality of life. Livestock keeping contributes to poverty alleviation, ensuring food security and generation of income for farmers. It provides many necessaries in daily socio – economic development in the society (Uddin, Khan and M. Islam, 2015: 63).

In Rwanda, livestock provides about 36.5% of total protein intake and livestock contributes 12 % of the GDP (Mwabonimana&. Habimana, 2015:3). In line with the role of livestock, the government of Rwanda has initiated a program called one cow per one family, the program «Girinka» aimed at enabling every poor household to own and manage an improved dairy cow which would help the family to better their livelihood through increased chiefly milk production, then meat and manure to improve soil fertility for crops production (Sung KyuKim, Tiessen, Mukankurunziza&Kamatari, 2013:6).

2.3.3 Challenge domains for agriculture and livestock

Increases in the world's population from 800 million at the start of the industrial revolution in 1790 to just over 7 billion today and the prospect that the human population will grow to around 9.3 billion in 2050 have created new concerns about our ability to feed the world in food and livestock derived products in a sustainable manner (UNDP, 2013: 9). Meeting world food demand would put more pressure on available land and that would lead to environment degradation. Thus, integrated-crop livestock farming (ICLF) is an ideal way to satisfy the global grown demand for food and animal products (Nizamuddin and Kumar, 2018: 38).

In Rwanda, the rapid growth of population has led to the fragmentation of landholdings. The declining trend in size of land holding poses a serious challenge to the sustainability and profitability of farming. The average size of the landholding has declined to 0.11 ha in 2015 from 0.9 ha during 1990 and 1.16 ha in 1970. If this trend continues, the average size of

holding in Rwanda would be mere 0.09 ha in 2020 and would be further reduced to 0.05 ha in 2030 (Nuwamanya, 2016). With this state of affairs, Integrated Farming System can be viewed as strategic instrument to increase agriculture and livestock production and productivity

2.3.4 Integrated-crop livestock farming cycle

Integrated farming system refers to a system in which crop farming and livestock rearing are practiced integrated and in this system crops and livestock depend and support each other (Uddin, Khan and Islam, 2015:67). In ICLF crop straw, oatmeal and fodder is provided by the crops for livestock production while draught power, solid excreta (manure) and urine are used for crop cultivation. The figure below shows that cycle.

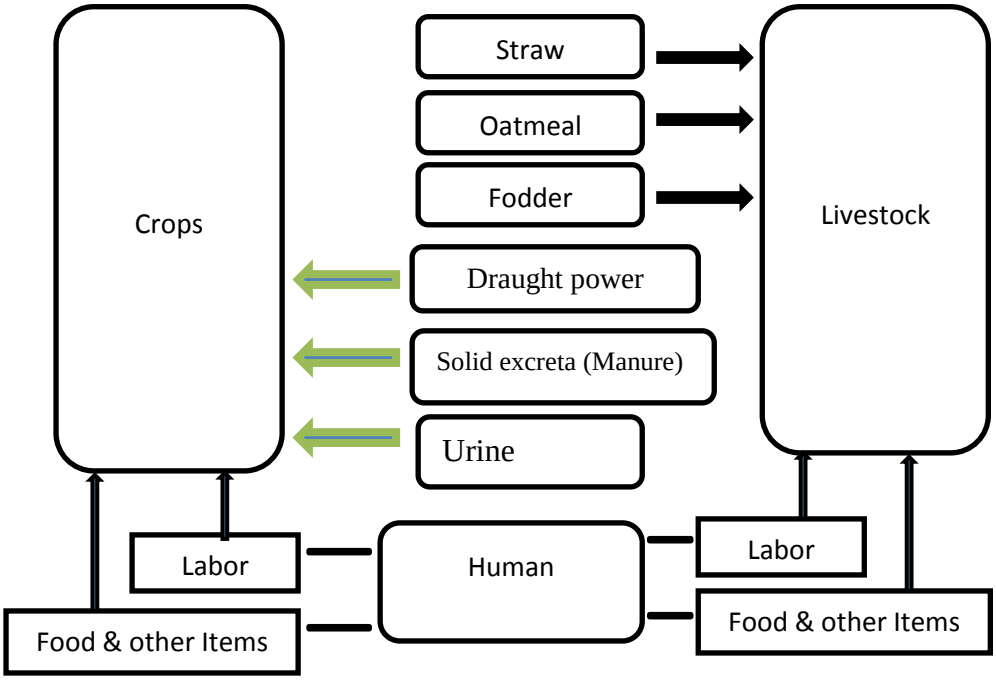

Figure 1: Integrated crop-livestock farming process
Source: Adapted from Nizamuddin and Kumar Parashari, 2018.

According to the figure above, leftovers from agriculture (farm wastes) are used to feed livestock, while animal waste (dung and urine) are used as fertilizers for crops. This process leads to labor supply, food supply and income. Overall, human being (farmer) is the first beneficiary of IFS.

2.3.5 Advantages of integrated-crop livestock farming system

Integrated-crop livestock farming provides quite a lot of advantages. Rana and Pankaj Chopra (2016:9) emphasize on the following:

- **Productivity**: IFS provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and livestock. Animal excreta contain several nutrients (including nitrogen, phosphorus and potassium, and major inorganic nutrient components (N, P and K).) which are important for maintaining the soil structure and fertility.
- **Profitability:** Use waste material of one component at the least cost. Thus reduction of cost of production and form the linkage of utilization of waste material and elimination of middleman interference in most inputs used.
- **Balanced Food:** Components of varied nature are linked to produce different sources of nutrition.
- **Environmental Safety:** In IFS waste materials are effectively recycled by linking appropriate components, thus minimize environment pollution. In addition, integrated crop livestock farming reduces reliance on chemicals and fertilizers, therefore lowers environmental pollution.
- **Recycling:** Effective recycling of waste material (crop residues and livestock wastes) in IFS. Therefore, there is less reliance to outside inputs – fertilizers, agrochemicals, feeds, energy, etc.
- **Income Rounds the year:** Due to interaction of crops and livestock, crop yields, eggs, milk are available and provide flow of money to the farmer round the year.
- **Saving Energy:**. Effective recycling technique the organic wastes available in the system can be utilized to generate biogas. Energy crisis can be postponed to the later period.
- **Meeting Fodder crisis:** Every piece of land area is effectively utilized. Plantation of perennial legume fodder trees on field borders will greatly relieve the problem of non – availability of quality fodder to the animal component linked.
- **Solving Timber Crisis:** Excreta can be dried and transformed into dung cakes which can be utilized as alternatives to firewood and charcoal for cooking.
- **Employment Generation:** Combing crop with livestock enterprises would increase the labor requirement significantly and would help in reducing the problems of under employment to a great extent.
- **Agro – industries:** When one of produce linked in IFS are increased to commercial level there is surplus value adoption leading to development of allied agro – industries.

2.4 Empirical review

Various previous researches have been conducted on integrated farming system, especially in India, South Africa and Nigeria. However, previous researches done specifically on integrated farming system in Rwanda were not found. The available researches were done on Girinka program and the aim of Girinka was among others to promote integrated farming system.

In his study conducted in South Africa, Ajuruchukwu (2013:8) showed that majority of respondents believed that agriculture will remain the driving force for rural transformation in South Africa since no country is known to have managed to reduce poverty without commensurately improving agricultural productivity. As for integrated farming system, respondents believed at 72% that it is preferable farming system, because it is a way of enhancing agricultural productivity and it improves the output of both crops and livestock products. Food security was shown to be a significant motive for a sizeable number of households choosing to integrate crop and livestock enterprises in the farming system. The study also revealed that local farmers hold several views about the value of crop-livestock integration, the most of which are that: (i) It leads to enhanced profit from the crop enterprise; (ii) It leads to increased meat output; (iii) It leads to increased milk output (iv) It is a source of energy (biogas); (v) It is a source of manure for regenerating soil fertility; (vi) It is a source of increased farm revenue; (vii) It is a source of food security; and (viii) It is a source of feed for livestock (Ajuruchukwu, 2013:8).

In his study entitled "*Integrated farming and its impact on farmers' livelihood in Bangladesh"* Uddin, Khan & Islam pointed out that the future development of Bangladesh depends particularly on the agriculture sector which is the mainstay of the economy. They further argue that since there is no scope to increase the area under cultivated land in Bangladesh, the only way to increase employment, farm production and income and thereby to improve livelihood of the farming community is to increase the productivity of land through integrated farming (Uddin, Khan and Islam, 2015: 62).

The findings of their study revealed that small farmers who practice IFS have better food security, higher income and improved livelihood. The findings showed also that integrated farming is important not only for employment creation, but also for promoting the overall economic condition (Op cit. p63). As for employment creation, the study reveals that integrated farming created more employment comparatively with monoculture farming. The

study showed that the average working hours/day for male labor was 6.4 and 6.2, and female labor was 3.8 and 3.5, respectively under monoculture or conventional farming. With integrated farming the average working hours/day for male labor was between 7.8 and 8.2 hours, and female labor was 4.8 and 5.5, respectively. Concerning annual income of sampled farmers (in respect of farm sizes) , it was observed that the average total income of the conventional or monoculture farming was Tk. 99,641, while farmers practicing integrated farming system earned highest annual income of Tk. 155,892 (Op cit.p63).

The impact of integrated farming system was further analyzed by Uddin, Khan and M. Islam (2015) based on asset pentagon approach which shows that there is a noteworthy improvement based on different capitals (namely, human capital, social capital, natural capital, physical capital and financial capital).

Human capital: Majority of the farmers under integrated farming reported that quality of the components of human capital has increased over the periods through gaining education and knowledge, improving health condition, more access to information, better training and development of skill in all the selected areas. This was not the case for farmers practicing conventional or traditional farming.

Social capital: In their study, involvement in social group, political involvement, self-managerial capability and social access were considered as the components of social capital. There were positive trends of social assets in the integrated farm households. Almost all the farmers' involvements in different social groups, their managerial capacity through integrated farming had improved.

Natural capital: Quantity of cultivable land had increased and remains constant in integrated farm households whereas in monoculture farm households, it fluctuated over time. Access to open water resources (Rain water) also showed increasing trend in integrated farmers.

Financial capital: Cash in hand, savings and liquid assets had increased for the integrated farm households. However, the rate of increase was not estimated. Farmers' income had increased and they were able to have more cash savings and liquid assets through integrated farming. Remittances and donation were constant for the integrated farm households. This was not the case for monoculture farm households.

Physical capital: Almost all the asset category showed positive trends in the integrated farm households rather than in monoculture farm households. Most of the farmers had tin roofed houses. Percentages of integrated farm households having straw roof houses decreased gradually with time (Uddin, Khan and M. Islam, 2015: 68).

In his study entitled "*Impact assessment of integrated farming system program for sustainable rural livelihood security in Kanker district of Chhattisgarh in India*", Rabighosh (2018) showed the impact of integrated farming. In his study, it was revealed that employment was generated through integrated farm activities and total income generated by households has increased. The increase of income resulted to increase of expenditure in the products like meat, fish, egg, and fruit. This implied balanced nutrition among households practicing IFS (Rabighosh, 2018: 31).

Last but not least, the study revealed some challenges for adopting Integrated Farming System: Poor land utilization and soil quality; Small/marginal size of land holdings; inadequate agriculture financing; Poor post-harvest management; Poor quality livestock – inadequate coverage of artificial insemination; and Poor risk management and insurance coverage (Rabighosh, 2018:40).

In Rwanda, previous researchers showed also the impact of integrated farming through Girinka program. For instance, Pia Nilsson, Mikaela Backman, Lina Bjerke& Aristide Maniriho (2017) in their study entitled " *One cow per poor family: effects on consumption and crop production in Rwanda*" found a positive effect of receiving a cow on crop production, indicating that fertilizers provided by the cattle has enabled households to increase their agricultural production. However, they found that the effects depend importantly on households' ownership of land and livestock, and knowledge and experience of rearing livestock (Pia Nilsson, Mikaela Backman, Lina Bjerke& Aristide Maniriho, 2017:3). The study showed that own a cow is one thing, but get the most out it is another important thing. Thus, benefits from Girinka program depend much more on the knowledge and experience in rearing livestock by the beneficiaries.

Another study entitled "Cattle manure management in Rwanda – A case of Girinka cow beneficiaries in the district of Ngoma" by Sung Kyu Kim*et al*.,(2013) showed that 90% of Girinka beneficiaries were using manure, and beneficiaries positively attributed increased yields and improved soil fertility to manure use. The survey data showed that the yields of beans, maize, sorghum, cassava and banana grown in the district doubled after manure use (Sung Kyu Kim*et al*., 2013: 6).

However, despite the high rate of manure usage, the estimated quantity of manure used was insufficient. The recommended rate for food crops in Rwanda (10,000 kg of manure per ha), but farmers were using 3,500 kg/ ha. Low or less-than-optimum levels of manure production

and application was due to small and scattered plots of land, far distance of travel to plots, poor cow sheds and manure collection facilities, lack of manure handling and transportation tools, availability of extension services, and better understanding and knowledge of manure preparation and application practices (Op cit, 7).

Overall, previous researches showed that integrated crop livestock farming contributes to socio-economic conditions of farmers who practice it. However, it is not integrated farming *per see* that result in a positive outcome, but the ability of the households to manage and practice Integrated farming system correctly.

2.5Theoretical framework to understand the adoption of Integrated farming system

A number of theories have been developed over the years to explain the factors that promote or hinder the acceptance and use of new system either in health, education or agriculture sector. The most cited and known is Diffusion of Innovation Model (DoI) by Everett Rogers.

According to Rogers's theory of diffusion of innovations, the decision to adopt and use an innovation starts first and foremost with the knowledge stage. It is difficult for an individual to adopt an innovation or new practice that he or she is not aware of. The main questions that an individual often asks in regard to a new practice, like IFS are; "What is integrated farming system?" "How does it work?" "Why does it work?" and "What will its advantages and disadvantages be in my situation?" Therefore, for adoption and diffusion of IFS to be successful a particular type of communication is needed whereby the information about IFS is regularly provided through training to the farmers, but also that information should regularly be exchanged among the farmers (Rogers, 2013: 21).

Furthermore, Rogers in his theory states that an innovation which has five attributes (relative advantage, compatibility, complexity, trial ability and observability) will be adopted more rapidly than other innovations. Five attributes of an innovation which determine its adoption are discussed below:

Relative advantage

Relative advantage is defined as the degree to which an innovation is perceived as being better than the idea it supersedes. Potential users want to know the degree to which a new idea or a new practice is better than an existing practice. The greater the perceived relative advantage of a new practice, the more rapid its rate of adoption will be (Rogers, 2013:52). As far as this study is concerned, the researcher argues that the adoption and practice of

integrated farming by farmers is determined by their perception of the relative advantages of integrated farming over monoculture and traditional farming system.

Compatibility

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, needs and practices (Rogers, 2013:15). An innovation that is more compatible is less uncertain to the potential user, and fits in more closely with the individual's life situation. As far as practice of integrated farming by farmers is concerned, the researcher argues that if integrated farming system is perceived as compatible with needs, expectations, cultural values and beliefs of farmers in Nyagatare district, it will be adopted and practiced easily.

Complexity

Complexity is the degree to which a new system is perceived as relatively difficult to understand and to use (Op cit. p16). He further states that the degree to which an individual believes that using a particular innovation would be free of physical and mental effort can directly affect his or her decision to adopt or not to adopt a particular innovation. In this context, the researcher argues that if farmers in Nyagatare district perceive integrated farming system as expensive, complex and difficult to implement, it will not be adopted and practiced.

Observability

Observability is the extent to which the results or outputs of an innovation are visible to others (Rogers 2013:24). If the results or outputs from adoption and utilization of an innovation are easily seen by other members of the community, that innovation is likely to be adopted. Such visibility stimulates curiosity and discussion about an innovation. Friends and neighbors are the first to be interested and are then likely to adopt an innovation. As far as practicing integrated farming system is concerned, the researcher argues that if practicing integrated farming system provides social status and prestige in the society, and changes visibly the socio-economic status of those who practice it, more people will want to adopt and practice it.

2.6 Conceptual framework

Based on previous parts of this chapter, a model analysis was developed and presented below

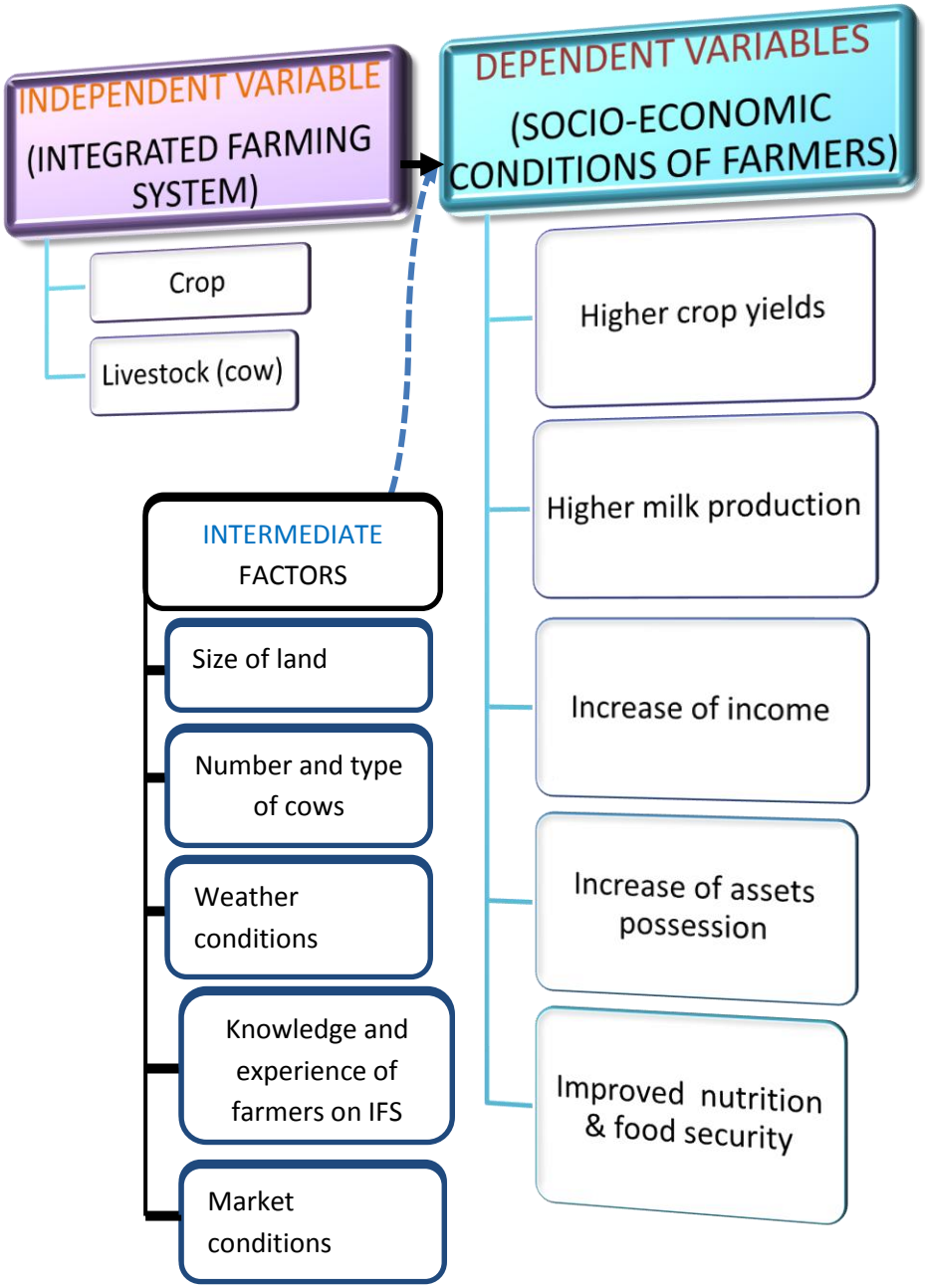

Figure 2: Model analysis
Source: Researcher own design, 2018.

Description of the model

According to the figure above, well-practiced IFS can contribute to the improved socio-economic conditions of farmers in Nyagatare district. Improved socio-economic conditions are measured by the variables such as higher crop yields, higher milk production which result to increased income and increased assets, and finally improved nutrition and food security.

Furthermore, for IFS to contribute to socio-economic conditions of farmers, some intermediate factors must be in place and these influence production and productivity of

agriculture and livestock. Those are; size of land one owns, number and type of cows (traditional or dairy cows), weather conditions, knowledge and experience of farmers on IFS and market conditions. However, the absence of the above intermediate factors may jeopardize the impact of integrated farming on socio-economic conditions of farmers.

Summary

The chapter presented the literature review where it was shown that agriculture will remain the driving force for economic transformation in many countries, including Rwanda. Also, it was pointed out that the future development of developing countries; including Rwanda depend on the agriculture sector which is the mainstay of the economy. However, future contribution of agriculture will depend upon how technologies in agriculture are used. As there is no scope to increase the area under cultivated land in Rwanda, the only way to increase employment, farm production and income of the farming community is to utilize integrated farming. Previous researches showed that integrated-crop livestock farming produced many advantages, such as increased production and productivity of agriculture and livestock, increased income, balanced nutrition and environment protection, to mention but few. The next chapter presents the methodology used for this study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

In the course of writing scientific paper, the researcher is requested to utilise methods and procedures which are based on facts that would enhance the probability of attaining validity (Mbati, 2013:13). This chapter presents the research methodology utilised in order to reach the objectives of the research. It presents the brief description of area of the study, research design and research approach; description of the target population, sample size and sampling procedures; research instruments, as well as data analysis technique.

3.2 Presentation of case studies (Nyagatare and Gatunda sectors)

The case studies chosen are two sectors of Gatunda and Nyagatare sectors of Nyagatare district of Eastern Province. These are the two sectors that practice integrated farming better than other 12 sectors of Nyagatare district and were chosen to make a comparison on success and challenges on integrated farming because they differ in many aspects, be it location, size, richness, distance from city centre where most of the infrastructures are concentrated, availability of technical experts in veterinary, market availability of crops and animal products and many others. Nyagatare district is made up of rural and urban, since the two case studies, one is rural and the other is urban they represent and give image of IFS in Nyagatare district. Therefore, findings of two sectors will guide the district administration to take facts-based strategies in order to strengthen the integrated farming in the whole district

3.2.1 Nyagatare sector

Nyagatare sector is one of the sectors in Nyagatare district. It came into existence in 2006 during the second phase of decentralization where seven former sectors of Nyagatare, Gakirage, Ryabega, nsheke ,Barija, Rutaraka and Nkerenke formed a sector now called Nyagatare sector. It is located in central of Nyagatare district ,it has nine cells and 40 villages ,the surface area of the sector is 164 km2 and its population is 52,125 people, the number of Men is 26,062 and number of women is 26,063, it has both the urban center (Nyagatare town) and rural area .The Nyagatare town is the city of Nyagatare District and it is one of the six secondary cities of the country, it is the second richest and 4th biggest sector in the district. The main economic activity of the people in this sector is business, dealing in different commodities and quality services,

crop production and livestock farming. The estimated number of households that practice integrated farming is two-hundred (200). The area where agriculture is practiced is 7,500 ha; part of it is under integrated farming more especially in Girinka program (Nyagatare sector report,2018).

3.2.2 Gatunda sector

Gatunda sector was formed in 2006 and is made up of former sectors of Gatunda and Rwebare, it is one of 14 sectors that make up Nyagatare District. It is located in the central west of the district and North West of the country. The location of the sector is 30km away from the main Tarmac road and Nyagatare Town. It is among the poorest and smallest sector in Nyagatare District, it is comprised of seven cells and 44 villages. The size of the sector is 52.1 km2 with the population of 27,776 and population density of 533/km2 .The number of males is 13,345 (48%) and Female is 14,431 (52%). Main economic activity of the sector is Agriculture with livestock , which makes up 98% of the sector .The area that agriculture activity is practiced in Gatunda sector is 4100 ha and in general total number of heads of cattle is 2600 (Gatunda Sector Report,2018).

Table 1 : The summary of comparison of Nyagatare and Gatunda sectors

Characteristics differentiating two sectors	**NYAGATARE**	**GATUNDA**
Ranking of the sector in wealth(richness) in 14 sectors of the district.	2nd Richest in 14 sectors	13th richest in 14 sectors
Surface Area	164 km^2	52 km^2
Distance from city center/district Head quarters	0-5 km	30-40 km
Population	52,125	27,776
Availability of market from agriculture and livestock products	No problem of markets for agriculture and livestock products.	Big problem related to market accessibility for livestock and agriculture products
Area where agriculture is practiced	7,500 ha	4,100 ha
Number of cows in the sector	7,000 cows	2,600 cows
The main economic activities	- Big business; - Trading on high class items; - Agriculture and livestock	- Agriculture and livestock; - Small business of lower quality items.
Availability of Veterinary officers	Always available(very many come from University campus that offer Veterinary Medicine courses), and some come from district administration.	Veterinary officers rarely available and very difficult for a farmer to get a veterinary officer on time. The sector has only one veterinary officer.

Source: Gatunda and Nyagatare archives, 2018

3.3 Research design and research approach

- **Research design**

Research design is defined a research design as a detailed outline of how investigation takes place (Creswell, 2014:2). This study is both descriptive and critical analysis research design. Descriptive research is designed to provide a picture of a situation as it happens. It is used to explain current practice and make judgment (Polonsky& Waller, 2014: 31). Critical analysis is a three-step process of asking questions regarding how it looks; how it works (by taking it to pieces) and how it is compared to others so as to make a judgement about its value or significance. It involves deeper analytic thinking to evaluate (Zikmund (2009). In addition, Kumar (2011) argues that critical analysis helps to: (i)Evaluate strengths and weaknesses; (ii)Weigh one piece of information against another; (iii) Make reasonable judgments; (iv)Argue a case according to the evidence; (v)Show why is relevant or suitable; (vi) Indicate why one will work best; (vii)Identify whether is appropriate or suitable; and (viii) Weigh up the importance of the component parts.

This study adopted descriptive design to provide a picture of the situation and explain current integrated farming practices by the farmers and finally make judgment. In addition, the study used critical analysis design, because the research wants to investigate and determine how integrated farming system as practiced by the farmers impacted on their socio-economic welfare. In other words, the research aims at determining the strengths and weaknesses of integrated farming, also to show the opportunities and threats for the integrated farming practice in Nyagatare district.

- **Research approach**

There are generally two broad research approaches, called quantitative and qualitative approach. Qualitative research and quantitative research provide different perspectives, and each has its limitations (Ranjit Kumar 2014: 21). Therefore, the limitations of one method can be offset by the strengths of the other method and the combination of quantitative and qualitative data provide a more complete understanding of the research problem than either approach by itself (Op cit, p22).To analyze the impact of integrated farming system on socio-economic

development of farmers in Nyagatare district, the mixed methods approach was appropriate and was used. The mixed methods approach helped the researcher to deeply investigate the topic of research. It further increased the reliability and validity of research findings, because the triangulation of data collection methods was used.

3.4 Target population, sample size and sampling procedures

In this section, population of the study, size of the sample and sampling procedures are discussed.

3.4.1 Target population.

Target population is defined as the entire population or main group of people from which the sample size is selected(Neuman, 2014:21).The target populations for this study include the households who practice integrated farming system and which fulfill the following criteria: (a) Households who have at least three (3) cows; (b) households who own at least 0.5 ha of land; and (c) households with at least three (3) family members. The target households who fulfill the above criteria in Gatunda and Nyagatare sectors were 200 households: 102 households in Nyagatare sector and 98 in Gatunda. This target population was rather too large to be covered by the researcher; therefore it deemed necessary for the researcher to determine the representative sample.

3.4.2 Sample size

A study must have adequate sample size relative to the goals of the study (Leedy&Ormrod, 2015:4). As indicated earlier, the target population of the study is 200 households. Thus, the researcher assumes that 20% of the target population is enough as a representative sample size. Overall, the sample size for this study comprised of 41 households and 5 administrative staff in charge of agriculture who were purposively selected for interviews (2 at sector level, 1 at the district level, 1 at provincial level and 1 at Rwanda Agriculture Board (RAB). The following table shows the respondents per cell and key informants per administrative level.

Table 2: Number of respondents per sector and per cells

No	Sector	Cells	Respondents (head of household)	Key informants for in-depth face-to-face interviews
1	Gatunda	Kabeza	5	1
		Nyamikamba	5	
		Nyamirembe	5	
		Nyarurema	5	
2	Nyagatare	Nyatare	4	1
		Nsheke	4	
		Ryabega	5	
		Gakirage	4	
		Rutaraka	4	
	District level	N/A	N/A	1
	Provincial level	N/A	N/A	1
	Central government level (RAB)	N/A	N/A	1
Total		**N/A**	**41**	**5**

Source: Researcher, July2018.

It is worth to mention that the selection of cells in Gatunda was based on how the activity of integrated crop-livestock is developed compared with other cells. 4 cells among 7 were selected. The same principle applied for Nyagatare sector, whereby 5 cells were selected among 9 cells.

3.4.3 Sampling procedures

Sampling is defined as the process of choosing a small number of respondents from a larger defined target population (Neuman 2014:6)**.**There are two sampling methods, namely non-probability sampling and probability sampling method. The types of non-probability sampling include: convenience sampling, quota sampling, purposive or judgmental sampling, and snowball sampling. The types of probability sampling include: simple random sampling, stratified random sampling, cluster sampling, systematic random sampling, and multistage-sampling(*Idem*).As far as sampling procedure for this study is concerned, non-probability

sampling specifically purposive sampling was used. As mentioned earlier, criteria were set and households who fulfilled the criteria were selected to answer the questionnaire. From 200 households who fulfilled the criteria, simple random sampling was used to select 41 households. Purposive sampling was also used to select 5 key informants for in-depth face-to-face interviews.

3.5 Data collection techniques

To collect data, triangulation of data collection techniques was used, namely documentary, questionnaire (Survey) and interviews.

3.5.1 Primary data

Primary sources of data are first-hand information gathered for the purpose of investigation (Khan,2014:13). Primary source of data are collected through the questionnaire, interviews and where necessary observations. In this study, primary data were mainly collected through the questionnaire and in-depth face-to-face interviews.

3.5.1.1 Questionnaire

- **Format of questions in the questionnaire**

The form and wording of questions used in the questionnaire are extremely important as they have an effect on the type and quality of information obtained from a respondent (Ranjit Kumar, 2014:2). There are two forms of questions, namely open ended and closed, which are both commonly used in social sciences research. For this study, both open-ended and closed questions were used, but open ended questions were dominant.

- **Content of the questionnaire**

The questions in the questionnaire were elaborated based on the research objectives and research questions. In this regard, the researcher ensured that questions are relevant and are aligned with research hypothesis, research objectives and research questions.

- **Pre-testing the questionnaire**

It is important to test the questionnaire before using it for actual data collection (Blumberg, Cooper & Schindler, 2016:55). Pre-testing a questionnaire entails a thorough examination of the meaning of each question as understood by a respondent (Ranjit Kumar, 2014:11). The research instrument for this study was pre-tested. In this regard, 3 respondents from the population of the study were given the questionnaire and requested to answer it. The problems in understanding the way a question has been worded, the appropriateness of the meaning it communicates were

detected. By testing the questionnaire, unclear and ambiguous questions were corrected to make them clear and unambiguous.

- **Administering the questionnaire**

The questionnaire had a covering letter which briefly: (i) introduce the researcher and the institution he is representing; (ii) Described in two or three sentences the purpose and rationale of the study;(iii) Conveyed general instructions; (iv) Assured respondents of the anonymity of the information provided by them;(vii) Provided a contact number in case they have any questions; (viii) Gave a return address for the questionnaire and a deadline for its return; and (ix) Thank them for their participation in the study. In addition, due to timeline the researcher trained and utilized one assistant field worker to speed up the collection of data.

3.5.1.2In-depth face-to-face interviews

A semi-structured interview guide was used. A list of questions (open ended) was prepared beforehand and was asked to interviewees. During interview, the researcher was flexible and had complete freedom in terms of the wording of questions and the way he explained questions to the respondents and all aimed to collect as much information as possible.

3.5.2Secondary data

While primary sources provide first-hand information, secondary sources provide second-hand data (Salkind, 2017:2)**.** The secondary data used in this study were gathered through documentary search and were coming from diverse sources, mainly the official government policies and reports related to the issue of integrated farming system. Books, articles from journals, dissertations and theses were consulted. Least but not least, Internet sources were crucial.

3.6 Data analysis

The process of data processing and analysis followed the following steps:

3.6.1Editing

The first step in processing the data is to ensure that the data is ‘clean that is, free from inconsistencies and incompleteness. Editing helped the researcher to identify and minimize as far as possible, errors, incompleteness, misclassification and gaps in the information obtained from the respondents.

3.6.2 Coding

Having 'cleaned' the data, the next step was to code. The coding process followed the following steps: coding the data; and finally verifying the coded data. The coding aimed at facilitating data entry in the computer. The coding helped to ensure that all the data are entered and data are not duplicated when entering them.

3.6.3 Statistical analysis

Before starting the statistical analysis, a frame of analysis was developed. Questions such as: "Which variables to analyze? How they should be analyzed? helped to develop the frame of analysis. The Statistical Package of Social Sciences (SPSS) and Microsoft Excel were used.They assisted to calculate the percentages, frequencies, standard deviation etc. and to generate tables and graphs. In addition, it is worth to mention here that SPSS was used to generate easily the tables and histograms for this study. To analyze and interpret qualitative data from interviews, main themes were identified and coded. Qualitative information were classified under the main themes and then, put into the report. The qualitative data was integrated in the report to supplement the quantitative information or data.

3.7Validity and reliability

Research instrument should be valid and reliable. Therefore, validity and reliability of research instrument for this study were ensured as follows:

3.7.1 Ensuring validity

Validity is the ability of an instrument to measure what it is designed to measure(Neuman, 2015:18). Three types of validity in quantitative research were identified: (i) Face and content validity; (ii) concurrent and predictive validity; and (iii) construct validity. Face validity is ensured by ensuring that each question or item on the research instrument has a logical link with an objective. Content validity is ensured by making sure that the items and questions cover the full range of the issue being measured(Neuman, 2015:19).As far as ensuring face validity is concerned, the researcher ensured that the research questions are well formulated and well linked to the research objectives. As for content validity, the researcher ensured that questions in the questionnaire cover the researcher questions and help to determine the impact of integrated farming system on socio-economic welfare of farmers.

Construct validity means that the measuring instrument fits with theoretical expectations (Leedy & Ormrod, 2017:3)**.** In this regard, to ensure construct validity the researcher did a thorough theoretical review and checked previous empirical studies in the domain of the study to be inspired. In addition, the questionnaire and interview guide were submitted to the supervisor for approval before starting the fieldwork.

3.7.2 Ensuring reliability

To ensure reliability special attention was be put on some factors affecting the reliability of a research instrument: (i) the wording of questions was check in order to avoid ambiguous questions; (ii) During the fieldwork, the conducive atmosphere was created to ensure respondent's positive and inspiring mood; (iii) The researcher ensured mutual trust and respect interaction between him and the respondent. Furthermore, the reliability of a research instrument can be assessed by means of Cronbach's(Leedy&Ormrod, 2017:5). Cronbach's Alpha coefficient should score above the 0.7 threshold. For this study, the research instrument was checked through SPSS and a Cronbach's Alpha of 0.8was obtained.

3.8 Ethical issues

In this study, the following codes of conduct were taken into account: (i) Informed consent- Before starting collecting data; the researcher explained the relevance and usefulness of the research and tried to convince the respondent to participate; (ii) Keeping confidentiality- The respondent was ensured that the information provided is kept anonymous and only used for the research purpose; (iii) Avoiding bias- falsification or fabrication of data and manipulation of the findings were avoided; and (iv) Biased reporting of the findings was also avoided.

Summary

This chapter discussed the research methodology of the study which focused on the research design, target population and sampling procedures, research instruments, and data analysis process. This study was both descriptive and co relational research design. It seeks to present the current practices of integrated farming system by the farmers, but also determine the correlation between integrated farming system and socio-economic welfare of farmers. The sampling procedure was judgmental whereby some criteria were set and households who fulfill those criteria were selected. From 200 households who fulfilled the criteria, 41 households were randomly selected. Five (5) key informants were purposively selected for interviews. The triangulation of data collection methods was used. Primary data were collected through the

questionnaire and interviews, while secondary data was collected through documentary research. The data was collected from 10 cells in 2 sectors of Nyagatare and Gatunda. The next chapter is dedicated to the analysis and interpretation of research findings.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION OF FINDINGS

This chapter presents a pragmatic analysis on integrated farming as strategy of social economic development of farmers in Nyagatare and Gatunda sectors of Nyagatare district.

4.1. Demographic data

Demographic characteristics, such as gender, marital status, age, education level and location (cells) of respondents were analyzed and presented below.

Table 3: Distribution of respondents by Sector and Gender

Sector	**Gender**		**Total**	**Percentage**
	Male	Female		
Gatunda	14	06	20	48.8%
Nyagatare	13	08	21	51.2%
Total	**27**	**14**	**41**	**100.0%**
Total %	**65.9%**	**34.1%**	**100.0%**	

Source: Research findings, July 2018.

Table 2 shows the distribution of respondents disaggregated by gender and their location. Forty one (41) respondents participated in the survey, including 65.9% (N=27) of males and 34.1% (N=14) of females. Overall, there was difference in terms of gender whereby males participated in the survey than females. This was due to the fact that males feel concerned and more involved in agriculture and livestock activities than females. Also, the study targeted the head of household and according to the Rwandan culture males are the heads of households. Households headed by females were not many. There was also small difference in terms of the number of respondents per sector, whereby Nyagatare has more number than Gatunda. This was due to the fact that Nyagatare has more number of farmers who practice IFS than Gatunda sector.

Table 4: Distribution of respondents by marital status and sex

Sex	Marital status				Total
	Single	Married	Divorced	Widow	
NYAGATARE SECTOR					
Male	1	11	1	1	14
Female	1	3	2	1	7
GATUNDA SECTOR					
Male	1	11	1	2	15
Female	1	4	0	0	5
Overall Total	**4**	**29**	**4**	**4**	**41**
Overall Total%	**9.8%**	**70.7%**	**9.8%**	**9.8%**	**100.0%**

Source: Research findings, July 2018.

Table 3 shows the distribution of the respondents based on their marital status. Overall, 70.7% of the respondents were married, 9.8% were single, 9.8% were divorced and 9.8% were widowed. As the table shows there were minor differences between two sectors, only that women (respondents) were many (7) in Nyagatare than in Gatunda (5). The researcher assumes that, as the integrated farming system creates more jobs (mixed crop-livestock activities) married couples whereby man and woman work together and complement each other have more chances to succeed in IFS than Widow or divorced couples. The coordination of both crop and livestock activities might become easier for married couples than for divorced or widowed (As it is said "*Two are better than one*"). In addition, the data of table 3 show that all categories of people, irrespective of their marital status can practice IFS.

Table 5: Distribution of respondents by Age category

Sex/Age	25-35	36-45	46-55	56-65	Total	Percent
NYAGATARE SECTOR						
Male	4	7	2	1	14	66.7
Female	0	4	2	1	07	33.3
Total	4	11	4	2	21	100%
Total %	19 %	52.5%	19 %	9.5%	100.0%	
GATUNDA SECTOR						
Male	3	8	3	1	15	75
Female	1	2	2	0	5	25
Total	4	10	5	1	20	100%
Total %	20%	50 %	25%	5%	100%	

Table 4 shows the distribution of respondents per age category. Majority of the respondents are in age range of **36-45**with **52.5%, 50%** in Nyagatare and Gatunda respectively. Followed by category in range of **46-55** with 25% ,19% for Gatunda and Nyagatare respectively .The last category for two sector is category of **56-65**with **9.5%, 5%** of Nyagatare and Gatunda respectively. The researcher assumes that people in these two age ranges are active, have more responsibilities (children) and want to do something to secure their source of income for the future. Nyagatare has bigger number of active working group of 52.5% compared to that Gatunda of 50.

Also, no negligible percentage 20% and 19% of young people between 25-35 age range in Gatunda and Nyagatare respectively is involved in IFS. This is a good indicator and results from the government' mobilization encouraging young people to get involved in agriculture and livestock business. However, this percentage is very low considering the number of unemployed youth. Well-practiced IFS is source of income (Rabighosh, 2018:4). Therefore, young people must be mobilized and facilitated to engage in IFS. This will reduce the rate of unemployment among the youth and this will contribute to their socio-economic conditions and also to the socio-economic development of their county.

Table 6: Distribution of respondents according to their level of education and sex

Sex	Education Level					Total	Percentage
	None	Primary	Professional	Secondary	University		
NYAGATARE SECTOR							
Male	0	1	2	7	4	14	66.6%
Female	0	0	0	5	2	7	33.4%
Total	**0**	**1**	**2**	**12**	**6**	**21**	**41**
Total %	**0%**	**4.7%**	**9.5%**	**57.3%**	**28.5%**		**100.0 %**
GATUNDA SECTOR							
Male	0	2	4	8	1	15	63.4%
Female	0	0	2	3	0	5	36.6%
Total	**0%**	**2**	**6**	**11**	**1**	**20**	**20**
Total%	**0%**	**10%**	**30%**	**55%**	**5%**		**100%**
Overall total	**0**	**3**	**8**	**23**	**7**	**41**	**41**
Overall total%	**0%**	**7.3%**	**19.5%**	**56.1%**	**17.1%**	**100 %**	**100.0 %**

Source: Research findings, July 2018.

Overall, table 5 shows the distribution of respondents based on their education level. The data shows that 56.% (N=23) of the respondents have secondary education, 19.5% (N=8) have vocational professional level of education, 17.1% (N=7) have university education, and 7.3% (N=3) have primary level of education. By comparing Nyagatare sector and Gatunda sector, the table shows that respondents in Nyagatare have the high level of education (secondary and university than the respondents in Gatunda sector. Also, it is shown that respondents in Gatunda sector have the lowest level of education (primary and professional) than respondents in Nyagatare. This difference may due to the fact that Nyagatare is urban where higher education infrastructure or institution are abundant than in Gatunda.

From the above figures, the researcher assumes that well-practiced integrated crop-livestock farming requires one to have a certain level of understanding. Knowledge and skills are important determinants for one to do things well and better. Again, when it comes to adopt an innovation, it becomes easier to mobilize educated people than uneducated. Resistances to change is likely to be higher for uneducated/illiterate rather than for educated or literate people (Rogers, 2013:46). Therefore, considering the level of education of the respondents, the

researcher assumes that they have a certain level of understanding and thus, can better practice IFS and gain much from it.

Furthermore, the results show that old mind-sets of university graduates who used to think that agriculture and livestock activities are for those who did not study start to change. In Nyagatare sector, the university graduates start to understand that well-done mixed crop-livestock farming is good investment, promising profession and very sure source of income and prosperity.

4.2 Integrated farming and socio-economic welfare of farmers

In their studies, RanaPankajChopa (2016), Rahman (2018), Pia Nilsson *et al*., (2017), Ajuruchukwu (2013), and Argent *et al*., (2014) to mention but a few, showed that IFS contribute to the socio-economic welfare of farmers. Therefore, this study investigated whether farmers in the selected sectors have improved their socio-economic status through IFS. Using Likert scale, a question was asked to determine the extent to which respondents appreciate the contribution of IFS to their socio-economic status. The results are presented below.

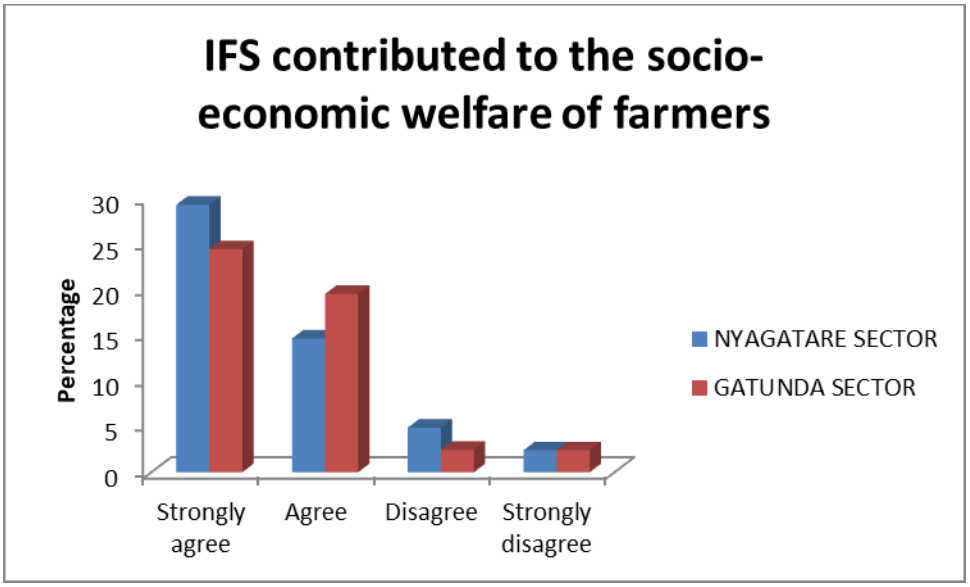

Figure 3: Appreciation of farmers on IFS contribution
Source: Research findings, July 2018.

The figure above shows the level of appreciation of the respondents on the contribution of IFS. In both Sectors, majority (53.7%) strongly agreed that their socio-economic status have positively changed because of IFS, while only 34.1% agreed. The figure shows that 7.3%disagreed and 4.8% strongly disagreed in Nyagatare and Gatunda sectors respectively, that

IFS did not contribute positively to the socio-economic welfare of farmers. This shows that even though the majority confirms that IFS contributed to the welfare of farmers, 12.1% percent(7.3%+4.8%=12.1%) revealed that IFS has not contributed to the welfare of farmers.

The positive contribution of IFS was also mentioned by interviewees. Interviewee at district level revealed "*Integrated farming has since after its adoption improved social economic status of the farmers in those two sectors; whereby it increased food production and milk*". In supporting, the interviewee at RAB said "*Integrated farming has increased food security and increased incomes of the famers in Nyagatare district.* Compared *to other districts, this district does not have the problem of food and the rate of malnutrition is low compared to other districts*".

The previous researches also highlighted the impact of Girinka program as a strategy to reduce poverty, malnutrition and promote IFS. For instance, Gumira Hahirwa&Karinganire(2017) researched and provided the impacts of Girinka program in Huye and Gisagara district. According to their findings, participants in their study revealed that the programme is crucial to addressing their fundamental needs. They indicated that progressively, they have been able to pay school fees for their children, health insurance and to access lump-sum cash which they use to buy small but important domestic things like salt, soap, sugar and affordable clothes. This is illustrated by one of the beneficiary of Girinka programme as follows:

"It is not so simple to take care of a cow but when you take time and feed it adequately, you are proud of its production and it helps you solve many problems. When I consider how much I can afford to different needs such as food, school fees for my children, contribute for savings and credit [through tontine], that I could not afford otherwise".

As shown in the figure 3 above, some respondents disagreed that IFS through Girinka contributed to the welfare of farmers. One farmer interviewed revealed *" I received a milk cow from Girinka program two years ago [then 2016] but couldn't manage to feed it because my plot is very small to grow foodstuff for the family and grasses to feed the cow that I have received from the Girinka program. I faced the challenge to feed the received cow and to handle the problem of feeding the cow, which generally needs too much fodder per day, I used to collect grasses from neighbouring bushes but since this was not enough during dry seasons I was tempted to give up and return it to the providers. To deal with the lack or insufficient cow feeding, local authorities encourage beneficiaries with limited resources and with small plot to form a livestock cooperative so that together they feed and care for their cows and facilitate*

veterinary visits, but this option also failed due to lack of enough skills in animal husbandry and cooperative management".

To go further, the researcher wanted to determine from which indicators those positive changes are manifested. Indicators such level of income, level of expenditure, assets possession, food intake (quality and quantity) were analyzed.

4.2.1 Comparison of level of income before and after integrated farming

This question was asked to check whether integrated crop-livestock farming helped the farmers to increase their monthly income.

Table 7: Monthly income before and after integrated farming (Gatunda Sector)

Monthly income from crop					
Level of income (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(31,000-100,000)	18	90%	9	45%	-45%
(101,000-200,000)	2	10%	6	30%	20%
(201,000-300,000)	0	0.0%	4	20%	20%
(301,000-400,000)	0	0.0%	1	5%	5%
>500,000	0	0.0%	0	0.0%	0.0%
Total	**20**	**100%**	**20**	**100%**	
Monthly income from animal products (milk)					
(31,000-100,000)	19	95%	11	55%	-40%
(101,000-200,000)	1	5%	5	25%	20%
(201,000-300,000)	0	0.0%	3	15%	15%
(301,000-400,000)	0	0.0%	1	5%	5%
>500,000	0	0.0%	0	0.0%	0.0%
Total	**20**	**100%**	**20**	**100%**	

Source: Research findings, July 2018.

The table above presents the findings which show significant changes in terms of income accumulated. After integrated farming, income from crop production has increased significantly compared to the situation before IFS. Respondents who earn between (31,000-100,000Rwf) dropped by -45%,due to the shifting to the high incomes. Respondents who earn from crop between Rwf101,000-200,000 increased to 20%, those who earn betweenRwf201,000-300,000 increased to 15% and those who earn between Rwf301,000-400,000 increased to 5%. Commenting on these figures, agronomist at sector level said "*Apply*ing *organic manure helped to increase crop production and this led to the increase of income from agriculture".*

Concerning the income from milk, the results show significant positive changes. IFS helped the farmers to increase milk production and the income from it. The farmers who earn between Rwf31,000-100,000 dropped by -40 %, while those who earn between Rwf101,000-200,000 increased to 20%, those who earn between Rwf201,000-300,000 increased to 20% and those who earn between Rwf301,000-400,000 increased to 5%. The results confirm with the findings of Argent *et al*., (2014) who found that through IFS milk production has increased in Odisha (India) and farmers earned more income from livestock rearing.The positive changes in terms of income from crop and livestock were also observed in Nyagatare sector. The results are presented in the table below.

Table 8: Monthly income before and after integrated farming (Nyagatare Sector)

Monthly income from crop					
Income (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(31,000-100,000)	15	71.4%	15	71.4%	0.0%
(101,000-200,000)	6	28.6%	4	19%	-9.5%
(201,000-300,000)	0	0.0%	2	9.5%	9.5%
(301,000-400,000)	0	0.0%	0	0.0%	0.0%
>500,000	0	0.0%	0	0.0%	0.0%
Total	**21**	**100%**	**21**	**100%**	
Monthly income from animal products (milk)					
(31,000-100,000)	18	85.7%	7	33.3%	-52.3%
(101,000-200,000)	3	14.3%	12	57.1%	42.7%
(201,000-300,000)	0	0.0%	2	9.5%	9.5%
(301,000-400,000)	0	0.0%	0	0.0%	0.0%
>500,000	0	0.0%	0	0.0%	0.0%
Total	**21**	**100%**	**21**	**100%**	

Source: Research findings, July 2018.

The table above shows changes that occurred in Nyagatare on monthly income from crop and milk due to IFS practice. As the findings show, there was no change between farmers who earn between Rwf31,000-100,000. Farmers who earn monthly income between Rwf201,000-300,000 increased from 0% to 9.5%. However, as it can be noticed changes in income from crop in Nyagatare sector was not realized compared to the results in Gatunda sector. This was due to the fact that Nyagatare sector is partly urban and people are more motivated in milk production because of available markets rather than in crop production. Positive significant changes were observed in terms of milk production and income from milk. Percentage of farmers who earn betweenRwf31,000-100,000 dropped significantly (-52.3%), while percentage of farmers who earn betweenRwf101,000-200,000 increased significantly (42.7%). Also, percentage of farmers who earn between Rwf201,000-300,000 increased to 9.5%.

Overall, in Nyagatare sector IFS helped the farmers to increase income from milk rather than income from crop. Respondents from Nyagatare sector enjoyed the advantage of owning a big land size that permits them to keep a number of cows than in Gatunda sector and nearby

veterinary services has been a contributing factor. Besides land size, famers adopted modern livestock farming techniques and hybrid animals that greatly affected their milk production. Comparing two sectors, one can notice that income from crop and livestock has increased through IFS in the two sectors. But in Nyagatare, IFS helped much to increase milk production and income from milk rather than crop. This was not the case in Gatunda, whereby the results showed that IFS helped the farmers to increase income from both crop and livestock.

Commenting on IFS impacts, one of the respondents narrated "*Before I start practicing IFS, I was poor and my children manifested the signs of malnutrition. My land was not fertile and feeding my two cows in that time was very challenging. But now, because of IFS I can harvest tons of maize and beans and feeding my four cows is no longer a problem. Today, I am gaining income from crop and animal products (milk and meat)".*

In this study, the researcher wanted to know the extent to which IFS contributed to the increase of production of selected main crops in Nyagatare district. Majority of about 89% in Nyagatare sector confirmed that IFS help to increase the production of Beans, Banana, Maize and others products such as vegetables and fruits. In Gatunda sector, big majority of 91% confirmed that IFS contributed to the increase of production of Beans, Maize, Banana and other products. Furthermore, the researcher asked the respondents to give the estimates of income gained from main crops. To determine the impact, the income gained from main crops before IFS were confronted with income after IFS. The comparison aimed at determining the changes.

4.2.2. Seasonal income from main agricultural products before and after IFS

Seasonal income from main agricultural products before and after IFS was compared to check whether there is difference or not.

Table 9 Income from main agricultural products before and after IFS

GATUNDA SECTOR Seasonal income from main agricultural products (Beans)					
Income (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(31,000-100,000)	19	95%	10	50%	-45%
(101,000-200,000)	1	5%	9	45%	40%
(201,000-300,000)	0	0.00%	1	5%	5%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**20**	**100%**	**20**	**100%**	
Seasonal income from main agricultural products (Banana)					
(31,000-100,000)	20	100%	17	85%	-15%
(101,000-200,000)	0	0.00%	2	10%	10%
(201,000-300,000)	0	0.00%	1	5%	5%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**20**	**100%**	**20**	**100%**	
Seasonal income from main agricultural products (Maize)					
(31,000-100,000)	18	90%	15	75%	-15%
(101,000-200,000)	2	10%	4	20%	10%
(201,000-300,000)	0	0.00%	1	5%	5%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**20**	**100%**	**20**	**100%**	

Seasonal income from other agricultural products (Vegetables, fruits etc.)					
(31,000-100,000)	2	10%	16	80%	70%
(101,000-200,000)	18	90%	4	20%	-70%
(201,000-300,000)	0	0.00%	0	0.00%	0.00%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**20**	**100%**	**20**	**100%**	

Source: Research findings, July 2018.

Table 10: Income from main agricultural products before and after IFS

NYAGATARE SECTOR Seasonal income from main agricultural products (Beans)					
Income (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(31,000-100000)	21	100%	9	42.90%	-57.10%
(101000-200,000)	0	0.00%	11	52.40%	52.40%
(201,000-300,000)	0	0.00%	1	4.80%	4.80%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
Seasonal income from main agricultural products (Banana)					
(31,000-100,000)	20	95.20%	14	66.70%	-28.50%
(101,000-200,000)	1	4.80%	7	33.30%	28.50%
(201,000-300,000)	0	0.00%	0	0.00%	0.00%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
Seasonal income from main agricultural products (Maize)					
(31,000-100,000)	17	81.00%	16	76.20%	-4.80%
(101,000-200,000)	3	14.30%	3	14.30%	0.00%
(201,000-300,000)	1	4.80%	2	9.50%	4.80%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
Seasonal income from other agricultural products (vegetables, fruits)					
(31,000-100,000)	17	81.00%	18	85.70%	-4.80%
(101,000-200,000)	3	14.30%	3	14.30%	0.00%
(201,000-300,000)	1	4.80%	0	0.00%	-4.80%
(301,000-400,000)	0	0.00%	0	0.00%	0.00%
>500,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	

Source: Research findings, July 2018.

Overall, the table 9 shows that through IFS the income from main and selected crops has increased in Gatunda sector. Because of high production, the high income was gained by the farmers. As it can be notice, income from beans has increased significantly, followed by income

from banana and maize. Changes of income from other products, such as vegetables and fruits were not observed. This is due to the fact that these products are not much cultivated in this sector.

The table 10 shows the changes that occurred in Nyagatare Sector after IFS. Overall, as a result of high crop production, majority of farmers started gaining higher income from key crops. The higher income came from beans, banana and maize, respectively. Before IFS, none of farmers could earn between Rwf101000-200,000 from beans. But after IFS, 52.4% can earn between Rwf101000-200,000. This is the case for banana whereby before IFS only one farmer (4.8%) could earn betweenRwf201,000-300,000, while after IFS 7 farmers (33.5%) can earn between Rwf201,000 -300,000 from Banana per month. Like in Gatunda sector, IFS did not help farmers in Nyagatare sector to increase income from vegetables and fruits. This is due to the fact that farmers concentrated on main crops and therefore, vegetables and fruits are not cultivated.

When asked to comment on the above findings, interviewee at district level revealed "*In the last 5 years, people here started to adopt IFS and the results were high production of main crops and animal products. Today I can assume that Nyagatare is the leader in terms of maize and beans production and animal products production (milk and meat). This was due to IFS whereby nothing is wasted. People feed their cows with crop residues and use dung and urine of animal and other crop residues as organic manure. Applying organic manure makes soils to be fertile".*

4.2.3Appreciation on expenditures before and after IFS

Generally, an increase in income goes hand in hand with an increase in expenditure. For instance, Dash *et al*., (2015:23) found that in Bangladesh farmers who practice IFS spend much more than farmers who practice monoculture. This is a result of high income that IFS practionners benefit compared to farmers who practice monoculture. Also, it was found that IFS practitioners spend much more on products, such as meat, fruits, fish and other expensive products rather than farmers who practice monoculture.In this study, the researcher wanted to check whether IFS impacted on farmers expenses. Expenditures on food, education, health services and cloths were analysed and the results are presented in the tables below.

Table 11: Expenditures before and after IFS in Nyagatare sector

FOODS					
Expenditure per month (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(15,000-30,000)	7	33.30%	1	4.80%	-28.50%
(31000-50,000)	13	61.90%	7	33.30%	-28.60%
(51,000-100,000)	1	4.80%	12	57.10%	52.30%
(101,000-200,000)	0	0.00%	1	4.80%	4.80%
>200,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
EDUCATIONAL SERVICES					
(15,000-30000)	5	23.80%	4	19%	-4.80%
(31,000-50,000)	12	57.10%	4	19%	-38.10%
(51,000-100,000)	4	19%	10	47.60%	28.60%
(101,000-200,000)	0	0.00%	3	14.30%	14.30%
>200,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
HEALTH SERVICES					
(15,000-30000)	8	38.10%	6	28.60%	-9.50%
(31,000-50,000)	8	38.10%	12	57.10%	19%
(51,000-100,000)	5	23.80%	3	14.30%	-9.50%
(101,000-200,000)	0	0.00%	0	0.00%	0.00%
>200,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
CLOTHING					
(15,000-30000)	11	52.40%	4	19%	-33.40%
(31000-50,000)	8	38.10%	12	57.10%	19%
(51,000-100,000)	2	9.50%	5	23.80%	14.30%
(101,000-200,000)	0	0.00%	0	0.00%	0.00%
>200,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	
EXPENDITURES FOR OTHER PRODUCTS					
(15,000-30000)	17	81%	13	62.00%	-19.00%
(31000-50,000)	2	9.50%	4	19%	9.50%
(51,000-100,000)	2	9.50%	4	19%	9.50%
(101,000-200,000)	0	0.00%	0	0.00%	0.00%
>200,000	0	0.00%	0	0.00%	0.00%
Total	**21**	**100%**	**21**	**100%**	

Source: Research findings, July 2018.

As it can be noticed in the table 11, higher income gained through IFS influenced expenditures on Food stuff. Before IFS, only one (1) farmer (4.8%) could afford to spend between Frw51,000-100,000 on food stuff, but now because of IFS 12 farmers (57.1%) can afford to spend between Frw51,000-100,000 on food stuff. Incomes increase and expenditures go proportionally. As for expenditure on education, percentages of famers who can afford to spend betweenRwf51,000-100,000 increased from 19% to 47.6%. This is to say that through IFS farmers can pay school fees for their children without problem. With their income, they can even afford to send their children in private and expensive schools. In this regard, one of the interviewee said "*I am a public servant, but there are schools that I cannot afford to pay for my children, but here in this sector, there are farmers who can send their children in whatever private schools. They have money because of IFS*".

Concerning health services, 12 farmers (57.1%) can afford to spend betweenRwf31,000-50,000, while before IFS only 8 (38.1%) could afford to pay that amount on health services. As it can be noticed, there is no significant change in terms of expenditures on health services, because of Mutuelle de Santé system. Before IFS farmers could pay for Mutuel de Santé as they capable to pay today with IFS.As far as expenditures on clothing are concerned, one can notice significant changes. Expenditures on cloths have increased. Because of high income through IFS, farmers can spend more much money on clothing than before**.** Lastly, the table shows that expenditures on other items also have increased. Other items can be communication, transport, and domestic equipment etc. Commenting on IFS impacts, one respondent in Nyagatare sector said "*Before, I used to experience the shortage of money, because money was coming from agriculture only and I had to wait for harvest period. But now, I always have money, because I can sell milk and cows. Today, buying airtime, go to Kigali to visit relatives is not an issue for me*".

Table 12: Main expenditures before and after integrated farming in Gatunda sector

FOODS					
Expenditures per month (Rwf)	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**Changes (%)**
(15,000-30000)	14	70	12	60	-10.00%
(31000-50,000)	6	30	6	30	0.00%
(51,000-100,000)	0	0	2	10	10.00%
(101,000-200,000)	0	0	0	0	0
>200,000	0	0	0	0	0
Total	**20**	**100%**	**20**	**100%**	
EDUCATIONAL SERVICES					
(15,000-30000)	11	55	4	20	-35%
(31000-50,000)	7	35	10	50	15%
(51,000-100,000)	2	10	6	30	20%
(101,000-200,000)	0	0	0	0	0.00%
>200,000	0	0	0	0	0.00%
Total	**20**	**100%**	**20**	**100%**	
HEALTH SERVICES					
(15,000-30000)	11	55	7	35	-20%
(31000-50,000)	6	30	12	60	30%
(51,000-100,000)	2	10	1	5	-5.00%
(101,000-200,000)	1	5	0	0	-5.00%
>200,000	0	0	0	0	0.00%
Total	**20**	**100%**	**20**	**100%**	
CLOTHING					
(15,000-30000)	14	70	4	20	-50%
(31000-50,000)	6	30	15	75	45%
(51,000-100,000)	0	0	1	5	5.00%
(101,000-200,000)	0	0	0	0	0.00%
>200,000	0	0	0	0	0.00%
Total	**20**	**100%**	**20**	**100%**	
EXPENDITURES FOR OTHER PRODUCTS					
(15,000-30000)	17	85	14	70	-15%
(31000-50,000)	3	15	4	20	5%
(51,000-100,000)	0	0	2	10	10%
(101,000-200,000)	0	0	0	0	0.00%
>200,000	0	0	0	0	0.00%
Total	**20**	**100%**	**20**	**100%**	

Source: Research findings, July 2018.

The table 12above shows significant changes in terms of expenditures on foods, education, health, clothing and other items, because of IFS practice. The results show that through IFS, farmers can afford to spend much more on food stuff, education, health, clothing and other items. This is contrary to the situation before IFS, whereby majority was able to spend little money between Rwf15,000-30000 on the items above.

Comparing the two sectors, it is noticed that the percentage of farmers who can afford to spend betweenRwf101,000-200,000 on education is higher in Nyagatare sector (14.3%) rather than in Gatunda sector (0%). Also, percentage of farmers who can afford to spend between Rwf51,000 - 100,000 on clothing is higher (14.3%) in Nyagatare sector, while it is 0 % in Gatunda. This situation can be explained by the fact that Nyagatare sector is urban and semi-urban area, while Gatunda is rural. In urban area, people can spend much on clothing and on education rather than people in rural areas.

Overall, though there were positive changes in the welfare of farmers due to IFS practice, it can be noticed that those changes are not very significant. This shows that IFS is not generating positive changes as expected. Further efforts are needed to maximize IFS contribution to the welfare of farmers in Nyagatare, but especially in Gatunda sector.

4.2.4 Assets possesion

In his study conducted in Nigeria, Ajuruchukwu (2013) found that farmers who practice IFS acquire more assets than farmers who practice monoculture. In this study, the assets of the respondents were analyzed. The focus was on the size of land and number of cows that farmers own. Normally, these two assets are critical for rural farmers.

Table 13: Land and cows possession

Hectares (ha) of land owned	Nyagatare Sector		Gatunda sector	
	Number	**%**	**Number**	**%**
[0.5-1.5] ha	6	28.60%	13	65.00%
[1.5-3.5] ha	6	28.60%	5	25.00%
[3.5-6.5] ha	8	38.10%	2	10.00%
[6.5-10.5] ha	1	4.80%	0	0.00%
Total	**21**	**100**	**20**	**100.00%**
Number of cows owned	**Nyagatare Sector**		**Gatunda Sector**	
	Number	**%**	**Number**	**%**
[3-5]	13	61.90%	9	45.00%
[5-7]	7	33.30%	1	4.80%
[7-9]	11	52.30%	10	50.00%
[9-11]	0	0.00%	0	0.00%
>11	0	0.00%	0	0%
Total	**21**	**100%**	**20**	**100%**

Source: Research findings, July 2018.

As said earlier, the prosperity of a farmer in rural area is measured by the size of land and number of cows one possesses. As it can be notice, farmers who practice IFS in both sectors are rich (Abakungu). In Nyagatare sector, majority of 64.7% possesses between 1.5ha to 6.5 ha, while it is 35% in Gatunda sector. Most of the time, this land was purchased after IFS. One of the respondents in Gatunda gave his testimony "*In 2014, I had only 1 cow and a piece of land of about 0.5 ha and I used to sell manure to others. One day, I visited my neighbor and saw how IFS is developing him and decided by then, to adopt IFS. I started applying manure in my small land, and as a result the crop production has increased significantly. I sold beans and maize yields and got 350,000Frw. From that money I bought another piece of land. Now I have 2.5ha of land and 4 cows that I have bought progressively. I acquired all those assets, because of IFS that I have adopted and practiced since 2014 up until now*".

By comparing two sectors, farmers in Nyagatare have acquired big size of land rather than in Gatunda. This may due to the fact that farmers in Nyagatare may gain more income from crops and animal products (milk and meat) than farmers in Gatunda. Farmers in Nyagatare can find markets easier(markets proximity advantage) and they may have other sources of income (small businesses)than the farmers in Gatunda.In addition, the findings in the table above show that, because of income from integrated crop-livestock farming, farmers increased the number of cows. More than 85% of farmers in Nyagatare have between 5 - 9 cows, while 54.8% possesses this number of cows in Gatunda. This difference can be explained by the fact that in Nyagatare due to big land owned by farmers, gives more chances of keeping a reasonable number of cows (5-9).Overall, through IFS farmers have acquired more land and cows.

4.2.5IFS impacts on food security

In the study undertaken by Nizamuddin and Ashish in India (2018) showed that ensuring food security is one of the reasons farmers decide to adopt and practice IFS.With IFS, farmers can have enough and balanced food. In Kenya for instance, cases of malnutrition were observed in households that practice monoculture rather than in the households who practice IFS (Rabighosh, 2018:27).In this regard, the researcher investigated whether IFS helped the farmers to improve their nutrition. The results are presented in the table below.

Table 14: Appreciation on quantity of foods eaten/day before and after IFS

GATUNDA SECTOR					
Quantity of food eaten	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**% Change.**
More than enough	5	25	6	30	5
Enough	5	25	10	50	25
Sometimes not enough	7	35	2	10	-25
Frequently not enough	3	15	2	10	-5
TOTAL	**20**	**100**	**20**	**100**	
NYAGATARE SECTOR					
Quantity of food eaten	**Frequency before IFS**	**%**	**Frequency after IFS**	**%**	**% change**
More than enough	7	33.3	10	47.7	14.4
Enough	5	23.8	7	33.3	9.5
Sometimes not enough	9	42.9	4	19	-23.9
Frequently not enough.	0	0	0	0	0
TOTAL	**21**	**100**	**21**	**100**	

Source: Research findings, July 2018

Overall, after IFS positive changes occurred in terms of quantity of food taken by the farmers. After IFS in Gatunda sector, majority of 80% confirmed that quantities of food they are taking are enough and more than enough. Before IFS, 50% of farmers confirmed that they could eat enough and more than enough. In Nyagatare sector, 81% confirmed that after they have practiced IFS, the quantities of food they are taking are enough and more than enough. Before IFS, only 57.1% could eat enough and more than enough food. From the figure below, it is noticed that integrated farming has impacted on food consumption and that contributed to well-being of farmers.

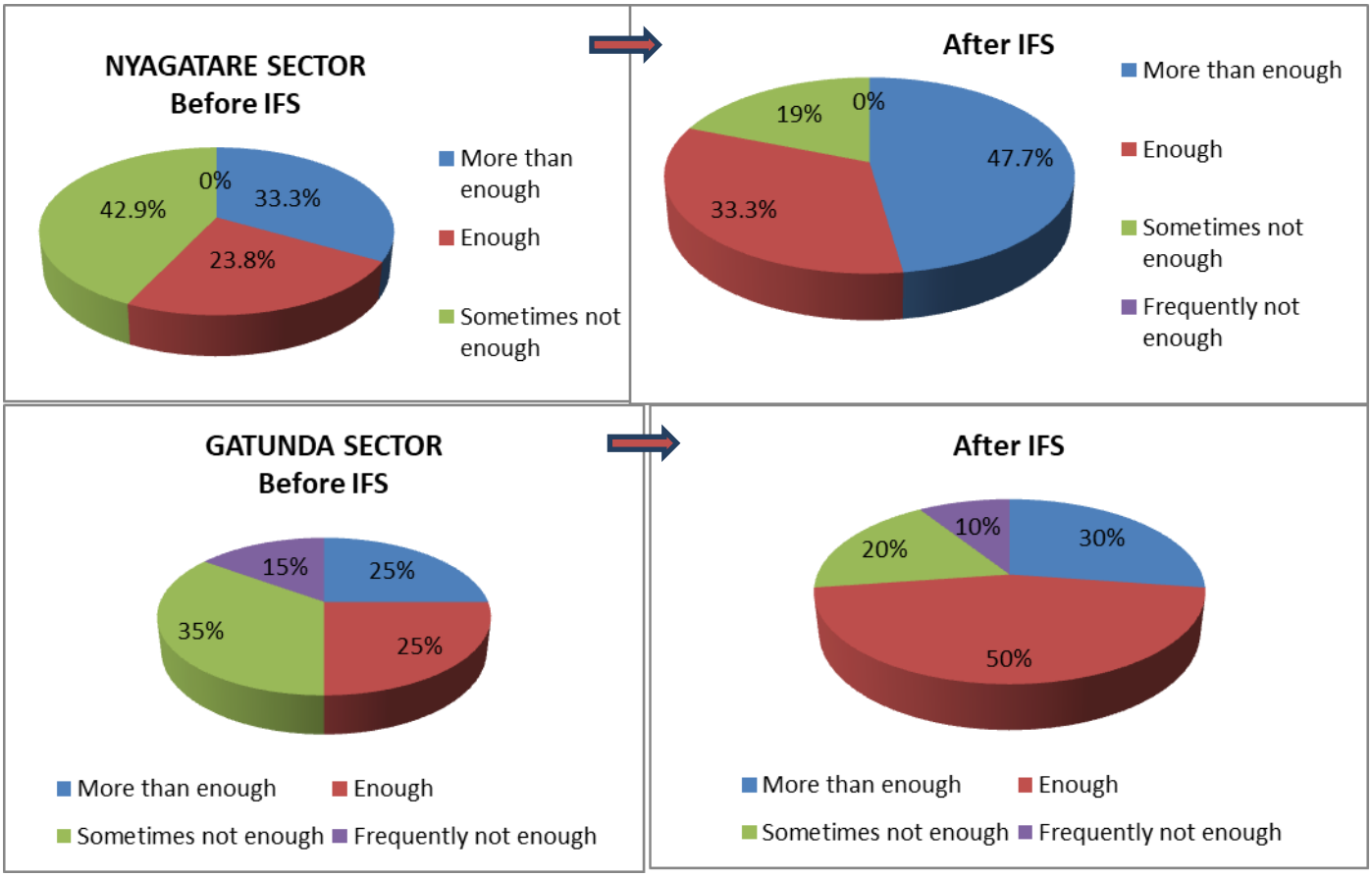

Figure 4: Food security before and after IFS
Source: Research findings, July 2018.

The results in figure 4 show that even if food intake has improved because of IFS practice, some farmers still do not eat enough food. In Nyagatare for instance, 19% sometimes do not find and eat enough food and this percentage increases to 20% in Gatunda sector. This shows that IFS still faces challenges in order to reduce poverty among farmers.

Previous researches showed the extent at which IFS through Girinka program (one cow per poor household) has contributed to reduce malnutrition and to food security in general. In their research in Huye and Gisagara district, Gumira Hahirwa&Kalinganire (2017) revealed that the girinka programme helped to eradicate child malnutrition within recipient families not only through milk consumption but also by preparing a rich diet from ingredients acquired with generated income. Through manure use the girinka programme also contribute to undertake various activities such as upkeep „akarima kiigikoni" (or a kitchen garden). This is another government programme consisting of mixing soil with manure or other kind of compost (within

the compound or near the residence) where various vegetables are grown to complement the main foodstuff such as food grains or tubers in order to fight against imbalanced diet among low income rural households

4.3 Extent to which IFS is practiced by the farmers

The contribution of IFS to the socio-economic development of farmers depends largely on how effective IFS is practiced. Effects of IFS depend importantly on households' knowledge and experience of rearing livestock, collection and generation of manure and applying manure (Pia Nilsson, Mikaela Backman, Lina Bjerke& Aristide Maniriho, 2017:3). Own a cow is one thing, but get the most out it is another important thing. Knowledge and experience in rearing livestock is critical (Dash *et al*., 201:21).In this study, a question was asked to check whether IFS is well practiced and whether farmers follow some recommended IFS practices.

4.3.1 Manure collection and usage

In IFS cow dung and urine as well as crop residues must be collected, kept and transformed in organic manure. After that, this manure must be applied into the field.

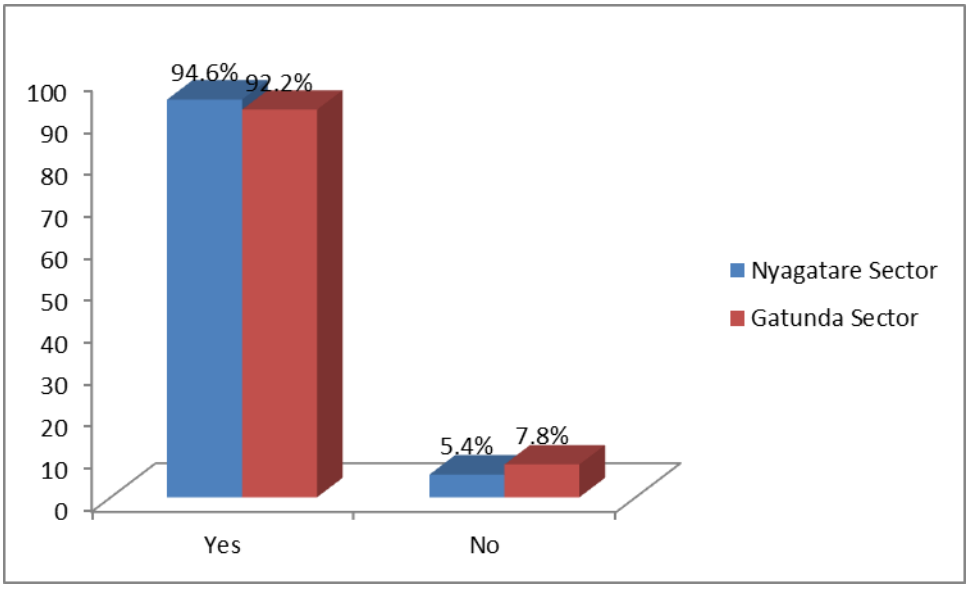

Figure 5: Utilization of organic manure in the field
Source: Research findings, July 2018.

In average (both sectors) majority of 93.4% (N=38) of the respondents collect cow dung and urine, keep them and transform them into organic fertilizers and apply them in the field. Average of 6.6% (N=3) do not apply the fertilizers on their fields. May be they sell the manure to others, because it is a source of revenue. Comparing two sectors, one can notice no significant differences, but farmers in Nyagatare utilize more manure than in Gatunda. One of the

explanations for this difference is that farmers in Nyagatare sector benefit from the services of district technicians and university campus of veterinary medicine.

- **Estimated quantity of manure applied**

The quantity of manure applied depends on quantity of cow dung collected and transformed into organic manure. A local Ankole, weighing 300 kg, reared in zero-grazing system is estimated to produce 6,000 kg of manure per year (Sung, Tiessen,Mukankurunziza and Kamatari , 2013:7).If farmers collect the recommended cow dung and produce 6,000kg of manure per cow, they will probably not have problem to produce and apply 10,000kg of manure per ha and per year. The figure below shows estimated tons of manure applied into the field by farmers.

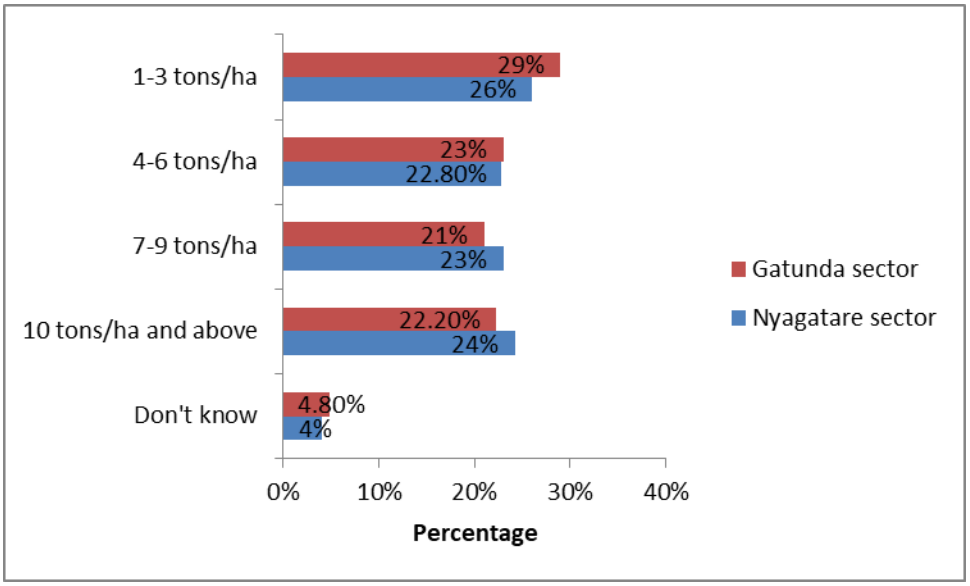

Figure 6: Estimated quantity of manure applied per ha
Source: Research findings, July 2018.

According to MINAGRI (2010), 10,000 kg of organic manure per ha is the recommended quantity for food crops in Rwanda. Therefore, the data in the Figure 7 show that in average72.4 % use less than 10,000kg or 10 tons per ha. However, farmers in Gatunda apply less quantity than in Nyagatare. This affects to some extent the quantity of crop production one can get per ha. Therefore, the researcher argues that farmers in Nyagatare and Gatunda would have benefited much more from IFS if it was well-practiced through sufficient manure application in their farms.

In their study, Sung *et al*., (2013:7) found that apply low or less-than-optimum levels of manure in Ngoma district (manure usage) was due to the factors such as small and scattered plots of land, far distance of travel to plots, poor cow sheds and manure collection facilities, lack of manure handling and transportation tools, availability of extension services, and better understanding and knowledge of manure preparation and application practices. In this regard, further research is recommended to assess the factors influencing low collection of cow dung and low usage of organic manure in Nyagatare and Gatunda sectors.

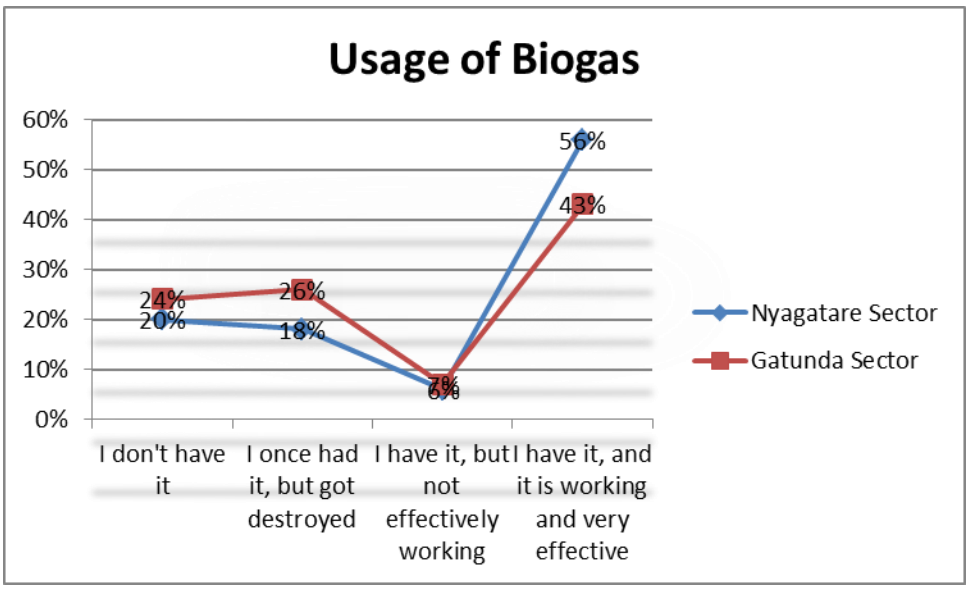

Figure 7:Use of biogas by farmers
Source: Research findings, July 2018

If well-practiced, IFS facilitate the construction and usage of biogas. However, majority (57%) doesn't benefit from biogas and quality of organic manure which is produced through Biogas in Gatunda sector, while 44% in Nyagatare don't benefit from biogas. This also shows shortfalls in the practice of IFS by some farmers.

4.3.2 Usage of agriculture residues to feed livestock (cows)

With IFS nothing is lost. Agriculture residues feed cows. It is in this regard that a question was asked to check whether farmers use agriculture residues to feed their cows.

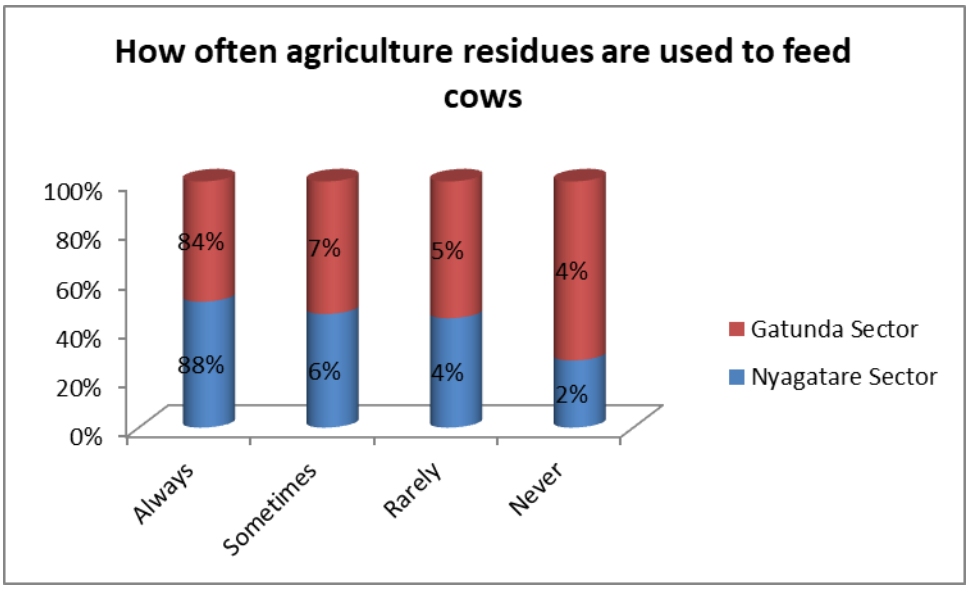

Figure 8: Usage of agricultural residues for cow feeding
Source: Research findings, July 2018.

In both sectors, majority (average of 86%) use agriculture residues to feed cows. However, there is slight difference whereby 88% of farmers in Nyagatare use agriculture residues to feed cows, while this percentage is 84% inGatunda Sector. Small percentage of farmers sometimes and rarely uses agriculture residues to feed their cows. This is very positive because farmers can save money which would have been used to buy cow feedings which are expensive. However, there is a concern about 2% in Nyagatare and 4% in Gatunda who don't use agriculture residues to feed their cows. Although it is a small number, they must be sensitized and trained on IFS, because they might have insufficient knowledge about it.

4.3.3 Storage of agricultural residues for future cow feeding

Effective IFS requires farmers to have facilities or ways to store agricultural residues for future cow feeding. Otherwise, these cow feedings can be damaged and wasted. A question was asked to check whether farmers have those facilities.

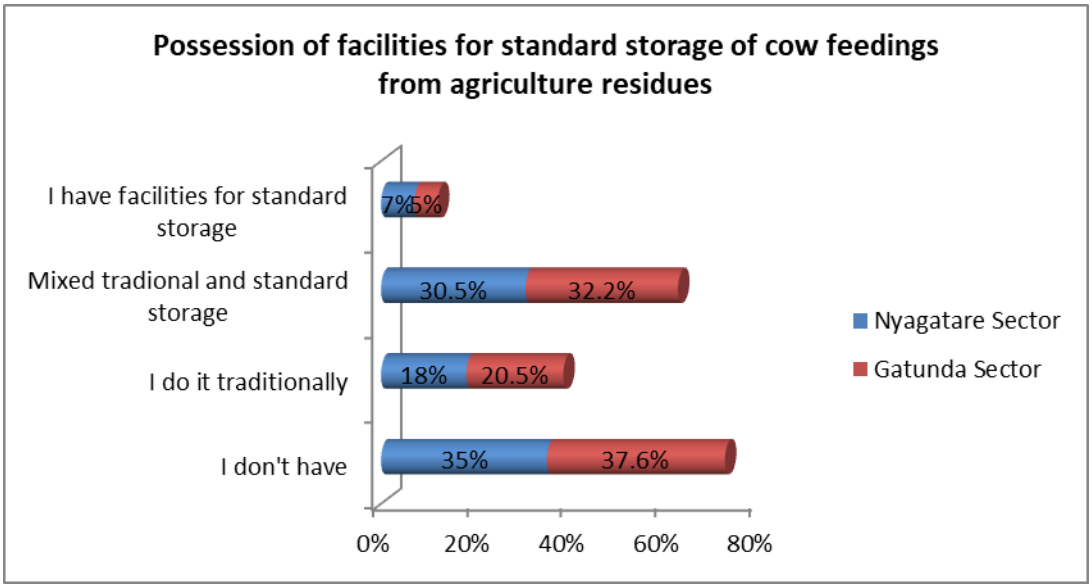

Figure 9:Facilities for standard storage of agricultural residues for future cow feeding
Source: Research findings, July 2018.

As it can be noticed, majority (average of 36.3%) don't have means to store agricultural residues for cow feeding and others do it traditionally (gathering them somewhere under the sun and rain). Only 12.2% (in two sectors) have facilities for standard storage. However, farmers in Gatunda have more challenges in storing agriculture residues for future cow feeding rather than in Nyagatare sector. This is an issue as these cow feedings are wasted and cannot be used for the future. This is loss for the farmers.

Overall, by comparing two sectors Nyagatare sector is a little bit in advance than Gatunda. One of the explanations is that farmers in Nyagatare are benefiting the trainings and advices from experts and technicians from the university as the University of Agriculture is nearby.

4.4 Challenges faced by farmers for effective IFS practices

The respondents were asked to give the challenges they are facing in practicing IFS. Challenges were classified per mean scored in the graph below.

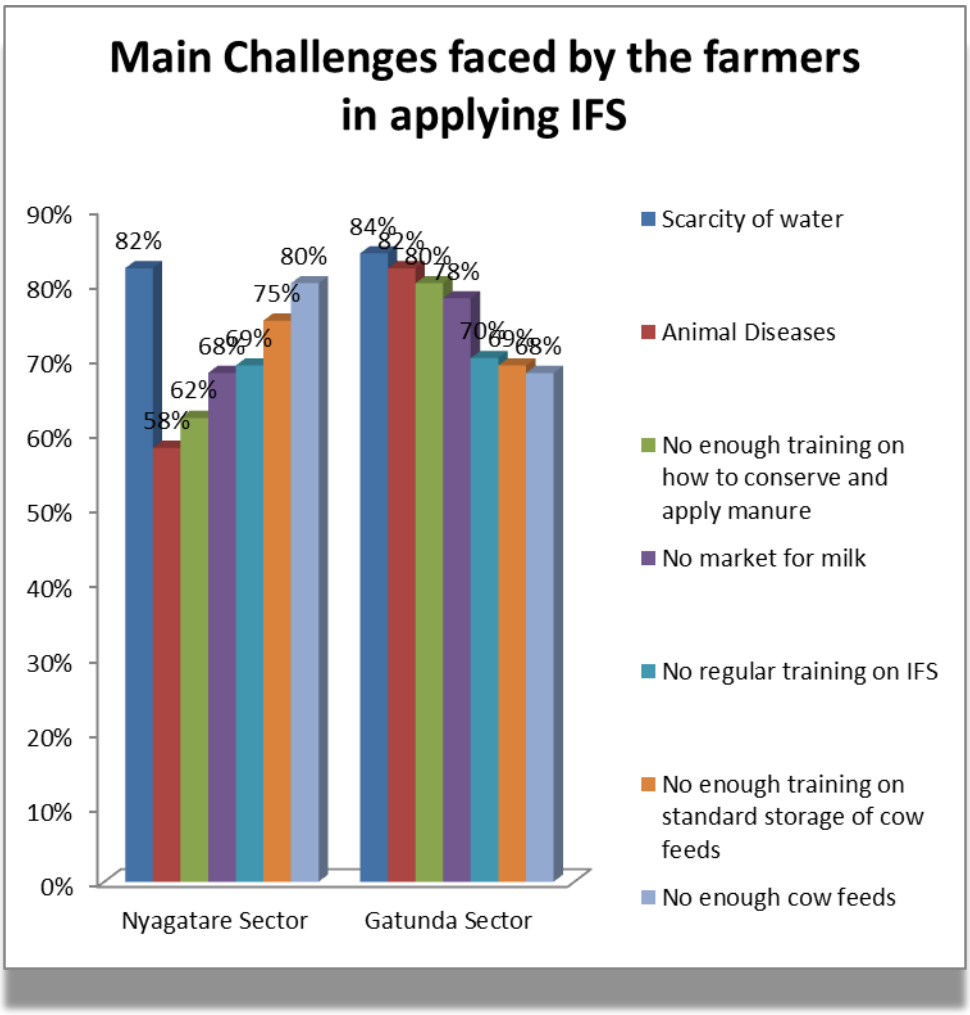

Figure 10: Challenges faced by the farmers in applying IFS
Source: Research findings, July 2018**.**

As the graph 11shows, respondents ranked scarcity of water as the main and common challenge of the farmers in both sectors. Animal diseases like lift valley fever and Bacteria xanthomonus wilt BXW (Kirabiranya) being the second challenge, especially in Gatunda sector, lack of enough animal feeds was the 2nd challenge on the hierarchy in Nyagatare, while it is 7th in Gatunda, lack of enough trainings on conservation and application of manure was the 4th, lack of training on storage of animal feeds was the 5th , the 6th being no market for milk in Nyagatare, while this is serious challenge in Gatunda.

There is a significant difference in comparing the challenge of animal diseases in Nyagatare sector (58%) and in Gatunda sector (82%). This difference between the two sectors is due to

easy access of veterinary services from the nearby university by the famers in Nyagatare compare to Gatunda sector.

CHALLENGES IN INTEGRATED FARMING SYSTEM THAT WERE IDENTIFIED BY INTERVIEWEES DURING FACE-TO-FACE INTERVIEW.

- Lack of enough training on post-harvest handling mechanisms;
- Local animal breeds which are not productive in milk;
- Inadequate veterinary services to the famers;
- Insufficient number of agronomist or veterinary officers in the sectors. their number is not enough to reach all the famers in time of need;
- Transport issues were also highlighted by the respondents. Veterinary and agronomist at sector level do not have transport facilities to attend and respond to the famers queries whenever they arise;
- Lack of laboratory and pharmacy at the sector level where most of cows die due to lack of these services.
- Lack of knowledge and skills to deal with new merging crops and animal diseases by both farmers and agronomists at sector level
- Lack of basic equipment to test soil structure in order to know the quality and quantity of fertilizers to apply;
- Small size of land and green pastures;
- Mind-sets of some farmers.

During the fieldwork, participants raised the issue of limited support from veterinary technicians and agronomists. One interviewed farmer said "*We rarely get advice from the veterinary and* agronomists are *rarely available. When we call for trainers in cooperative management, animal husbandry for instance, we don't get any because they are always busy. We do not see them when we need their advices. They occasionally provide information during the monthly community work ["Umuganda"] but this is not enough. But, we really need trainings.*

Lack of accompaniment or assistance to farmers and Girinka beneficiaries in general was confirmed by one of veterinary officer interviewed. He said *"We are very often overloaded and we do not have enough time to make field visit for particular assistance to all our farmers „We*

generally concentrate on the office tasks and it is not always easy to have time for any particular emerging problems of girinka program beneficiaries. Though to visit our farmers in their respective localities is needed, this is not so simple unless the district possesses and provides to us enough facilities, transportation means in particular".

From the identified challenges, respondents proposed some strategies to overcome them:

- Through Public private partnership (PPP) construction of sheeting dams in the areas that have no access;
- Training of veterinaries on new emerging animal diseases;
- Increase the number of veterinaries and agronomists in order to reach and respond to the farmers queries;
- Increasing high breed or crossbreed cattle that are more productive through artificial insemination;
- Regular trainings to farmers on manure collection, conservation and application;
- Subsidies to storage facilities;
- Modern laboratory and pharmacy at the sector level;
- Equipment that help in testing soil structure;
- Changing farmers mind set through regular mobilization to embrace IFS;
- Land consolidation should be encouraged.

4.5 Verification of hypotheses

The first hypothesis which was aligned with main objective stipulated that IFS has positively contributed to the socio-economic welfare of farmers in Nyagatare and Gatunda sectors. The findings presented in figure 3 and findings from table 7 to table 14 showed significant positive changes in terms of income, expenditures, assets accumulation and food consumption due to IFS practice. Furthermore, by comparing two sectors, farmers in Nyagatare showed more positive changes due to IFS than in Gatunda. This was due among others to service and market proximity comparative advantage. Farmers in Nyagatare have easy access to markets, veterinary services, laboratory and pharmacy facilities than farmers in Gatunda sector.

The second hypothesis which was aligned with first specific objective stipulated that IFS is effectively practiced by the farmers in Nyagatare and Gatunda sectors. The findings from figure 4 to 10 showed that IFS not 100% well-practiced by farmers. The gaps identified were in quantity of dung collected, quantity of manure applied, and possession of facilities for standard storage of agricultural residues for future cow feeding. The hypothesis three was aligned with second specific objective and stipulated that farmers face some challenges in practicing IFS, but those challenges are manageable. The findings in the figure 11 show the challenges faced and it was shown that those challenges can be overcome by some strategies which were presented.

Summary

The chapter four dealt with analysis and interpretation of findings. Findings from table 7 up to table 14 showed positive changes due to IFS practice by the farmers. It was shown that IFS impacted on socio-economic welfare of farmers in the sectors of Nyagatare and Gatunda. However, farmers do not maximize the benefits of IFS, because of some gaps in IFS practices. It was found that IFS is not 100% well-practiced. Some challenges faced by the farmers in applying IFS were identified, namely lack of trainings for farmers, veterinary services which are not easily accessed by the famers, insufficient water, insufficient storage facilities and lack of good markets for crop and livestock production. The next chapter deals with general conclusion and recommendations.

CHAPTER FIVE: GENERAL CONCLUSION AND RECOMENDATIONS

5.1. Introduction

The poverty incidence in Nyagatare district stands at 44.1 %, while extreme poverty incidence stands at 19.5%. In other words, 44.1 % of Nyagatare population is identified as poor, while 19.5 % are identified as extremely poor. This rate of extreme poverty is higher compared to that of national level which is 16.3% (NISR (EICV4), 2014:21). The prevalence of stunted children was 38 percent, Wasting (too thin for height) was 2 percent, while 9percent were underweight (NISR (RDHS, 2014-2015), 2016: 7). However, well-practiced integrated crop-livestock farming is at the heart of the battle against poverty, food insecurity and malnutrition. This study was undertaken with major objective to evaluate and show the contribution of integrated farming system on socio-economic welfare of farmers. The motivation to carry out this research came from the researcher' observation that the information about the contribution of integrated crop-livestock on socio-economic welfare of farmers is not well-known, and this was evidenced by the fact that many people in Nyagatare district still practice traditional and monoculture farming.

The following sections provide the summary of major findings, conclusions derived from the study and key policy recommendations.

5.2 Summary of major findings

The general objective of the study was to assess the contribution of integrated farming system on social economic welfare of farmers in Nyagatare district. The target population for the study was 200 households (farmers) who practice integrated farming in the two sectors of Nyagatare and Gatunda. From the target population, a sample size of forty one respondents (41) were purposively picked out;20 households in Gatunda sector and 21 households in Nyagatare sector. In addition, five (5) staff involved in agriculture related activities at sector, district, provincial and central government level (RAB) were purposively selected for interviews. Quantitative and qualitative data were all used in this study and were collected through the questionnaire, interviews and documentary research (triangulation).

Objective 1: To determine the contribution of integrated farming system on social economic welfare of farmers in Nyagatare district/ Hypothesis 1: ***Integrated crop-livestock farming improved the socio-economic welfare of farmers in the sectors of Nyagatare and Gatunda.***

To evaluate the contribution of integrated farming on the socio-economic conditions of farmers, key indicators, such as overall income per month, income from the production of key crops and production of livestock, level of expenditures, assets accumulation and food intake were assessed. The findings in the figure 4 showed that farmers appreciate at very high level (100%) the contribution of IFS to their socio-economic welfare. Findings in the table 7 and 8, showed that majority of farmers saw their monthly income increase after practicing IFS. This income increase resulted from the increase in the production of key crops (Beans, Banana and Maize) as it was shown in table 9 and 10. For instance, before IFS there was no farmer (0%) who could gain from beans yield an amount between Rwf201,000-300,000per season. But, with IFS, some farmers (5%) can get this amount from beans yield per season.

The findings showed that farmers who practice IFS have increased their expenditures on food, education, clothing and other items and this was not the case before IFS. This was shown in the table 11 and 12. For instance, before IFS the percentage farmers who could spend between Rwf51,000-100,000 on food stuff were 4.8% and it increased to 52.3% after IFS. Findings in table 13 showed that, because of the increase of income, farmers managed to buy and expand their land, and to increase the number of cows. For instance, 64.4% of farmers in Nyagatare sector own between 1.5ha -6.5 ha, and 85.6% own between 5- 9 cows. The findings in the table 14 showed the IFS impacts on food security. Before IFS, 46.4% could eat enough and more than enough food , but this percentage increased to 80.5% after IFS.

Objective 2: To determine the extent at which integrated farming is practiced by the farmers/ ***Hypothesis*** **2:** ***Integrated farming is effectively practiced by the farmers in Nyagatare district.***

The findings in figure 6 showed that 95% of farmers collect cow dung and urine and utilize them as manure for their crops. However, findings in the figure 7showed that compared to the expected quantity (kg) of cow dung per cow (6,000kg), farmers collect less quantity and that

affects the quantity of manure produced and applied in the field. Recommended manure application per ha is 10,000kg (10 tons per ha/year). However, findings in the figure 8 showed that the quantity of manure applied per ha is less than the recommended quantity. 68.4% apply less than 10 tons of manure per ha. This affects to some extent the quantity of crop production per ha.

With IFS, agriculture residues are used to feed the livestock (cows). For this to happen, farmers must have standard storage facilities, so that agriculture residues can be kept and used for the long time to feed livestock. However, it was shown in the figure 11 that only 12.2% of farmers have standard storage facilities. Lastly, IFS goes hand in hand with biogas production and usage. However, figure 9 showed that only 43.9% of farmers do have and utilize biogas. Overall, the IFS is not 100% well-practiced by the farmers.

Objective 3: To determine the challenges that the farmers face when practicing the integrated farming system and propose the strategies to overcome them/ ***Hypothesis 3: Farmers encounter some challenges in practicing integrated farming, but those challenges are manageable through well-thought strategies.***

The findings in the figure 12 showed the challenges that farmers are facing in practicing IFS. Major challenges were related to water scarcity in the area, drought, insufficient knowledge on modern agriculture and livestock farming; animal diseases and insufficient feeds for cows due to small size of land. Strategies to overcome the challenges include among others: Construction of dam sheets in the areas that have no access to water through Public private partnership (PPP); Training of veterinaries and farmers on new emerging animal and crop diseases; increase the number of veterinaries and agronomists in order to reach and respond to the farmers' queries.

5.3 Conclusion

Based on findings of the study, the SWOT analysis of IFS as practiced by the farmers was done. The identified strengths, include: (i) High level of awareness on the importance of Integrated farming system; (ii) Enough consolidated land area that allow farmers to practice integrated crop-livestock farming (majority has between 1.5 - 6.5 ha); (iii) Adequate number of cows that allow farmers to practice integrated crop-livestock farming (majority has between 5-9 cows); (iv) High level of understanding of the importance of cow manure usage for crop production; (v)

High milk production and high agricultural production (beans, maize and banana) which leads to high household income and food security; and (vi) Zero grazing.

The identified weaknesses, include: (i) Most of the work is done manually; (ii) Lack of manure handling and transporting tools; (iii) Low production of cow manure due to poor construction of cow sheds (particularly the roofing and pavement); (iv) Insufficient knowledge and skills in modern agriculture and livestock farming, especially in Gatunda sector; (v) Low quantity of organic manure applied per ha and per year, compared with the recommended of 10,000kg per ha; (vi)Low production of high-value crops including: horticulture, flowers, vegetables, and fruits; (vii)Lack of post-harvest handling and storage facilities; (viii) Lack of standard storage of agriculture residues for future cow feeding; (ix) Low level of agriculture irrigation and mechanization; (x) Low level of usage of biogas; and (xi) Low usage of rainwater due to insufficient rainwater harvesting facilities.

The identified opportunities for optimal exploitation of integrated crop-livestock farming, include: (i) Availability of unexploited land and swamps; (ii) Fertile soil; (iii) Easy access to district, national and regional markets especially Nyagatare sector; (iv) Government commitment to promote integrated crop-livestock farming through programs such as Girinka; (v) Availability of manpower; (vi) Existence of plains, rivers and low inclined hills that make possible agricultural irrigation and mechanization on both sectors and (vii) Presence of a university that has agriculture and livestock development programs, especially in Nyagatare sector.

Lastly, potential threats to integrated crop-livestock farming were identified and include: (i) Climate changes :insufficient rainfall leading to drought; (ii) Prevalence of pests; (iii) Animal diseases; (iv) New emerging crop diseases, for instance Bacteria xanthomonus wilt (BXW) Kirabiranya; (v) Decreasing of arable land for agriculture and green pastures; (vi) Lack of agriculture insurance schemes; (vii)Insufficient veterinary pharmacies and laboratories; and (viii) Insufficient number of specialized veterinary and agronomist personnel at sector level, especially in Gatunda sector; (vii) Lack of or insufficient water.

5.4 Recommendations

Based on the above conclusions, the following recommendations are made:

- **To the Government of Rwanda:**

- Establish model integrated farms for the farmers for which it will serve as demonstration farm to attract more farmers to adopt the IFS approval;
- Construct modern and well equipped laboratory at district level;
- Put in place pharmacies at the sector level with all necessary equipment and all necessary drugs to facilitate the farmers;
- Provide to modern equipment that helps testing soil structure. Testing soil structure will help to know which type and quantity of fertilizers to apply. Also, it will help to know which particular crop is suitable for the soil;
- Subsidize agricultural irrigation and mechanization equipment and storage facilities;
- Provide more trainings to veterinaries and agriculture officers, so that they are equipped with updated knowledge and skills to deal with new emerging crop-livestock diseases;
- Put in place strong mechanisms to support and promote integrated farming system.

- **To the District:**

- Facilitate farmers to get dam sheets that will be used by the farmers during drought;
- Intensive mobilization of farmers on IFS and performance contract should be signed between sector agronomist and the farmer;
- Regular trainings by the district technicians to the farmers about modern storage of crop yields, storage of agricultural residues for cow feeds, manure collection, and standard manure application per unit area;
- Provide incentives to the best performers in integrated farming. This will motivate other farmers to adopt the system; and
- Train sufficient number of field school farmer facilitators and farmer promoters in animal husbandry, fighting malnutrition, income generating activities and skills in

running small businesses, the management of cows, the importance of savings and credit, and calculation, veterinary medicine first aid, etc.

- **To the farmers:**

- Acquire rain water harvesting facilities. The water harvested will be used and will help to save the money which can be used for other things;
- Comply with the instructions about manure production and manure application
- Construct and utilize biogas. The usage will help to save money and to reduce the usage of biomass which causes the environment degradation; and
- Produce high-value crops including; horticulture, flowers, vegetables, and fruits. This will help to prevent malnutrition through balanced diet intakes.

5.5. Areas of further research

This study covered only two sectors in one District of Nyagatare and therefore quite limited in generalizing the findings to the farmers in Rwanda. Therefore, there is a need to conduct a similar study at a much larger scale. There is also need to carry out a research on the following:

- Factors influencing farmers to construct and use biogas
- Hindering factors to massive adoption of IFS
- To do a comparative study on the benefits of integrated crop- livestock (cows) versus integrated crop- livestock (pigs).

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LIST OF APPENDICES

APPENDIX : A

QUESTIONNAIRE FOR THE HEAD OF HOUSEHOLD (FARMER)

Iam Sabiti Atuhe Fred, student number *216367875, 1am pursuing* Master's degree in Local Governance Studies at the University of Rwanda (UR) and I am working on research project entitled "**Integrated Farming: A Strategy for Social Economic Development of Farmers in Nyagatare district*: case study of Gatunda and Nyagatare sectors".***

Purpose of the questionnaire

The purpose of this questionnaire is to determine how Integrated Farming determines the Socio-Economic Development of farmers in Nyagatare and Gatunda sectors. You are requested to provide accurate responses, so as to enable the researcher to determine the Integrated Farming Impacts on Socio- Economic Development of farmers.

Instructions

• For each of the questions bellow, mark the answer that comes closest to the way you feel about the question;

Please answer the question as honestly as possible.

• Mark your responses by placing a cross (X) in the appropriate box.

• If you do not understand any of the questions or how to complete the questionnaire the researcher will assist where accordingly.

1.DEMOGRAPHIC CHARACTERISTICS

1.1.Localization of respondents
Umurenge/sector…….
Akagali/cell……..
Umudugudu/village……..

sex	Code	1.2 Age-Range/***Icyiciroabantubarimoukurikijeimyaka***	Code	1.3.Poverty levels/ ***Ikiciroabantubarimoushingiyekubyiciroby'ubudehe***	Code
Male	**1**	25-35	1	Category / *Icyicirocya*	1
Female	2	36 -45	2	Category II/ *Icyicirocya 2*	2
		46-55	3	Category III/ *Icyicirocya 3*	3
		56- 65	4	Category IV/ *Icyicirocya 4*	4

1.4 **Marital status** /*Irangamimerere*	Code	1.**5. Education level/** *Amashuriwize*	**Code**
Single /*Ingaragu*	1	Primary level / *Amashuriabanza*	1
Married/*Arubatse*	2	Professional/ Vocational school *Amashuriy'imyuga*	2
Divorced /*Yatandukanyen'uwobashakanye*	3	Secondary /*Amashuriyisumbuye*	3
Widowed /*Umupfakazi*	4	University/ *Kaminuza*	4
			5

1.6.Number of hectares the house hold owns / Umubare wahegitari umuryango ufite.

1. [0.5-1.5]hegitari	**2. [1.5-3.5]hegitari**	**3. [3.5-6.5]hegitari**	**4. (6.5-10.5)hegitari**	**5.(>10)**

1.7.Number of family members in ahouse hold / Umubare w'abantu bari mumuryango

1.(3-5)	**2.(5-7)**	**3.(7-9)**	**4. (9-11)**	**5. 11>**

1.7 Number of cows in the house hold /Umubare w' inka umuryango ufite

1.(3-5)	**2.(5-8)**	**3.(8-12)**	**4.(12-15)**	**5. 15>**

SECTION II: SOCIO –ECONOMIC STATUS OFFARMERS BEFORE AND AFTER INTEGRATED FARMING.

2.1.As a farmer is the integrating system practices improve your social economic status?(ubuhinzibokomatanyijeubonaharicyobihindurakumiberehoyawe?).In a range of **1-5.Where 1=strongly disagree 2=.Disagree 3. Neutral4.Agree 5.Stronly Agree.** Tick X to the appropriate one

1	2	3	4	5

2.2MONTHLY INCOME (FRW) BEFORE AND AFTER INTEGRATED FARMING/UKWO BURI KWEZI WINJIZAGA MBERE NA NYUMA YUBUHINZI-BWOROZI BUKOMATANYIJE

2.3.SOURCE OF INCOME BEFORE INTEGRATED FARMING(RWANDA FRANCS)/INKOMOKO Y'AMAFARANGA UBONA MBERE YUBWOROZI NUBUHINZI BUKOMATANYIJE
2.3.1.MONTHLYSALARY/UMUSHAHARA WA BURI KWEZI 1.(30,000-100000**) 2.(**101000-200,000**) 3**.(201,000-300,000) **4**.(301,000-400,000) **5**.>(500,000)
2.3.2 MONTHLY INCOME MAIN CROPS 1.(0-30,000**) 2.(**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5.(**301,000-400,000) **6.>(**50,000)
2.3.3. MONTHLY INCOME FROM MAIN ANIMAL PRODUCTS **2.3.3.1.Milk .1. (**0-30,000)**. 2. (**31,000-100,000) **3.(**101,000-200,000)**.4 (**201,000-300,000) **5.(**301,000-400,000) **6.>(**500,000)
2.3.4.SEASONAL INCOME FROM MY MAIN AGRICULTURAL PRODUCTS
2.4.4.1.MAIZE.1.(0-30,000) **2**.(31,000-100,000**) 3**.(101,000-200,000) **4**.(201,000-300,000) **5**.(301,000-400,000**) 6**.>(500,000).
2.3.4.2..BEANS: 1.(0-30,000) **2.(**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5.(**301,000-400,000) **6.>(**500,000).
2.3.4.3. .BANANA: 1 .(0-30,000) **2.(** 31,000-100,000) **3**. (101,000-200,000) **4.(**201,000-300,000) **5.(**301,000-400,000) **6.>(**500,000)
2.3.4.4. .OTHER AGRICULTURE PRODUCTS:1.(0-30,000) **2.(**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5.(**301,000-400,000)0 **6.>(**500,000)
2.3.5. OTHER MAIN SOURCE OF INCOME: 1.(0-30000) **2.(**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5.(**301,000-400,000) **6.>(**500,000)

2.4.SOURCE OF INCOME AFTER INTEGRATED FARMING (RWANDA FRANCS)/INKOMOKO Y'AMAFARANGA UBONA MBERE YUBWOROZI NUBUHINZI BUKOMATANYIJE
2.4.1.MONTHLYSALARY/UMUSHAHARA WA BURI KWEZI 1.(30,000-100,000) **2.(**101000-200,000) **3. (**201,000-300,000) **4(**301,000-400,000) **5 (**>500,000)
2.4.2 Monthly income from my business. 1.(0-30000) **2. (**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5. (**301,000-400,000) **6.**> **(**500,000)
2.4.3.Monthly income from main Animal products **2.4.3.1.Milk .1**. (0-30,000**) 2.(**31,000-100,000) **3. (**101000-200,000) **4.(**201,000-300,000) **5. (**301,000-400,000) **6.**>(500,000)
2.4.4.MAIN SEASONAL INCOME FROM MY AGRICULTURAL PRODUCTS
2.4.4.1. MAIZE.1. (0-30,000) 2. (31,000-100,000**) 3**. (101,000-200,000) **4**.(201,000-300,000**) 5**. (301,000-400,000**) 6**>(500,000).
2.4.4. 2.. BEANS: 1. (0-30,000) **2. (**31,000-100,000) **3. (**101,000-200,000) **4.(**201,000-300,000) **5. (**301,000-400,000) **6>(**500,000**).**
2..4.3.3 .BANANA: 1 .(0-30,000) **2. (**31,000-100,000) **2.(**101,000-200,000) **3. (**201,000-300,000) **4.(**301,000-400,000) **5.**>500,000
2.4.4.4 .OTHER AGRICULTURE PRODUCTS:1.(0-30000) **2.(**31,000-100,000) **3.(**101000-200,000) **4.(**201,000-300,000) **5**.(301,000-400,000) **6.>(**500,000)
2.4.5. OTHER MAIN SOURCE OF INCOME: 1.(0-30000) **2.(**31,000-100,000) **3.(**101,000-200,000) **4.(**201,000-300,000) **5**.(301,000-400,000 **)6.>(**500,000)

2.5. WHAT ARE THE MAIN EXPENDITURES BEFORE AND AFTER INTEGRATED FARMING

Main Monthly expenditure Before integrated farming.
2.5.1.FOOD: **1**. (15,000-30,000), **2** (31,000-50,000) ,**3**. (51,000-100,000).**4**. (101,000-200,000) . **5.**above (200,000)
2.5.2.EDUCATIONAL SERVICES:**1**. (15,000-30,000,) **2.** (31,000-50,000) ,**3**. (51,000-100,000).**4**. (101,000-200,000) **5**. Above (200,000)
2.5.2.HEALTH SERVICES:**1**. (15,000-30,000), **2** (31000-50,000) ,**3**. (51,000-100,000).**4**.(101,000-200,000) **4**.above (200,000)
2.5.3.CLOTHINGS:**1**. (15,000-30,000), **2** (31,000-50,000) ,**3**. (51,000-100,000).**4. (**101,000-200,000) .above 200,000
2.5.4.**OTHERS**: (15,000-30,000,) **2** (31000-50,000) ,**3.(** 51,000-100,000).**4**.(101,000-200,000) **5.**above (200,2.5.000)

2.6.Main Monthly expenditure After integrated farming.
2.6.1.FOOD: **1**.(3000-15000), **2**. (16,000-30,000), **3**. (31,000-50,000) ,**4**.(51,000-100,000).5.(101,000-200,000) **6** .above (200,000)
2.6.2. SERVICES: .1. 15,000-30,000**, 2 (**31000-50,000 **),3.** (51,000-100,000)**.4.**(101,000-200,000) **4.**above (200,000)
2.6.3 HEALTH SERVICES:1. (15,000-30,000), **2** (31,000-50,000**) ,3**. (51,000-100,000) **4**.(101,000-200,000**) 5.**above(200,000)
2.6.4.CLOTHINGS:1.(15,000-30,000)**, 2** (31,000-50000) **,3**.(51,000-100,000).**4**(.101,000-200,000) **5. above** (200,000)
2.6.5.OTHERS:1. (15,000-30,000)**, 2** (31000-50,000) **,3**.(51,000-100,000).**4**.(101,000-200,000) **5.**above (200,000)

What is the percentage of your expenditure to the incomes? (a) Before integrated farming……. (b) After the integrated farming
…….

2.7 THE QUANTITY OF FOOD YOUR FAMILY EAT PER DAY(Uko umuryango urya burimunsi)

2.7.1.Before Integrated farming(mberey'Ubuhinzi bukomatanyije)	**Code**	**2.7.2.After Integrated farming(nyuma yubuhinzi bukomatanyije**	**Code**
More than enough/ Twararyaga tugasagura	1	*More than enough/ Turarya tugasagura*	1
Enough/ Twararyagatugahaga	2	*Enough/ Turarya tugahaga*	2
Sometimes not enough/ Rimwe narimwe ntibyabaga bihagije	3	*Sometimes not enough/ Rimwe narimwe ntibibabihagije*	3
Frequently not enough /Akenshi ntitwahagaga.	4	*Frequently not enough /Akenshi ntitwahagaga.*	4

SECTION III: SOME OF THE ACTIVITIES RELATED TO INTEGRATED FARMING PRACTICES.

3.1. Manure Usage

Do you apply/use cattle manure in your field? 1= Yes 2=No**.**

3.2.How many tons of Cow dung collected in 6 months/ifumbire ukusanya(kosora no. ikwiriye).

1..100 kg-300kg , **2**. 300kg-500kg**, 3**. 500-1000kg **, 4**.1 -2 ton, **5**.2 -5 tons
6. 5-10 tons**, 7**>10 tons

3.3.Do you apply all those collected organic fertilizers in your field(manure from cow dung)? 1= Yes 2= No

If Yes, to what extent?

1= (1-3 Tons/ha) **2.(**4-6 tons/ha).**3**. (7-9 tons/ha)**4**.(10Tons/ha and above)

3.4.Do you have Bio-Gas

1 I don't have it **2.**I once had it but got destroyed **3**. I have it but no effectively working **4.** I have it and it is very effective

3.5.How often do you feed your cows with agriculture residues?

1= Always **2**= sometimes 3 = Rarely **4**= Never

Do you have means of standard storage of agriculture residues for future cow feeding?

1. I don't have **2**.I do it traditionally **3**.some traditional others modern **4**. I have a modern one

SECTIO**N:1V.CHALLENGES THAT AFFECT INTEGTATED FARMING AND STRATEGIES**

4.1 Are there Challenges that affect the farmers for effective management of livestock and maximum production of milk 1=Yes 2=No. if yes what are those challenge(the numbering has been random)

1. Scarcity of water **2**.Animal diseases **3**. No enough feeds for the cows

4. .No market for Milk **5**.No enough training to Conserve and apply manure **6**.No enough training about storage of cows' feeds.**7**.No training at all……(it has been random numbering.

You are requested to rank them according to the **MOST** problem. You have .one(**1**) is the Most problem and Seven**(7**) is the least problem.

4.2. Are there some challenges that affect agriculture production and productivity?

1. Agriculture diseases **2**. Draught **3 .**Market for agricultural products **4. Farmers** mind set about fertilizer use/still believing in traditional methods**. 5**. Other challenges

***4.*2What are the strategies to address those challenges /hakorwa iki kuri ibibibazo wagaragaje?**

A) *For Livestock*……

B) *For agriculture*……

*I **thank you very much**.*

APPENDIX: B

INTERVIEW GUIDE

I am Sabiti Atuhe Fred, student number *216367875, 1am pursuing* Master's degree in Local Governance Studies at the University of Rwanda (UR) and I am working on research project entitled "**Integrated Farming: A Strategy for Social Economic Development of Farmers in Nyagatare district*: case study of Gatunda and Nyagatare sectors".***

Purpose of the questionnaire

The purpose of this questionnaire is to determine how Integrated Farming determines the Socio-Economic Development of farmers in Nyagatare and Gatunda sectors. You are requested to provide accurate responses, so as to enable the researcher to determine the Integrated Farming Impacts on Socio- Economic Development of farmers.

Instructions

• For each of the questions bellow, give the answer that comes closest to the way you feel about the question;

Please answer the question as honestly as possible.

• If you do not understand any of the questions, the researcher will assist where accordingly.

1.0. DEMOGRAPHIC CHARACTERISTICS

Sex.1.Gore…… 2.Gabo……

Age…….

Level of education…….

Name of the institution……..

Q1:*Has integrated farming been successful in bringing social economic development to farmers in Nyagatare District. If yes explain……*

if no give reasons.……?

Q2.: How often do you conduct training for farmers 1. Always 2, some times . 3. rarely .4.I don't train farmers

Q3: *Are there some challenges that farmers face during the implementation of integrated farming ?.if yes what are those challenges*……
……
……
how can these challenges be eliminated……
……
……
……
……
……?

Q4:*Are there some efficient and effective communication between the agronomists/veterinary officers and farmers?*

Explain----------

Q5**:** *Is the farmer aware of how much manure is applied in his/her field? If yes to what extent.?1.**poor 2.Fair 3.good. 4.very good? If no why*……
……

Q..6.*Are there some challenges You technicians face during the following up on implementation of integrated farming **?.1**..Yes.**2**.No. .if yes list them, and propose the solutions*……
……
……
……
……

Q7 .what are the urgent technical support that Government of should provide so it gives quick impact to the farmers……

Q8.Integrated farming is so benefiting to the farmers and brings immediate social economical impact to them , yet the number that practice integrated farming is still very . what do say about this?

:Q9..What are the strategies to make integrated farming more sustainable.?....a) As. farmers .b).As Government.....

……

I thank you very much.

APPENDIX: C

LETTERS AUTHORIZING FIELD DATA COLLECTION

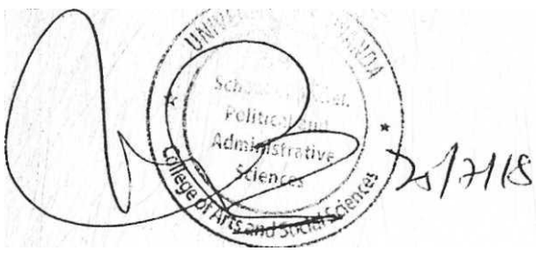
ADMINISTRATL [T]E SCIENCES

TO WHOM IT MAY CONCERN

This is to testify that **SABITI ATUHE FRED,** Registration number **216: 67875** is a Student in Masters of Local Governance Studies, School of Social, Political and Administrative Sciences, College of Arts and Social Sciences. He is currently in the process of gathering data for his research work entitled:**."Integrated farming system as a strategic approach to social economical development in Farmers".**

He will be approaching you with the aim of collecting relevant information *m* to complete this assignment. We are humbly requesting you to kindly extend the necessary cooperation in providing the needed data.

We thank you very much in anticipation of your kind cooperation and pli ase do not hesitate to contact us should you be in need of further information. •



Sincerely,

Assist. Prof. Ismael Buchanan, PhD

Dean
School of Social, Political and Administrative Sciences

Tel:+250783545891

Email:ismaelofr@yahoo.fr

ibuchanan@ur.ac.rw

Tel: +250788S95398

10th/August/2ol8

TO THE MAYOR NYAGATARE

DISTRICT EASTERN PROVINCE.

RE: REQUESTING TO CONDUCT DATA

COLLECTION Dear sir,

I am a student In the University of Rwanda pursuing master's degree in local governance studies. I hereby write this letter requesting you to allow me conduct data collection in Nyagatare district, basing on the letter dated 25*July.2018 from the Dean's office University of Rwanda, school of social, political and administrative sciences, allowing me to conduct data collection on the topic titled "integrated farming a social economic development activity In Nyagatare district".

I kindly request you to allow me carry out the data collection In Nyagatare and Gatunda sectors of nyagatare district as my areas of interest, t am grateful, as I look forward to receiving your positive response. I hope my request will be put into consideration.

Yours

SABITI ATUHE FRED
Thank you.

REPUBLIC OF RWANDA **Nyagatare, J.Q../...M^..../2018**

Nº...../ 07.05.K.F

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EASTERN PROVINCE
NYAGATARE DISTRICT P. O.
BOX: 20 Nyagatare Tel:
0252565249.
E-maU:nvagataredistrict@rninaloc.gov.rw

To SABITI ATUHE **Fred**
Tel:0788595398

Subject: Reply to your Later

Dear Sir

Referring to your letter dated 10th august 2018 requesting Nyagatare District to carry out data collection in Sectors of Nyagatare and Gatunda of Nyagatare District.

Nyagatare District is pleased to inform you that you are granted the permission as per your request.

Sincerely

MUSHABE DAVID Claudian
Mayor of Nyagatare District

APPENDIX: D

SWOT ANALYSIS OF NYAGATARE DISTRICT (AGRICULTURE AND LIVESTOCK DOMAIN)

SECTOR	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Agriculture & livestock	• Plenty of land and swamps available for agricultural and livestock production • Soil conditions suitable for maize, beans, Sorghum, coffee, banana, cassava, vegetables and fruits production • High agricultural and livestock productivity • Availability of manpower • Existence of plains and low inclined hills that make them suitable for agricultural mechanization • Existence of 8	• Insufficient agro-processing plants • Deficit of agriculture produce storage facilities • Lack of skilled agricultural technicians and farmers • Insufficient modern farms • Insufficient agriculture irrigation and mechanization • Lack of a modern slaughter house • Insufficient veterinary pharmacies and specialized	• Availability of unexploited land and swamps • Extensive agriculture and livestock practices • Existence of Inyange Industry • Existence of Girinka and other livestock promotion programmes • Existence of financial institutions including UMURENGE SACCOs • Presence of a University that has agriculture and livestock development	• Insufficient rainfall leading to drought • Fragile soil • Prevalence of pests • Animal diseases (high rates of livestock disease) • Immigration that causes high demography pressure on land

SECTOR	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
	modern markets for cows • Crops production is labour intensive and therefore, promotes job creation • Easy access to national and district markets • Land Consolidation at high level	veterinary medicine personnel or staffs • Limited capital (low number of people accessing both to financial services and business financing facilities	programs • Existence national agricultural agencies in the district (RAB and NAEB) • Existence of active farmers' cooperatives • High local and national agricultural and livestock production demand	
SECTOR	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Agriculture & livestock	• Plenty of land and swamps available for agricultural and livestock production • Soil conditions suitable for maize, beans, Sorghum, coffee, banana, cassava, vegetables and fruits production • High agricultural and livestock productivity • Availability of manpower	• Insufficient agro-processing plants • Deficit of agriculture produce storage facilities • Lack of skilled agricultural technicians and farmers • Insufficient modern farms • Insufficient agriculture irrigation and	• Availability of unexploited land and swamps • Extensive agriculture and livestock practices • Existence of Inyange Industry • Existence of Girinka and other livestock promotion program • Existence of financial institutions including UMURENGE	• Insufficient rainfall leading to drought • Fragile soil • Prevalence of pests • Animal diseases (high rates of livestock disease) • Immigration that causes high

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Appendix E: Map of Nyagatare district