

ANALYSIS OF TOMATO VALUE CHAIN IN RUGOMBO DISTRICT, BURUNDI

MUGURUTSI MWADJUMA

**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
AGRICULTURAL AND APPLIED ECONOMICS OF THE SOKOINE
UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.**

ABSTRACT

This study analysed the tomato value chain in Rugombo district in order to develop new insights on the nature of activities along the chain and shed light on possible strategies that may increase primary actor's (smallholder farmer's) income. Primary data for this study were collected from various primary, support and institutional actors of the value chain using structured questionnaire and checklist. Descriptive statistics, gross margin and multiple linear regression models were used to analyse the collected data. The findings of this study show that although the tomato value chain in Rugombo constituted by conventional actors such as input suppliers, farmers, rural assemblers, wholesalers, retailers, consumers, support and institutional actors, the chain is largely dominated by smallholder producers. Furthermore, the tomato value chain is characterized by the lack of value addition, weak horizontal and vertical coordination among actors in the chain. The gross margin results show that retailers enjoy high margins with a minimum of 312.58BIF per Kg of tomato when compared to producers whose margin stands at a minimum of 260.06 BIF per kilogram of tomato. The results from multiple linear regression indicate that level of education ($p < 0.05$), member of organisation ($p < 0.05$), land under tomato production ($p < 0.1$) and experience in tomato production ($p < 0.1$) are statistically significant to influence tomato profit at farm level. Therefore, the results of this study suggest that smallholder tomato producers in Rugombo are not fetching high margins in value chain. Their incomes are consistently reflected by low margins fetched from participation in tomato value chain activities. Therefore, any strategies geared towards improvement of producers' income should take into account the fact that farmers (as strategic primary actors) fetch low margins compared to other actors in the chain.

DECLARATION

I, Mugurutsi Mwadjuma, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work, done within the period of registration and that it has neither been submitted nor is being concurrently submitted to any other institution.

Mugurutsi Mwadjuma

(MSc. Candidate)

Date

The above declaration is confirmed by;

Dr. Daniel W. Ndyetabula

(Supervisor)

Date

COPYRIGHT

No part of this dissertation may be reproduced, stored in any retrieval system, or transmitted in any form or by any means without prior written permission of the author or Sokoine University of Agriculture in that behalf.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to the African Economics Research Consortium (AERC) for the scholarship award to pursue Master studies in Collaborative Masters in Agricultural and Applied Economic (CMAAE).

My sincere gratitude goes to my supervisor, Dr. Daniel W. Ndyetabula of School of Agricultural Economics and Business Studies, Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture for his exemplary guidance, insightful comments and constructive feedbacks which assisted me in successfully carrying out this study. I am greatly thankful for having had the opportunity to work with him.

I am equally thankful to all staff in the Department of Agricultural Economics and Agribusiness for their comments and suggestions which helped me to shape this study. I also wish to extend my heartfelt thanks to Prof. Willy Marcel Ndayitwayeko of the Faculty of Economic Science and Management, University of Burundi for his encouragement and support.

Lastly, I greatly appreciate contributions of all the people who in different ways helped me to build up this dissertation.

DEDICATION

This work is dedicated to my husband, Bela Adasopo Toussaint, and my brother Ntibasharira Abdallah for their support and encouragement.

TABLE OF CONTENTS

ABSTRACT	ii
DECLARATION	iii
COPYRIGHT	iv
ACKNOWLEDGEMENTS.....	v
DEDICATION	vi
TABLE OF CONTENTS.....	vii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF APPENDICES.....	xiii
LIST OF ABBREVIATIONS AND SYMBOLS	xiv
CHAPTER ONE.....	1
1.0 INTRODUCTION.....	1
1.1 Background Information	1
1.2 Problem Statement and Justification	2
1.3 Objectives of the Study	4
1.3.1 Overall objective	4
1.3.2 Specific objectives.....	4
1.4 Hypotheses	4
1.5 Organization of the Dissertation.....	4
CHAPTER TWO.....	6
2.0 LITERATURE REVIEW.....	6
2.1 Theoretical Review.....	6
2.1.1 Value Chain Concept	6
2.1.2 Value chain theory and its application in this study	6
2.1.3 Transaction cost theory	10

2.1.4 The structure of value chain	10
2.1.5 Mapping the value chain	12
2.1.6 Measures of profitability	13
2.2 Empirical Literature Review	14
2.3 Conceptual Framework	16
CHAPTER THREE	19
3.0 METHODOLOGY	19
3.1 Description of the Study Area	19
3.2 Research Design	21
3.3 Sample size and Sampling Procedure	21
3.3.1 Producers sampling	21
3.3.2 Traders sampling	22
3.4 Type of Data, Their Sources and Collection Instruments	23
3.5 Questionnaire Pre-testing	24
3.6 Data Processing and Analysis	24
3.7 Methods of Data Analysis	24
3.7.1 Descriptive statistical analysis.....	24
3.7.2 Mapping and characterizing the structure of the value chain actors	25
3.7.3 Profitability analysis of tomato value chain	25
3.7.3.1 Gross margin analysis	25
3.7.3.2 Marketing margin analysis	26
3.7.4 Econometric analysis.....	27
3.8 Variables Definition and Problems Associated with Regression Analysis.....	28
3.8.1 Dependent variables	28
3.8.2 Independent variables.....	29
3.9 Problem of Parameters Estimation	31

CHAPTER FOUR.....	33
4.0 RESULTS AND DISCUSSION.....	33
4.1 Overview	33
4.2 Descriptive Analysis	33
4.2.1 Socio-economic characteristics of smallholder tomato producers	33
4.2.1.1 Age of household head.....	33
4.2.1.2 Sex of households head and education level.....	34
4.2.1.3 Land possession.....	34
4.2.1.4 Access to credit, extension services and price information.....	34
4.2.1.5 Family size and farming experience in tomato production	35
4.3 Value Chain Analysis.....	36
4.3.1 Key actors in tomato value chain	36
4.3.1.1 Input suppliers	37
4.3.1.2 Producers	37
4.3.1.3 Rural assemblers	38
4.3.1.4 Urban commission agents	39
4.3.1.5 Wholesalers	39
4.3.1.6 Retailers.....	40
4.3.1.7 Consumers.....	42
4.3.1.8 Institutional support services.....	43
4.3.2 Mapping and characterising the structure and relationship among actors	43
4.3.2.1 Strand 1: Farmers→ consumers	43
4.3.2.2 Strand 2: Farmers → retailers → consumers	44
4.3.2.3 Strand 3: Farmers →rural assemblers→ wholesalers /rural retailers → consumers.....	44
4.3.2.4 Strand 4: Farmers → urban wholesalers→ retailers/ consumers	44
4.3.2.5 Strand 5: Farmers → rural wholesalers→ rural retailers→ consumers ...	45

4.3.2.6 Strand 6: Farmers → urban commission agents → wholesalers/ retailers/ consumers	45
4.4 Value Chain Linkages	47
4.5 Prices and Marketing Margins Realized by Value Chain Actors.....	48
4.5.1 Selling prices comparison along tomato value chain	48
4.5.2 Marketing margin realized by the value chain actors.....	48
4.6 Profitability Analysis.....	49
4.6.1 Gross margin at farm level	49
4.6.2 Gross margin at trading level	50
4.6.2.1 Gross margin at rural assembler’s level	50
4.6.2.2 Gross margin at wholesaling level	50
4.6.2.3 Retailers’ gross margin.....	51
4.6.3 Comparison of gross margin between actors along the tomato value chain	52
4.7 Econometrics Results	53
4.7.1 Statistical test.....	53
4.7.2 Factors influencing profitability at farm level.....	53
4.8 Constraints of Tomato Production and Marketing.....	55
4.8.1 Production constraints of tomato value chain	55
4.8.2 Traders constraints of tomato value chain.....	57
CHAPTER FIVE.....	58
5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS	58
5.1 Summary and Conclusion	58
5.2 Recommendations	60
REFERENCES	62
APPENDICES	73

LIST OF TABLES

Table 1: Sample distribution of tomato producers in selected district	22
Table 2: Distribution of sampled traders, consumers and key informants.....	23
Table 3: Socio-economics characteristics of sampled Producers.....	36
Table 4: Land allocation, inputs used and production of tomato by sample household	38
Table 5: Description of assemblers	38
Table 6: Description of wholesalers	40
Table 7: Description of retailers.....	41
Table 8: Description of consumers and sources of tomato bought	42
Table 9: Comparison of selling prices along the tomato value chain	48
Table 10: Marketing margins distribution along tomato value chain	49
Table 11: Average cost of production and profitability of tomato (BIF/kg).....	49
Table 12: Gross margin at rural assembler’s level.....	50
Table 13: Gross margin at wholesaler’s level	51
Table 14: Retailers’ gross margin	52
Table 15: Comparison of mean gross difference along the chain	52
Table 16: Regression Results for tomato farmer in Rugombo District.....	54
Table 17: Tomato production and marketing constraints at farm level	56
Table 18: Traders constraints	57

LIST OF FIGURES

Figure 1: Conceptual framework of the study18

Figure 2: Map of the Rugombo District in Burundi20

Figure 3: Value chain mapping46

LIST OF APPENDICES

Appendix 1: Expected sign of explanatory variables73

Appendix 2: Sources of inputs use74

Appendix 3: Cost incurred in tomato production.....74

Appendix 4: Variance of inflection factors75

Appendix 5: Farmer’s questionnaire76

Appendix 6: Trader’s questionnaire82

Appendix 7: Consumers questionnaire86

Appendix 8: Checklist for key informants interview88

LIST OF ABBREVIATIONS AND SYMBOLS

ADISCO	Appui au Développement Intégral et à la Solidarité des Collines (Support for Integral Development and Solidarity of Hill Sides)
AERC	African Economics Research Consortium
ANOVA	Analysis of Variance
BIF	Burundian International Franc
BLUE	Best Linear Unbiased Estimator
CC	Contingency Coefficients
CMAAE	Collaborative Masters in Agricultural and Applied Economic
COOPEC	Cooperative d'Épargne et de Crédit (Cooperative of Savings and Credit)
DAP	Diammonium Phosphate
FAO	Food and Agricultural Organisation of the United Nations
Freq.	Frequency
GHS	Ghanaian cedi
GMM _A	Gross Marketing Margin of Rural Assemblers
GMM _P	Gross Marketing Margin of Producers
GMM _W	Gross Marketing Margin of Wholesalers
ha	Hectare
ILO	International Labor Organization of the United Nations
ISTEEBU	Institut des Statistique et d'Études Economique du Burundi(Institute of Statistics and Economics Survey of Burundi)
ITC	International Trade Centre
Kg	Kilogram

MINAGRI	Ministry of Agriculture
OLS	Ordinary Least Squares
PNIA	Programme National d'Investissement Agricole (National Program for Agricultural Investment)
S.E.	Standard Error
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan African
Stdv	Standard deviation
TGMM	Total Gross Marketing Margin
TR	Total Revenue
TVC	Total Variables Cost
UN	United Nations
UNIDO	United Nations Industrial Development Organisation
USAID	United States Agency for International Development
VIF	Variance Inflation Factors
ZMK	Zambia Kwacha
%	Percentage

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Vegetables play a significant role in Sub-Saharan Africa (SSA) through enhancement of food security, human nutrition, income generation, poverty alleviation and foreign currency earnings (ADISCO, 2013; Chagomoka *et al.*, 2015). Evidence from literature indicates that global fruit and vegetable production has been increasing at the rate of 3% annually with almost 637 million tons of fruits and more than 1.1 billion tons of vegetables over the last decade and its marketing has been one of the fastest growing sub-sectors in SSA (Joosten *et al.*, 2015). Marketing system has been a key factor in influencing the success or failure of efforts to improve crops production, consumption and poverty reduction in the region (Morris *et al.*, 2005). According to Debello (2007), improving and promoting vegetable marketing stabilizes income at micro and macro level.

In Burundi, vegetable production is the fourth most important agricultural production activity after cereals, tubers, and industrial products (cotton, coffee and tea) with the average annual production of 250 000 tons per year (FAO, 2014). The major vegetables grown in the country include tomato, onion, cabbage, carrots, leek, amaranth, garlic, celery, cucumber and a variety of other leafy vegetables that are produced under rain-fed and irrigated conditions (Vyizigiro, 2012). About 90 % of the produced vegetables in Burundi are mainly produced by smallholder farmers for subsistence as well as for local markets (Niyongere *et al.*, 2015).

Moreover, vegetables and fruits have been identified as new cash crops for increasing the supply for local and export consumption as envisioned in the 2025 National Vision and

National Plan for Agriculture Investment (PNIA) (Burundi-Vision 2025, 2011). One among the key government initiatives includes the establishment of Horticulture Strategic Framework which aims at increasing the quantity and quality of vegetables and fruits (FAO, 2014). Nevertheless, the increase in production of the same has not been transformed into improved real income and welfare of the farmers. For example, about 64.6 % of smallholders have been characterized by income poverty (UN, 2016).

The smallholders' income poverty has been attributed to poor performance of vegetable markets and marketing and has been regarded as one of the factors contributing to poor performance of the vegetable sector. The pertinent market and marketing challenges attributed to the poor performance of vegetable production include post-harvest handling, high transaction costs, and perishability nature of vegetables (Poulton *et al.*, 2006). Challenges facing vegetable sector have economic significance because they cause losses that affect negatively producers' and traders' income (Arah *et al.*, 2015).

Therefore; more attention is required to improve the benefits accrued from those crops for the poor rural thereby improving food security and hence contributing to poverty alleviation. It is against this background that the current study aimed at inquiring the value chain analysis of tomato in Rugombo district in order to help local value chain players and supporters to improve their livelihood.

1.2 Problem Statement and Justification

As a high value vegetable that is consumed by many households, tomato has high potential for income generation in Burundi especially in Rugombo district due to agro-ecological conditions suitable for its production. Dominated by smallholder farmers, the existing production faces various challenges emanating from both production and marketing

something which resulted to supply and price fluctuations. These fluctuations affect negatively the value chain players' income along the chain. For instance, according to 2009-2010 market data, average seasonal wholesale prices of tomatoes varied by as much as 400 percent from US\$0.2/kg to US\$1/kg (Bamber and Gereffi, 2014).

In addition, despite the suitable agro-climatic condition of the district and the government's initiative for promoting the quantity and quality of vegetables and fruits to reduce poverty and increase household income, it has been observed that tomato sector has not reached its potential regarding improvement of standard of living of actors where 64.6% and more than 50% of farmers are faced by basic need poverty and unemployment respectively (UN, 2016).

Empirical evidence indicate that the success of production for achieving well-being for the major population depends on how market operates and the way producers are connected to final markets (Xaba and Masuku , 2013). Therefore, there is a need to analyse the whole value chain of tomato in Rugombo district to find out the respective actors and their activities in relation to their income and income distribution. A better understanding on how value chain operates could more efficiently help to show where tomato marketing chain constraints exist and hence address them accordingly for the benefit of all actors.

Additionally, it is noteworthy that the availability of value chain information for tomato would be useful to both policy makers, researchers and other development stakeholders to ascertain the prevailing situation, pertinent challenges, strengths and alternative means to curb the challenges that would be recommended from this study.

1.3 Objectives of the Study

1.3.1 Overall objective

The overall objective of this study was to analyse the tomato value chain in Rugombo district for developing an understanding of actors, and their activities in relation to their income and income distribution.

1.3.2 Specific objectives

1. To map and characterize the structure of value chains actors along the tomato chain in study area.
2. To determine profit and profit distribution among actors along the tomato chain; and
3. To determine socio-economic and institutional factors influencing the profitability of tomato at farm level.

1.4 Hypotheses

1. There is no significant variation in profit among the various actors in the tomato value chain.
2. The socio-economic and institutional factors do not influence significantly the profitability of tomato at farm level.

1.5 Organization of the Dissertation

This dissertation is organized into five chapters. The first chapter provides a general background to the study, problem statement, study objectives and hypotheses and limitations of the study. The second chapter elaborates a review of the literatures relevant to the study while the third chapter presents a detailed description of the study area and methodology employed. The findings of the study are presented in the result and

discussion part in chapter fourth. Finally, chapter five presents conclusion and recommendations that are drawn from the study findings.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Value Chain Concept

Value chain is defined as the set of interconnected, value-creating activities undertaken by an enterprise or group of enterprises to develop, produce, deliver and service a product or service (Brown, 2009). It is also defined as a full range of activities that firms and workers do to bring a product from its conception to its end use and beyond (Pietrobelli and Saliola, 2008). This includes activities such as design, production, marketing, distribution and support to the final consumer (Cunningham, 2001). The activities that comprise a value chain can be contained within a single firm or divided. Therefore, a value chain can be viewed as the way in which a firm not only develops competitive advantages and creates shareholder value but also demonstrates the interrelationships and dynamics between individual businesses.

The concept of value chain is regarded as a development tool that helps in identification of the policies that can be implemented for individual producers and countries to increase their share of the gains (The International Trade Centre, 2003). It also gives a better understanding of how the sector is performing and contributing to national socio-economic development. Moreover, it represents an analytical framework that helps to understand how the trade functions. Based on the researcher's objectives, a value chain framework can be used to increase commercial profit, improve the competitiveness of a specific target group in a market or reduce poverty.

2.1.2 Value chain theory and its application in this study

Michael Porter, the first person to introduce the term "value chain" in the 1980s, described it in details in his work entitled *Competitive Advantage: Creating and Sustaining Superior*

Performance (Porter, 1985). The concept of value added in the form of a value chain has been used to build up an industry's sustainable competitive advantage in the business field. A large body of literature on agricultural market has considered value chain in different way. A value chain can be used to increase commercial profit and improve the competitiveness of a specific group in a market or reduce poverty (Mitchel *et al.*, 2009). The concept is also considered as an important construct that facilitates understanding of the distribution of returns from the different activities of the chain (Kaplinsky and Morris, 2000). Also, Kumar *et al.* (2011) visualized the concept as a strategy for enhancing food security as well as alleviation of poverty of the stakeholders in the chain. Moreover, the concept can also be regarded as a vehicle by which new forms of production, technologies, logistics, labor processes and organizational relations and networks are introduced (Trienekens, 2011).

Different researchers have begun to examine how the value chain could be used as a tool for analysis, especially in understanding the distribution of income in agricultural sector or for the identification of effective policy actions to increase farmers' income. One of the key ways in which VCAs differ and which continues to be under debate amongst scholars is the scale of the analysis. Some researchers believe that every process and transaction from input to the consumer end-use product ought to be included in the analysis, while other researchers select segments and actors along the chain to analyze.

Accordingly, a large body of literature on agricultural market has evolved many methods of value chain analysis. Porter (1985) developed the *filière* approach for empirical agricultural research whose main objective was to increase efficiency through identifying flows of physical inputs and services required in the production of a final product as well as the actors involved. The approach was used to gain more understanding of economic

processes in production and distribution chains in agricultural commodities such as analysis of the production of cocoa in the developing countries formally under French colonization (Jakpa, 2015). However, experts in the field of value chain analysis regard the French approach as static, not taking into consideration dynamic characteristics of growth and fall of products, of knowledge and of number of actors. In addition, the approach is considered as too descriptive, neglecting the strategic approach to value chain analysis.

Therefore, the weakness of Porter's approach according to Faße *et al.* (2009) was its restriction to the firm level activities neglecting the analysis of upstream or downstream activities beyond the industry. This paved way for the launching of the Global Commodity Chain Approach (GCCA) reflecting a more dynamic view of the four core dimensions through which a value chain could be analysed holistically thus input-output structure, geographical territory covered, institutional framework, and value chain governance (Sturgeon, 2008; Gereffi *et al.*, 2005).

However, it was found that the framework for value chain analysis requires extensive data. Aspects that need to be considered are the structural issues like cost objectives, budgets and value cost drivers. Linkages and interrelationships must also be looked into as the cost of performing one activity will often be influenced by the way in which other activities are performed (Hergert *et al.*, 1989).

Hence, Cathelijne *et al.* (2007) considered the Structure-Conduct-Performance (SCP) approach which covers functioning structure (products, types of actors), conduct (behavior and interactions among actors) and finally the performance with respect to criteria like efficiency, flexibility, innovation and responsiveness as the basis for value chain analysis.

Moreover, some authors consider SCP as a model that allows analyzing from an external point of view without taking into account the opinion of the actors and does not emphasise the nature and the structure of relationships between buyers and sellers and their satisfaction level (Attai and Fourcade, 2003). Nevertheless, the model is limited to only one value chain stage. Hence, Osen (2011) suggest that, the Agent-Based Models (ABMs) are useful approaches when modelling systems that are composed of interacting agents, where agents may represent individual farmers, social groupings, or institutions.

In addition, as Van den Berg *et al.* (2009) observes that value chain analysis can be viewed in a narrow or broad sense. In the narrow meaning, a value chain focuses on a single firm and includes the conception and design stage; the acquisition of inputs; production, marketing and distribution activities; and the performance of after sale services. The broad approach to value chains looks starts from the production system of the raw materials used to produce a product and includes linkages with all other actors engaged in activities. It comprises all backward and forward linkages, up to the level in which the raw material produced is linked to the final consumers. Furthermore Rich (2009) argue that value chain analyses can be conducted through a combination of qualitative and quantitative methods, featuring a further combination of primary survey, focus group work, participatory rapid appraisals (PRAs), informal interviews, and secondary data sourcing. The information is useful in itself to understand the linkages and structure of the value chain and serves as the basis for identifying many of the key constraints and policy issues that require further exposition.

The tomato value chain in Rugombo is comprised of activities and actors involved in the initial cultivation all the way to the end-product that a consumer purchases. This dissertation focused on the entire chain. Thus, based on the approaches as discussed

above, the value chain of tomato is assessed by combining qualitative and quantitative approaches in order to understand various aspects in the chain focusing on identification of the cost, profit and critical issues that undermine the value chain development.

2.1.3 Transaction cost theory

When deciding to sell a particular commodity, producers base their decisions not only on the price they expect to receive but also on additional costs related to transacting in available markets (Jaffee, 1995). Considering transaction costs, farmers are more likely to supply their commodities through a channel that has less transaction costs in their quest to maximise profit (Mabuza *et al.*, 2014).

Transaction costs play an important role in the organisation of procurement regimes (Ruben *et al.*, 2007). According to the literature review, it emerges that firms must not only make a comparison between internal and external transaction costs but also choose the lowest cost which enables them to increase profits. This means farmers have to reduce transaction costs to the minimum level to achieve more profits and competitive advantage (Yousuf, 2017). In addition, traders and consumers also incur costs of monitoring and losses that affect their profit, partly due to the high perishability of tomato product.

2.1.4 The structure of value chain

The structure of the value chain can be characterized in term of five elements including vertical relations, horizontal relations, the enabling environment, the supporting markets and the end market (Elizabeth, 2012).

Horizontal relations reflect on the balance between cooperation and competition among actors performing the same function in the chain (McCarthy, 2008). They can be formal

(cooperatives and associations) or informal. Reflection on horizontal relations calls attention to the presence or absence of collective action and its effect on the performance of the chain. Consequently, it reveals the factors which influence the formation of formal and informal horizontal linkages such as trust, interdependency and institutional aspects. From the perspective of small producers it enables them to achieve economies of scale and increase bargaining power (Shepherd, 2007).

Vertical relations refer to the sequence of value adding activities that constitute the spinal cord of the chain. They are defined by the linkages among actors operating in a varied range of functions between raw material supply and final market distribution (Kula *et al.*, 2006). Actors performing different functions in the value chain are vertically linked through buying and selling relationships. Through these vertical relations knowledge, information, technical, financial and business services are transferred from one actor to another along the chain (Trienekens, 2011). Vertical relations highlight the level of cooperation, coordination, trust, interdependency and power along the chain. Powerful actors act as coordinators; they have capacity to set and impose criteria and requirements to regulate transactions in their chains. This explicit form of coordination is known in the value chain terminology as governance (Gereffi *et al.*, 2005). Therefore, the nature of vertical relations often determines the distribution of benefits between actors in the chain and influence on the creation of incentives and constraints to innovate in order to increase value added.

Chains also operate in business enabling environment that can be all at once global, national and local and includes norms and customs, laws, regulations, policies, international trade agreements and public infrastructure (roads, electricity, storage etc.). As

documented by Lusthaus *et al.* (2002), it referred as the forces outside the organization that can facilitate or inhibit the adequate performance of the chain.

The supporting markets include firm and organisation provided business support services, such as financial, communication, packaging or transport. In this study, the supporting markets consists of the institutional service with attention to aspects related to tomato market information and credit services.

The end market indicates the location of the final consumers which is considered by some authors as the starting point of value chain analysis because the demand in the end of the market defines the opportunities that drive the value chain (Elisabeth, 2012). It is where the final transaction takes place in a value chain. Analysis of the end market provides information about the segment to which the end user belongs. It also determines the characteristics (price, quality, quantity and other attributes that define consumer preferences) of the final product or service (Kula *et al.*, 2006).

2.1.5 Mapping the value chain

Mapping a chain means creating a visual representation of the connections between businesses in value chains as well as other market players (ILO, 2009). This exercise is carried out in qualitative and quantitative terms through graphs presenting the various actors of the chain, their linkages and all operations of the chain from pre-production (supply of inputs) to industrial processing and marketing (UNIDO, 2009). It is an ideal tool for measuring and quantifying the cost of administrative distortions that hinder competitiveness of products and industries. It also enables identifying the appropriate linkage between a supplier and its customers for maximum benefit, including internal supply matter relationships throughout the organization.

According to Kaplinsky and Morris (2000), mapping a value chain provides a descriptive structure that is good for data generation and analysis. The result of the mapping of the value chain should result in an understanding of where there are gaps or redundancies, opportunities for value addition or expansion of existing activities (Sanogo, 2010). Nevertheless, value chain mapping can be complex due to some actors being involved at multiple levels (Muiruri, 2015). A farmer can be a producer, consumer and a trader while at times they are involved in more than one chain hence leading to a value chain network. Moreover, mapping of a value chain leads to identification of the principal functions at each stage, agents carrying out these functions and principal products developed (Faße *et al.*, 2009).

2.1.6 Measures of profitability

In agricultural context, profitability is a measure of performance that shows how well the available resources are used by the farmer to generate income and profit, whereby profit refers to the difference between money that comes in from the sales of agricultural produce and the money that goes out to produce it. This also measures the success of the farm business, which is vital for the firm's survival and growth (Kahan, 2010). According to Arthur *et al.* (2001) profitability can be measured in two ways such as relative profitability and absolute profitability. Relative profitability measures are expressed as a percentage of assets, cost or revenues and therefore, take account of different farm scale. For example, two relative measures include total farm profit over total farm asset values (return on assets) or farming gross margin over total farm asset values. Relative profit measures provide to the analyst an indication of the wealth being generated across disparate industries. Absolute farm profit is a measure of "whole farm" performance. It may be calculated as total farm receipts less total (fixed plus variable) costs or total farm

receipts less variable costs which are call gross margin. Absolute profit is appropriate for analyzing the financial performance of a farm.

Moreover, different studies employed gross margin methods to determine profitability in agricultural products (Ayoola, 2013; Daniel, 2015; Xaba and Masuku, 2013). The current study employed also this approach to assess profit gained by different actors along the chain.

2.2 Empirical Literature Review

There are substantial empirical studies conducted by different researchers on value chain of agricultural commodities. A study by Bidogeza (2016) analyses vegetable value chain in the selected locations in Cameroon using the value chain approach. The analysis included value chain mapping, detailed description and quantification of value chains, and economic evaluation of value chains. The findings of the study show that most of vegetable farmers have poor access to input and output market support services, including agricultural credit. The value chain shows a benefit-cost ratio is greater than one for vegetable production, processing and marketing which indicates that vegetables sector is generally profitable for all actors along the chain.

Also, Kumi (2017) conducted a study on tomato in Kpone-katamanso district in Ghana using the value chain approach to determine the costs, returns and profit distributed along the chain by each actor. The findings of the study reveal that, the retailers of fresh tomato earned the highest profits of GHS 4.50 on every 5 kg of fresh tomatoes sold. This is followed by the distributors with GHS 0.89 on every 5kg of fresh tomatoes distributed, and finally the farmer earns GHS 0.37 on every 5 kilograms of fresh tomatoes sold. The dominant actors who commanded power over others in the tomato value chain are the

distributors of fresh tomatoes. The use of tomato, food security and its derivatives were regarded as opportunities.

Chagomoka *et al.* (2014) analysed the value chain of traditional vegetable from Malawi and Mozambique. The study combined both qualitative and quantitative approaches. The study's results show that traditional vegetable sales contributed about 35% and 30% to smallholders' income in Malawi and Mozambique respectively. Linkages between value chain actors were found to be weak; mostly based on spot market transactions, except for those between retailers and supermarkets, which were based on relationship marketing. Malawi's relative competitiveness in tomato is mainly due to slightly higher productivity and the cost advantage in labor (low wages) and irrigation costs.

Karim and Biswas (2016) investigated the existing vegetable supply chain in Bangladesh through value stream analysis by identifying different stakeholders and their activities, and illustrated various cost and price movement towards different stages of the supply chain. The results of the study revealed a huge portion about 64% of non-value added activities. The study assessed price movement along the chain and found that consumer price of vegetable was almost double when compared to producer price margin. Different market intermediaries share profit margin with the farmer and producer while consumers are not getting the full benefit of vegetable price due to deficient access to market information and undeveloped infrastructure.

Hailu *et al.* (2017) conducted a study on value chain analysis of onion in Ejere district West Shoa, Oromia national region state of Ethiopia using Structure Conduct and Performance model. The results of the study show that, gross marketing margin of producers in potato and onion markets channels were 65.76% and 72.84% in channel III

and V, respectively and the econometric results revealed that five variables such as productivity of potato, sex of household head, distance to the nearest market, off/non-farm income and area of land allocated for potato production, statistically affect the volume of potato supplied to the market while four variables such as productivity of onion, education level, farming experience and land allocated for onion significantly affect the volume of onion supplied to the market. The potato producers choices of market outlets for their produce are significantly influenced by both socio economic characteristics and marketing factors while quantity of onion sold, extension contact, farming experience, distance to nearest market, non/off-farm income, selling price of onion, trust in traders, ownership of motor pump and land size allocated for onion were among determinants which affect significantly onion producers choice of alternative market outlets.

Jeke (2011) used value chain approach to study tomato value chain and gross margin in Chipata district of Zambia. The results show that the supply is higher during the dry season than the wet season while prices are higher in the wet season than the dry season. The gross margin analysis revealed that tomato production and marketing is profitable in Chipata. Producers are able to get a gross margin of ZMK2.3 million (US\$483) in the dry season and ZMK5.8 million (US\$1218) in the wet season per hectare. Factors that limit tomato production and marketing include pest and disease problems, lack of skills and appropriate technologies, poor market infrastructure and information system, lack of organized farming and marketing by farmer groups, limited access to finance, inefficient extension service, small domestic market and limited export market and lack of processing facilities for value addition.

2.3 Conceptual Framework

Figure 1 presents a conceptual framework used in this study for value chain analysis of tomato in Rugombo district which provided a visual view of flow of the product and

interactions between tomato producers with internal and the external environmental factor within fluid tomato marketing chain actors. In this framework, tomato move from producers and are sold in different markets before they reach the end market (consumers). During this process, transaction costs are incurred and have influence on profit received by actors.

At farmer's level, there are several factors (internal and external) that influence their profitability. The internal factors refer to the factors that are within the farmers' control such as socio-economic factors and that are directly related to the farmers and their circumstances that shape how farmers undertake the production of tomato. The external factors refer to the factors that can influence tomato profitability and that are outside the farmers' control (support services for example). In certain circumstances, different factors might have some impact (negative or positive) on the profit made by farmers.

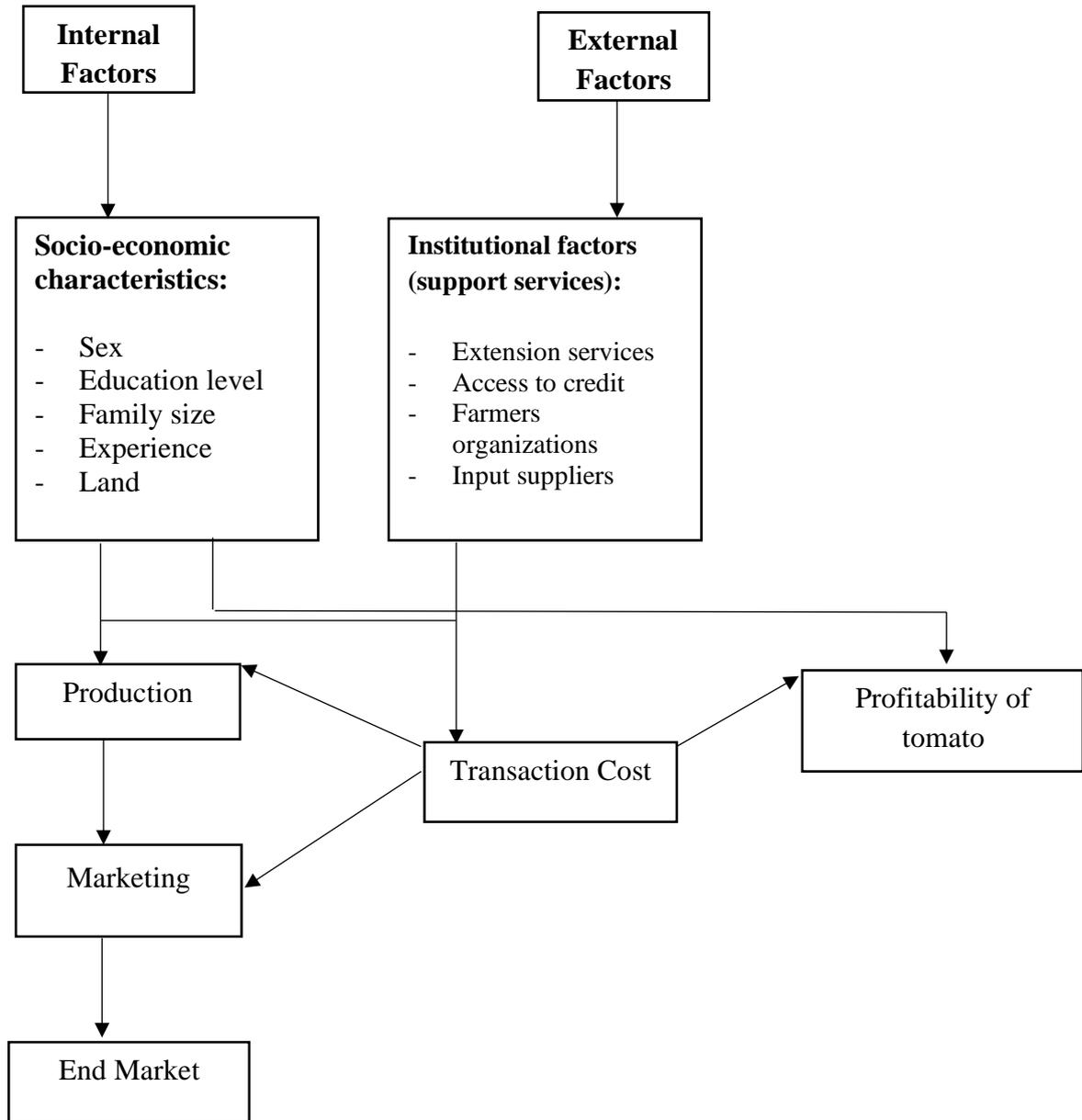


Figure 1: Conceptual framework of the study

Source: Author, 2018

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

The research was carried out in Rugombo district located in the North-West part of Burundi in Cibitoke province. The district is one of the six municipalities of the Cibitoke province. It borders two countries, Rwanda to the North; and Democratic Republic of Congo to the East. On the Burundian side, it borders Buganda, Mugina and Murwi districts. Rugombo is spread over an area of 237.70 km².

In addition, Rugombo district is located in the Imbo natural region. The latter encompasses almost the entire Rugombo districts. Imbo region is characterized by an altitude between 800 m and 1000 m, a tropical climate, a network river basin constituted by the waters of the Rusizi catchment area, an average annual rainfall of 900 mm, a vegetation made up of savannah grassy plant with stunted and thorny trees (Monograph of Rugombo District, 2006).

The main economic activities of the district are mainly agriculture, livestock keeping and trade. In fact, Rugombo district is one of the major agricultural areas of Burundi producing a number of vegetables including tomato. Therefore, the choice for Rugombo district as a study area was purposive and this was due to the fact that it has great concentration of tomato production and traders as compared to other districts.

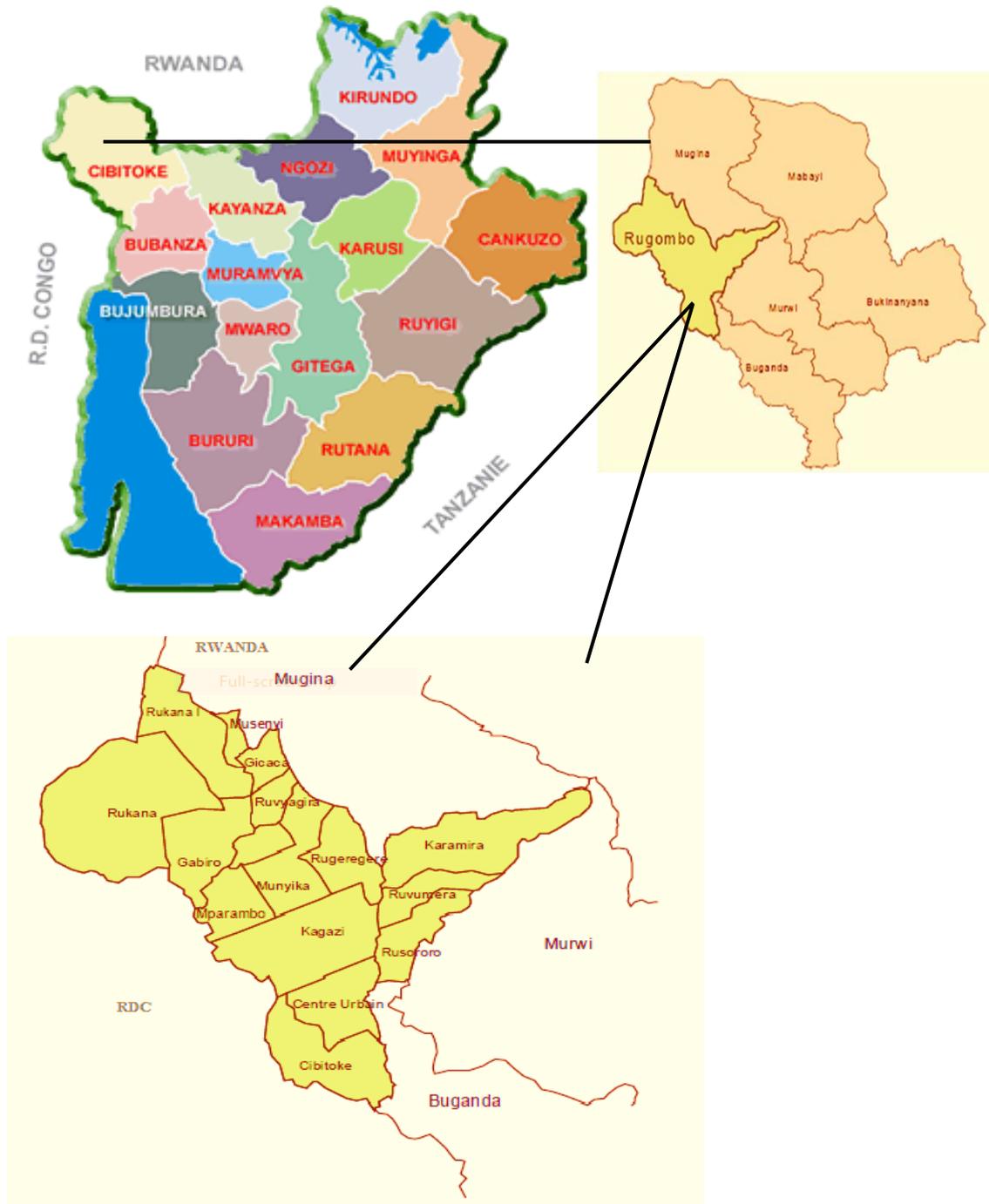


Figure 2: Map of the Rugombo District in Burundi

Source: Monograph of Rugombo District, 2006.

3.2 Research Design

This study employed a cross sectional research design. Under this design, data from producers' households, traders, consumers and key informants were collected. This design is chosen because it allows the collection of detailed on more than one case and at a single time on respondents and it facilitates the determination of relationships between variables (Bryman *et al.*, 2014).

3.3 Sample size and Sampling Procedure

The target population of this study was tomato producers, traders, consumers, and key informants especially from the Ministry of Agriculture at district levels and district financial officers.

3.3.1 Producers sampling

Farmers involved in this study were randomly selected using multi stage random sampling technique. The first stage involved selection of the district. Rugombo district was selected purposively in first stage based on its potential in tomato production. In the second stage, eight villages producing more tomato in the district were randomly selected based on the list received from the district agricultural officer. In the last stage, from each sampled village producer farmers were listed out with the help of village government leaders. From these population lists, sixteen farmers were selected using simple random sampling technique. Therefore, the sample size constituted 128 farmers from village's population was selected. As Sudman (1976) confirmed, a minimum of 100 respondents is enough for each group for when a comparative study is conducted.

Table 1: Sample distribution of tomato producers in selected district

District	Villages	Sampled farmers
Rugombo	Rukana II	16
	Rukana I	16
	Gabiro-Ruvyagira	16
	Mparambo I	16
	Mparambo II	16
	Munyika I	16
	Munyika II	16
	Kagazi	16
Total		128

3.3.2 Traders sampling

Researchers do not agree on sample size and procedure that should be used in each segment of the marketing chain (Mendoza, 1995). The decisions involved were partly due to the information available, time and resources available, accessibility to and openness of marketing participants as well as the estimated size of the trading population. To have enough possible level of representative traders, rural assemblers, rural and urban wholesalers and retailers were selected from rural market and two main urban markets (Bujumbura and Ngagara Cities Markets) during marketing days. Here sampling was a very difficult task due to the absence of recorded list of population of traders since most of them do not reside in the district. Thus, a purposive sampling method was adopted to select wholesalers, rural assemblers and retailers operating in tomato chain. As a result, 18 wholesalers, 5 rural assemblers and 26 retailers were selected for the purpose of the study. Furthermore, 21 consumers were selected purposively from both rural and urban areas and interviewed to obtain information related to consumers. Finally, 4 key informants were also selected randomly based on their official capacities.

Table 2: Distribution of sampled traders, consumers and key informants

Area	Rural assemblers	Wholesalers	Retailers	Consumers	Key informants	Total
Rural	5	7	10	9	4	35
Urban	-	11	16	12	-	39
Total	5	18	26	21	4	74

A total of 202 respondents (128 producers, 70 traders and 4 key informants) were interviewed for this study.

3.4 Type of Data, Their Sources and Collection Instruments

The qualitative and quantitative data for this study were collected from both primary and secondary sources. Primary data were collected from samples of respondents using both the interview and two types of structured questionnaire for farmers and traders. The primary data included information such as socio-economic characteristics of both farmers and traders such as age, gender, education status, years of experience in tomato production, income from other crops. Moreover, data on output produced and input used by farmers as well as marketing information and the different cost incurred during production and marketing were collected. The questionnaires targeted tomato producers and traders who had been active for the last two seasons. Data from key informants were collected using checklists.

The main sources of secondary data included the Ministry of Agriculture (MINAGRI), the Institute of Statistics and Economic Survey of Burundi (ISTEEBU), Sokoine University of Agriculture Library, the Central Library of the University of Burundi and other research findings on tomato production and marketing statistics. Secondary data contained information on agricultural production potential of the study area, production and price of tomato.

3.5 Questionnaire Pre-testing

Pre-testing of questionnaire was done one week prior to the actual data collection of data by trained enumerators who used French and Burundian national language for easy understanding. The pre-testing was done on 20 respondents (10 producers, 5 traders and 5 consumers) in order to check if the questionnaire was comprehensive to carry out the whole exercise of data collection and some necessary modifications was required. On average, it took 30 minutes to administer the questionnaire in English and 25 minutes to translate into French. The final questionnaire used in the study have been included in the appendices.

3.6 Data Processing and Analysis

Data were coded, summarized and analysed using Statistical Package for Social Science software version (SPSS) 16 and STATA version 13. Descriptive statistics such as mean and standard deviation were computed and analysed using SPSS. The regression analysis performed to determine factors that influence tomato profitability at farm level was employed and analysed using STATA. Gross margin along the node was also computed to determine the variation in profitability between actors along the chain.

3.7 Methods of Data Analysis

In this study, both qualitative and quantitative approaches were used to analyze the data collected from the respondents in order to address the set objectives and corresponding hypotheses.

3.7.1 Descriptive statistical analysis

Socio-economic characteristics of the sampled smallholder farmers, traders and consumers were analyzed using descriptive statistics and were summarized and presented in

percentage, frequency, mean and standard deviation. The method was also employed in the process of describing marketing margin value and margin share among tomato value chain actors.

3.7.2 Mapping and characterizing the structure of the value chain actors

Tomato value chain in this study was mapped and characterized using the sub sector value chain mapping approach. In this approach, channels through which tomato passes from production to consumption were identified using the graphical representation (process mapping) of the product flows, information flows and relationships within and between the actors that constitute the tomato value chain from input supply to consumption of final product and volumes of sales. Such details were generated using descriptive statistics such as means, standard deviations and frequency distribution.

3.7.3 Profitability analysis of tomato value chain

3.7.3.1 Gross margin analysis

To assess the profit accrued by different actors in the tomato value chain, gross margins were determined at each stage of tomato value chain. This was done by estimating actors' gross margin at each node of the value chain. The gross margin was obtained by subtracting total variables costs of production and marketing from total revenues as indicated in equation 1.

$$GM_{ij} = \sum_{i=1}^n (R_{ij} - C_{ij}) \dots\dots\dots (1)$$

Where:

GM_{ij} = Gross Margin of each market actor earned by the i^{th} actor in the j^{th} stage in Burundian International Franc per kilogram (BIF/KG)

R_{ij} = Total revenue received by the i^{th} actor in the j^{th} stage in BIF

C_{ij} = Total variable costs incurred by the i^{th} actor in the j^{th} stage (BIF)

i = tomato market actors (1, 2, 3, 4, n)

3.7.3.2 Marketing margin analysis

According to Scarborough and Kydd (1992), the term market margin is commonly used to refer to the difference between producer and consumer prices of an equivalent quantity and quality of a commodity. Marketing margin analysis deals with comparison of price at different levels of marketing over the same period of time. It measures the share of the final selling price that is captured by a particular agent in the marketing chain and always related to the final price or the price paid by the end consumer, expressed in percentage (Mendoza, 1995).

No other term associated with agricultural marketing is more misunderstood than the concept of a marketing margin. A big marketing margin may, in fact, result in little or no profit or even a loss for the seller involved. This depends on the marketing costs as well as on the selling and buying price. Since precise marketing costs are frequently difficult to determine in many agricultural marketing chains, the gross and not the net marketing margin is calculated. The marketing margins of the respondents was calculated using the formula in equation (2):

$$TGMM = \frac{\text{End buyer price} - \text{First seller price}}{\text{End buyer price}} * 100 \dots \dots \dots (2)$$

Whereby: TGMM= Total gross margin

The producer margin is also estimated by introducing the idea of ‘farmers’ portion’, or ‘producers’ gross margin’ (GMMp), which is the portion of the price paid by the consumer that goes to the producer. It is calculated by using the following formula:

$$GMM_P = \frac{\text{End buyer price} - \text{Farmer's Price}}{\text{Consumer Price}} * 100 \dots\dots\dots (3)$$

Also,

$$GMM_R = \frac{\text{Retailing price} - \text{Farmer's Price}}{\text{Consumer Price}} * 100 \dots\dots\dots (4)$$

$$GMM_A = \frac{\text{Assembling Price} - \text{Farmer's Price}}{\text{Consumer Price}} * 100 \dots\dots\dots (5)$$

$$GMM_W = \frac{\text{Wholesaler Price} - \text{Farmer's Price}}{\text{Consumer Price}} * 100 \dots\dots\dots (6)$$

Whereby:

GMM_P = the percentage of the total gross marketing margin received by the farmers in tomato marketing channel

GMM_R = the percentage of the total gross marketing margin received by the retailer

GMM_C_A = the percentage of the total gross marketing margin received by rural assembler

GMM_W = the percentage of the total gross marketing margin received by the wholesaler

3.7.4 Econometric analysis

Multiple linear regression was employed to determine factors influencing tomato profitability at farm level in Rugombo District. Regression analysis can describe a linear relationship between two or more variables by determining the mathematical equation, which relates the variables (Gujarati, 2004).

In this study, the estimated regression model of profitability is represented by equation 7 as follow:

$$GM = \beta_0 + \beta_i X_i + e_i \dots\dots\dots (7)$$

Whereby:

GM = Gross margin obtained from tomato production (in BIF)

β_0 = the intercept of regression equation

β_i = estimated coefficients of explanatory variables(i= 1 up 11)

X_i = explanatory variables (j= 1 up 11)

This equation is further specified as follow:

$$GM = \beta_0 + \beta_1 SEX + \beta_2 EDU + \beta_3 HSIZ + \beta_4 LAND + \beta_5 ASSMEMB + \beta_6 EXPER + \beta_7 DISTMARK + \beta_8 MARKINFO + \beta_9 ACCREDIT + \beta_{10} INCCROP + \beta_{11} EXTSERV + e_i \dots \dots \dots (8)$$

Whereby:

$X_{1, 2, \dots, 11}$ are explanatory variables, β_0 is the intercept of the model, and $\beta_{1, 2, \dots, 11}$ are estimated coefficients of the explanatory variables and e_i is the error term.

3.8 Variables Definition and Problems Associated with Regression Analysis

Different variables were expected to influence the profit of tomato at farm level in the study area. Thus, it is important to define their measurement and identify the potential explanatory variable as well as the symbol to represent them. Several studies revealed that farmers' profitability can be influenced by many factors such as socio-economic characteristics and institutional factors (Masunga, 2014; Phatela and Ajuruchukwu, 2015). Accordingly, the major variables expected to have an influence on the tomato profitability are explained as follow.

3.8.1 Dependent variables

Gross Margin (GM): It is a continuous variable that represents the dependent variable; the profitability of tomato at farm level measured in BIF/kg.

3.8.2 Independent variables

(1) Sex of household Head (SEX): This is a dummy variable taking one if the head of household is male and zero if female. As both men and women participate in production and marketing of tomato, no sign could be expected from this study a priori for this variable. It could take either a positive or a negative relation with the profit of tomato.

(2) Level of education of household Head (EDUC): It is a categorical variable measured in terms of level of education obtained by the farmer. Education is considered to improve the knowledge of the household in terms of production technology and marketing strategies. In other words, the higher the level of education, the more production and profit because farmers are expected to have the capacity to access production and marketing information. In this study the education is hypothesized to affect positively the profit margin of tomato.

(3) Family size (HSIZE): This is a continuous variable measured in term of total member in the household. This variable is expected to influence positively the profit of the farmers. It has been hypothesized that the larger the household size the higher the labour availability for more production hence more profit.

(4) Land under tomato production (LAND): The total size under tomato production is among the variable that could influence production and eventually the profit. If the farmer ploughs a large area of land, although not always, it is likely that he/she will produce more. Increased production has a direct bearing on increased profit. This is a continuous variable which is expected to influence positively the dependent variable.

(5) Association membership (ASSMEMB): This was a dummy variable taking the value of 1 for membership of an organization and 0 otherwise. This variable was expected to influence profit positively since it enhances access to technical assistance, exchange information and ideas about tomato production and marketing which will result into increased output and profit in particular.

(6) Years staying on farm production of tomato (EXPER): It is a continuous variable which is measured by the total number of years a farmer is engaged in tomato production. A farmer with better experience in tomato farming was expected to produce more volumes of tomato and is expected to gain more profit in tomato selling.

(7) Distance to the market (DISTMARK): It is a continuous variable which is the distance between the household residence and market measured in kilometers. Closeness to the market and low transportation charges reduce tracking time and product spoilage. In this study, distance to the market was hypothesized to affect tomato profit negatively. Households which are close to market are likely to have more profit.

(8) Access to market information (MARKINFO): This is a dummy variable taking a value of 1 if the farmer had access to market information and 0 otherwise. It is hypothesized to affect the tomato profit positively. This is due to the fact that farmers who have access to information are more likely to sell more at a better price.

(9) Access to credit (ACCREDIT): This is a dummy variable that takes the values 1 if the farmer took loan and 0 otherwise, which indicates credit taken for tomato production. Access to credit may enhance the financial capacity of the farmer to purchase the

sufficient input thereby increasing tomato production and hence increase profit. It was hypothesized that getting access to credit has a positive influence on tomato profit.

(10) Income from other crops (INCROP): It is a continuous variable which refers to the amount of cash income measured in BIF that a farmer gains from other crops than tomato. If the farmer gains more from other crops, he/she will strengthen his /her financial capacity in those crops which may lead the farmer to produce less tomato. Income from other crops was expected to affect negatively.

(11) Extension services contact (EXTSERV): is a dummy variable indicating that farmer gets in touch with extension service. It is expected that the extension service not only widens the household's knowledge with regard to the use of improved technologies but also has a positive impact on tomato profit. The objective of extension service is to introduce farmers to improved agricultural inputs, better methods of production, and better market options. In this study, extension was hypothesized to have a positive contribution to tomato profit.

3.9 Problem of Parameters Estimation

Multiple Linear Regression Model (OLS) was used to analyze factors affecting profitability at farm level. However, when some of the assumptions of the Classical Linear Regression model are violated, the parameter estimates of the above model may not be the Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of heteroscedasticity and multicollinearity problem before fitting important variables into regression models for analysis.

Multicollinearity refers to a situation where it becomes difficult to identify and separate the effect of independent variables on the dependent variable because there exists strong relationship among them. This means that the coefficients cannot be estimated with great precision or accuracy and can lead to wrong conclusion of individual coefficient (Gujarati, 2004).

There are two measures which are often suggested to test the existence of multicollinearity. These include Variance Inflation Factor (VIF) for association among the continuous explanatory variables and Contingency Coefficients (CC) for dummy variables (Mason *et al.*, 1991). VIF was used to check multicollinearity among explanatory variables in this study. As a rule of thumb, if the VIF is greater than 10, it is thought to signal harmful collinearity. The VIF measure of multicollinearity is defined as:

$$\text{VIF}(X_j) = (1 - R_j^2) \dots \dots \dots (9)$$

Where, R_j^2 is the coefficient of determination in the auxiliary regression. It measures the relationship between the raw and column variables of a cross tabulation. The value ranges between 0 and 1, with 0 indicating no association between the raw and column variables and value close to 1 indicating a high degree of association between variables. Conversely, heteroscedasticity assessment had been undertaken for this study. Heteroscedasticity implies that the variances of the residuals are not constant and consequently the standard errors could be inappropriate and any inference made could be misleading. There are a number of test statistics for detecting heteroscedasticity. However, according to Gujarati (2004), there is no ground to say that one test statistics of heteroscedasticity is better than the other test statistics. Breusch-Pagan-Godfrey test of heteroscedasticity was employed in this study due to its simplicity.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents and discusses findings obtained from the various analyses undertaken to address the three specific objectives of this study. It starts with the descriptive analysis, value chain mapping and characterising the structure of relationship among actors. The next section presents the profitability of the tomato value chain and how this profit is distributed between actors along the chain. The determinants of profitability at farm level are presented and results of the analysis of each actor's perception of constraints at each level are presented in the proceeding sections.

4.2 Descriptive Analysis

4.2.1 Socio-economic characteristics of smallholder tomato producers

This section provides socio-economic information of the sampled respondents in Rugombo district based on their age, sex, family size, experience, level of education and land possession.

4.2.1.1 Age of household head

Measured in years, the survey on this socio economic factor provided a clue on working ages of head of households. Out of the interviewed farmers, the findings reveal that the largest age groups were between the ages of 36 and 50 and 21 and 35 with 50% and 26.6% respectively. This implies that the heads of households were in active age for production activities. These findings concur with Parvin (2017) who argued that most tomato farmers are between ages of 20 and 50, implying that majority of tomato farmers are the ones who are still active enough to run the tomato production enterprise.

4.2.1.2 Sex of households head and education level

Rugombo district was found to be more dominated by male than female tomato growers. First, the findings indicate that 32% of the farmers who were found in the study area were female while 68 % were male. With regard to the education level, 48.4 % were secondary certificate holders and 25.8 % were primary certificate holders. This implies that farmers may be responsive to pertinent challenges regarding the use of new technology, information sharing, price awareness, market cost and margin forecasts as well as the choice of inputs to use in the production.

4.2.1.3 Land possession

One of the most important factors that influence crop production is the availability of land for crop production. In fact, land is the basic asset of the sample farmers. The survey revealed that the majority of sampled households owned land less than 0.25 hectares and land between 0.25 hectares and 0.75 hectares with 44.5% and 21.1% respectively. This concurs with the findings of research conducted by Karuku *et al.* (2016) in Kenya who claim that 86% of farmers owning between 0.13 and 1ha.

4.2.1.4 Access to credit, extension services and price information

Household respondents were also interviewed on whether they had access to services such as credit, extension services and market price information as depicted in Table 3. It is well understood that access to different services contribute to crop production and marketing. The findings revealed that 21.88% of the respondents reported to have contact with the extension services and the access to credit was insignificant in study area with only 3.9%. As for the price information, the survey results indicate that 90.62% of the households had access to price information before selling their produce to the nearby market.

4.2.1.5 Family size and farming experience in tomato production

The findings indicate that the respondents had an average household size (7 persons per household) as well as farming experience (7.45 years) as indicated in the Table 3. The minimum number of year the respondents have been in tomato production was 1 year and maximum of 30 years. According to Joosten *et al.* (2015), fruit and vegetables production require twice as much labour than the cereal production does. Similarly, study by Masunga (2014) shows that 24.4% of the producers have adequate family labour with 5-7 family members with the productivity at above 9 tonnes/ha, while the same level of production was reached by very few producers (13.3%) whose family labour availability was moderately adequate.

Table 3: Socio-economics characteristics of sampled producers (N=128)

Variables	Freq.	%
Age of the farmer		
>20	1	0.8
21-35	34	26.6
36-50	64	50.0
51-60	23	18.0
<61	6	4.7
Sex		
Female	41	32
Male	87	68
Education		
Non educate	18	14.1
Primary	62	48.4
Secondary	33	25.8
Certificate of secondary education	11	8.1
University	4	3.1
Own land		
> 0.25	57	44.5
0.25 - 0.75	27	21.1
0.75 – 1.5	14	10.9
<1.5	30	23.4
Access to credit		
With	5	3.9
Without	123	96.1
Contact with Extension service.		
With	28	21.88
Without	100	78.13
Access to information		
With	116	90.62
Without	12	9.38
Variables	Mean	Standard deviation
Family size	7.44	3.598
Farming Experience	7.45	5.378

4.3 Value Chain Analysis

4.3 1 Key actors in tomato value chain

It is clear that along the chain a number of actors participated in the marketing of tomato from the production to the consumer points. The main actors involved in the tomato value chain, their roles and inter relationships are discussed below.

4.3.1.1 Input suppliers

The input supply system was largely informal and poorly structured with non-suppliers specialized in agricultural inputs. Main actors involved in input systems were agro-dealers (who supply seeds, fertilizers and insecticides) and individual farmers. According to the findings, majority of the sampled producers (64.1%) bought their seeds from agro-dealers while 35.9% bought from individual farmers. Regarding the use of fertilizers, 82% of the farmers used inorganic fertilizer (Diammonium Phosphate (DAP) and UREA) depending on the land size allocated to tomato and the soil fertility status as perceived by the farmer while a few among them (18%) mixed inorganic and organic fertilizer (manure and compost). Moreover, the results indicated that, 53.9% of the farmers used DAP procured from market and 56.2% used UREA bought from agro input dealers while the organic fertilizer was procured from neighbors (10.94%) or fellow farmers (6.25%) (Appendix 2).

The survey results further revealed that majority of suppliers of chemical were private traders from market and fellow farmers shop. That is, about 68.8% of the farmers purchased insecticides from farmers shop while 31.2 % purchased from the market.

4.3.1.2 Producers

Tomato farmers were the primary actors in value chain and are dispersed. They decided what inputs to use and where to buy, when to sow and harvest, how much to sell, considering the available resource. The main activities that tomato farmers perform included land preparation/ploughing, nursery preparation, transplantation, fertiliser application, weed management, disease controlling, harvesting, post-harvest handling and finally marketing. The average land allocated for tomato production was 0.21 ha with the minimum of 0.013 ha and the maximum of 0.5 ha. The mean quantity of seed used is 0.27 kg. In land fertilization, farmers use the mean quantity of 21.17 kg and 18.48 Kg of DAP and UREA (Table 4). In the prevalence of diseases and insects, farmers used an average of

34.39 kg and 4.29 liters of insecticides. The average quantity of tomato produced by sampled farmers was 6254.37 kg per farmer per season.

Table 4: Land allocation, inputs used and production of tomato by sample household

Variables	Mean	Minimum	Maximum	S.E.
Land (Ha)	0.20	0.013	0.5	0.12
Input (Kg)				
Seeds (Kg)	0.27	0.12	1	0.16
DAP (Kg)	21.77	3	50	12.46
UREA (Kg)	18.43	2	50	11.94
Manure (Kg)				
Insecticides(Kg)	34.39	0	91	19.50
Insecticides(Liters)	4.29	0	35	3.85
Quantity produced (Kg)	6254.37	360	16800	3916.55

4.3.1.3 Rural assemblers

Rural assemblers whose trading activities include buying and assembling, packing and selling to retailers and wholesalers in rural area are independent actors who assemble tomato from farmers. Their major sales outlets are retailers. The majority of assemblers are male with an average of 37 years of age. About 40% of assemblers have the primary level education and only 20% completed secondary education.

Table 5: Description of assemblers

Variables	Rural Assemblers (n=5)	
	Mean	Std.
Age (years)	37	4.39
Household size (numbers)	7.2	1.30
Variables	Freq.	%
Sex		
Female	0	0
Male	5	100
Education level		
No formal education	0	0
Primary	2	40
Secondary	3	40
Certificate of secondary education	1	20
University	0	0

4.3.1.4 Urban commission agents

Urban commission agents acted as wholesalers in urban area; they sold tomato for a commission on behalf of the farmers whom they represent and did not themselves take the title of the producer. Most farmers who sold tomato in town (urban area) passed through urban commission agents. Those commission agents do not enter into written legal contracts, rather they made verbal agreement with farmers based on mutual understanding and trust. The commission agents received commissions in respect of service delivered and percentage of quantity sold. No further amounts shall be payable by the farmers in case of losses. The price was set by market and the agent was not allowed to sell the product at less than such market price unless it had first been authorized by the respective farmers and the transactions were made by cash. The money obtained from the sales transaction is transferred to the respective farmers through the bank or mobile financial services such as Ecocash or Lumicash.

4.3.1.5 Wholesalers

Wholesalers were traders who mostly purchase tomato directly from farmers or from urban commission agents and sold them to retailers in the village and in the urban market. The results reveal that majority of the sampled wholesalers were male with 88.9 %. Female wholesalers were confined in urban areas and they represented only 18.2 % while their counterparts were 81.8 % and were found in both rural and urban areas (Table 6).

There are a few urban wholesalers who buy tomato from producers or rural assemblers and sell the same in urban areas because they spare their time and money at the same time reducing the cost of transport in the marketing channel. From the survey, only 27.8% of wholesalers bought tomato from producers while 55.6% of them bought from urban commission agents. Furthermore, a large party of sampled wholesalers were educated:

According to the finding, about 66.7% and 22.2% received primary and secondary education respectively. The mean experience was 4.28 years with 4.29 years in rural area and 4.27 years in urban area.

Table 6: Description of wholesalers

Variables	Rural Wholesalers (n=7)		Urban wholesalers (n= 11)		Total sample	
	Mean	Std.	Mean	Std.	Mean	Std.
Age	43.43	6.024	40.27	11	41.5	6.828
Experience	4.29	0.756	4.27	1.794	4.28	1.447
Hsize	6.14	1.574	4.73	2.005	5.28	1.934
Variables	Freq.	%	Freq.	%	Freq.	%
Sex						
Female	0	0	2	18.2	2	11.1
Male	7	100	9	81.8	16	88.9
Education level						
Primary	5	71.4	7	63.6	12	66.7
Secondary	2	28.6	2	18.2	4	22.2
Certificate	0	0	2	18.2	2	11.1
Source of tomato	7					
Farmers	4	57.1	1	9.1	5	27.8
Rural assemblers	3	42.9	0	0	3	16.17
urban commission agents	0	0	10	90.9	7	55.6

4.3.1.6 Retailers

There is a large number of retailers in the tomato market with small businesses, selling small quantities of products. Retailing in tomato products is mainly undertaken by women (over 88 % of retailers are women). These findings are consistent with the FAO (2009) report, indicating that trading of agricultural products in developing countries is particularly dominated by females, giving the example of South Africa where women represent 53 percent of the actors involved in the trading of horticulture products.

District retailers (rural) do buy tomato either from farmers, assemblers or wholesalers at the district level while urban retailers do buy from urban commission agents and wholesalers and sell to urban consumers. During the market visit, it was observed that

retailers keep small amount of tomato because of lack of adequate storage facilities. Consumers usually buy the product from retailers who offer according to requirement and purchasing power of the buyers.

The mean ages of sampled retailers were 38 years old and with an average of the mean age of 37 years old in rural and urban area. Furthermore, the retailers sampled had attained basic education. The results show that 62.5% of total retailers interviewed attained primary education while 37.5% attained secondary education (Table 7). No one in both urban and retailers sampled completed secondary education. According to the findings, the mean years of experience in tomato trading were 4.9 years in rural area and 3.56 in urban area. Similarly, the most important source of tomato sold came from rural urban wholesalers (38.5%) followed by farmers (23.1%) and urban commission agents (23.1%).

Table 7: Description of retailers

Variables	Rural Retailers (n=10)		Urban Retailers (n=16)		Total sample	
	Mean	Std.	Mean	Std.	Mean	Std.
Age	37.10	8.958	37.37	6.52	37.88	7.202
Experience	4.90	1.853	3.56	1.548	4.08	1.765
Variables	Freq.	%	Freq.	%	Freq.	%
Sex						
Female	7	70	16	100	23	88.5
Male	3	30	0	0	3	11.5
Education level						
Primary	10	100	10	62.5	20	76.9
Secondary	0	0	6	37.5	6	23.1
Source of tomato						
Farmers	6	60	0	0	8	23.1
Rural wholesalers	2	20	0	0	2	7.7
Rural assemblers	2	20		0	0	7.7
Urban wholesalers	0	0	10	62.5	10	38.5
Urban commission agents	0	0	6	37.5	6	23.1

4.3.1.7 Consumers

Consumers are the final purchasers of tomato products who mostly buy tomato for consumption purpose. Tomato is consumed at district level and outside the district in both rural and urban areas. Consumers purchase from different marketers along the chain based on the quantity desirable for them. The results in Table 8 show that the large quantity of tomato consumed is from retailers with 28.6% and 38.1% from rural retailers and urban retailers respectively. This is due to the lack of storage of most consumers that lead them to buy small quantity to avoid the deterioration.

As it is indicated in Table 8, the majority (76.2%) of final buyers of tomato are females. This is common since females are the ones who are mostly involved in the purchase and preparation of tomato. The respondent consumers are adults of mean ages of 44.33 years in rural area and 44.45 years in urban area. The average family size of the buyers is 7.8 persons in rural areas and 5.58 persons in urban areas.

Table 8: Description of consumers

Variables	Rural consumers (n=9)		Urban consumers (n= 12)		Total sample	
	Mean	Std.	Mean	Std.	Mean	Std.
Age	43.33	8.37	44.5	8.36	44.45	10.72
Hsize	7.8	2.67	5.58	1.24	6.57	2.25
Variables	Freq.	%	Freq.	%	Freq.	%
Sex						
Female	7	77.8	9	75	16	76.2
Male	2	22.2	3	25	5	23.8
Education level						
Non educated	3	33.3	0	0	3	14.3
Primary	3	22.2	4	33.3	6	28.6
Secondary	3	22.2	2	16.7	4	33.3
Certificate	1	11.1	4	33.3	5	23.8
University	1	11.1	2	16.7	3	14.3
Source of tomato						
Farmers	1	11.1	0	0	1	4.8
Wholesalers	2	22.2	2	16.7	2	19
Rural retails	6	66.7	0	0	7	28.6
Urban retailers	0	0	8	66.7	8	38.1
urban commission agents	0	0	2	16.7	2	9.5

4.3.1.8 Institutional support services

Among the relevant services for supporting tomato value chain development in the study area include extension services and financial institutions. Agricultural offices at district level provided agricultural extension services, train tomato farmers, advise on tomato cultivation and management of agronomic practices. Extension services are responsible for technology development for farmers to improve their productivity. However, from the survey, it was observed that the farmers who got access to the extension services were few with only 21.88 percent of the total number of interviewed farmers.

Accordingly, private financial institutions offer their expertise on financial issues, micro-credit implementation and promotion. However, given the insecurity created by civil wars, services such as micro-credit are not quite remarkable on the ground. Only 3.9% of the farmers interviewed recognized receiving micro-credit from the cooperative of savings and credit (COOPEC). Also, it has been observed that there is no support from finance departments in tomato marketing at the district level.

4.3.2 Mapping and characterising the structure and relationship among actors

Subsector mapping was used to map and characterise the relationship among the value chain actors in order to understand the sequence of activities and the key actors and relationships existed among them. Figure 3 provides an overview of six strands of tomato value chain, each with different end markets. Using the logical sequence of activities in the chain as described by different interviewed individuals, the different strands of tomato value chains identified in the study area is represented below.

4.3.2.1 Strand 1: Farmers→ consumers

This strand is the shortest of all strands along the tomato value chain identified during the survey in study area. Consumers buy tomato from farmers and those work as retailers in

the rural market mostly in period of low supply. It represented 0.86 % of total tomato marketed in the whole chain which amounted to 6 720 Kg per season. However, the selling and buying of tomato in this strand is made based on the negotiations on the price and volume directly at the market. The average price of this strand was 562.5 BIF per Kg.

4.3.2.2 Strand 2: Farmers → retailers → consumers

In this strand, farmers sell their product direct to retailers and retailers resell directly to the end consumers. The retailers who bought tomato from the farmers are the local retailers (they buy and sell in Rugombo) and restaurant. This strand represent 3.58 % of the total tomato sold with 28 000 Kg per season at an average price of 568.75 BIF per Kg. The transaction in this strand depends on network relationships between actors and sellers and buyers.

4.3.2.3 Strand 3: Farmers →rural assemblers→ wholesalers /rural retailers → consumers

Rural assemblers bought tomato from farmers and then sold to the wholesalers (urban and rural) and rural retailers. This stand represents 14.04% which accounted 109 739 Kg of total tomato marketed during the survey period at an average price of 584.375 BIF per Kg. The channel was found to be the second less important marketing in terms of actors involved. The transaction in this stand depend on the network relationship with producers (credit, cash or contract). For those who purchase tomato by contract, the transaction is made by credit and they pay after sale. Most of the farmers who sell tomato by contract to rural assemblers do it during the high supply period the fair to miss market.

4.3.2.4 Strand 4: Farmers → urban wholesalers→ retailers/ consumers

In this strand, farmers sell their product to the urban wholesalers who transport their product to the urban markets (Bujumbura City market and Ngagara market) and sell them

to various retailers and consumers. In Rugombo market, for instance, it is not common for wholesalers to sell their product to consumers. About 7.17 % of total tomato marketed is accounted to be sold in this strand with 56 000 Kg at an average price of 584.375 BIF per Kg. The exchange of product in this strand is made by negotiation and agreement between the two parties and it was observed from the survey that this strand operates in regular market.

4.3.2.5 Strand 5: Farmers → rural wholesalers→ rural retailers→ consumers

This strand represents rural wholesalers who buy tomato direct from farmers and sell them to rural retailers. It represents 4.27% of total marketed volume of tomato with 33 340 Kg at 500 BIF per Kg in average. During the survey, it was observed that the strand operates in regular market and the transaction is made according the agreement between actors (either by cash or Credit).

4.3.2.6 Strand 6: Farmers → urban commission agents → wholesalers/ retailers/ consumers

This is the largest and most regular important strand accounting for 70.08 % of total marketed volume of tomato with 547 660 Kg at 652.61 BIF per Kg. In this strand, farmers sold their tomato in the urban market through commission agents who worked on their behalf. Most of traders (wholesalers and retailers) who bought tomato from urban commission agents came from different urban markets. Similarly, there were also some consumers who supplied from those agents and were often those who have mean of storage facility. The exchange was mostly based on the spot market transaction as well as price market situation with high price during the shortage of product and low price when there is oversupply.

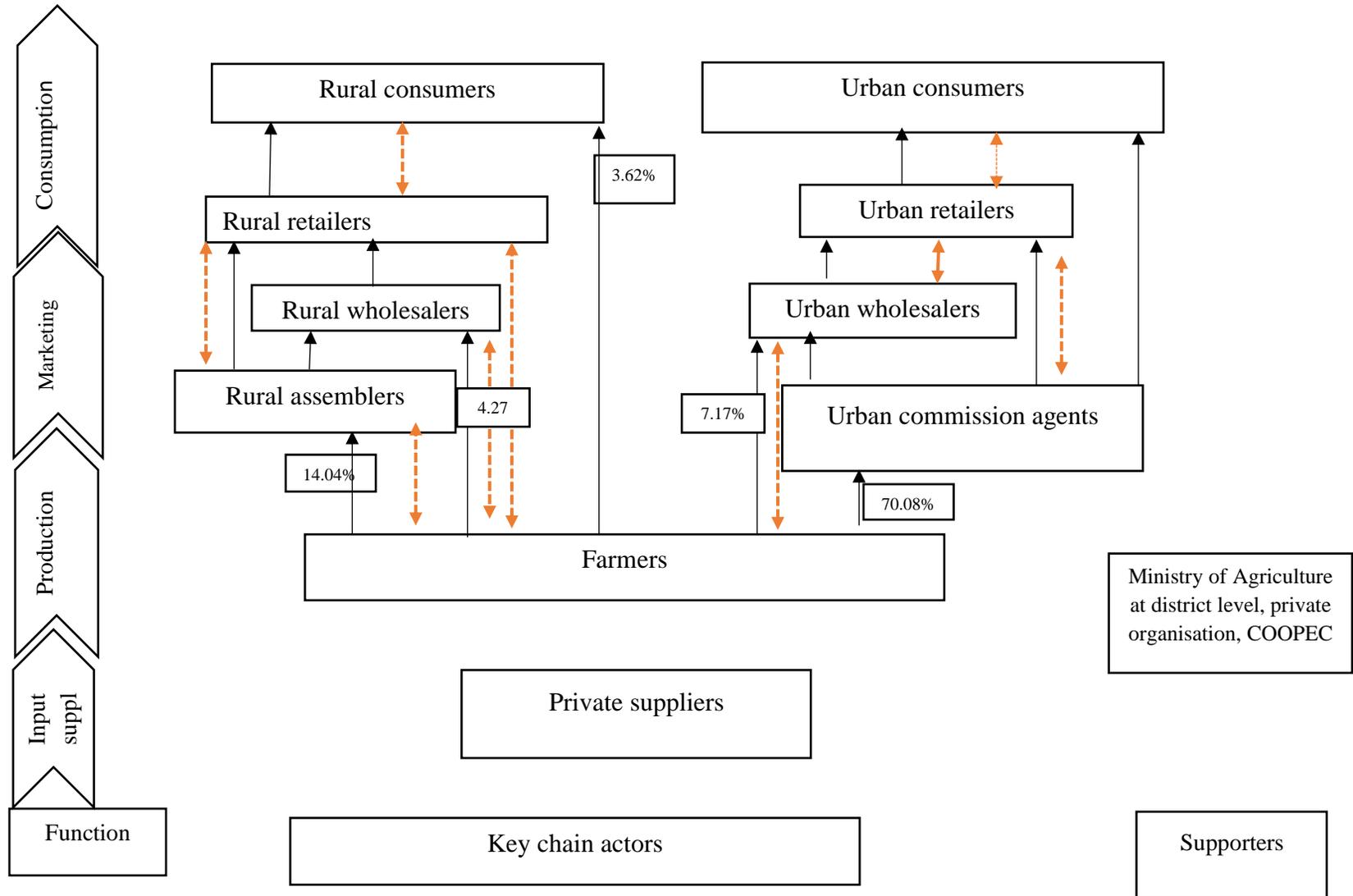


Figure 3: Value chain mapping

Legend: —▶ : Flow of product

◄---▶ : Flow of information

4.4 Value Chain Linkages

Horizontal linkage along tomato value chain was found to be weak and informally in the study area. For instance, only 35% of farmers were found to be members of farmers' organizations which aimed at helping them to access market information. However, the survey results indicate that farmers' tomato production and marketing were being handled individually and even some farmers regarded those organisations as non-important and time consuming with little benefit. Also, with regards to bargaining power, it is evident from the field study that the lack of valuable storage facilities minimize the bargaining power of farmers and forces them to sell their product at the price offered by traders. Consequently, they hardly negotiate the price due to fear of post-harvest loss, in case the product is not sold.

Furthermore, the vertical linkage among actors in different stages are critical for moving a product. The findings of the study show that the actors are linked through buying and selling relationships. For instance, tomato producers in Rugombo district network through telephone communication with commission agents and wholesalers in urban towns. These actors exchange information on tomato prices, local supply situations and demand on destination markets. Then, they agree on the price at which the buyer is willing to take and the urban commission agents determine the farmers' price taking into account profit margins.

Furthermore, it was observed during the survey that farmers had informal contract without lawyer assistance with their traders. For instance, only 1.6% of farmers sold their product by contract due to the fact that they were afraid to miss the market to sell their products after harvest. In general, the linkage relationship among actors in the study area was characterized by low coordination among the value chain actors in information exchange

and knowledge transfer and non-involvement in changing the rules and regulations that was exercised in the study area.

4.5 Prices and Marketing Margins Realized by Value Chain Actors

4.5.1 Selling prices comparison along tomato value chain

From the results, the price differs according to the market chain level and this has influence on the marketing margin. To test if the variability of price was statically different among tomato value chain actors, analysis of variance (ANOVA) was done. The test results indicate that, the difference of mean selling price among actors was significant at 0.05 level. Furthermore, the Post Hoc test of pair-wise group comparison revealed that the mean selling price differed significantly among all actors (farmers and wholesalers price, farmers and retailers price, farmers and assemblers price and wholesalers and retailers) along the chain at $p < 0.05$.

Table 9: Comparison of selling prices along the tomato value chain

Actors	Mean Price Difference	Sig.
Farmers Vs Wholesalers	179*	0.000
Farmers Vs rural assemblers	43.2*	0.012
Famers Vs Retailers	635.89*	0.000
Rural assemblers Vs wholesalers	136*	0.000
Rural assemblers Vs retailers	679.09*	0.000
Wholesalers Vs Retailers	499.89*	0.000

F- Value=123.601, * significant at 0.05 level

4.5.2 Marketing margin realized by the value chain actors

Determination of Marketing Margin is based on the price (payment) received or selling price. The findings as presented in Table 10 show that retailers received the largest gross marketing margin (469.2 BIF/Kg) followed by rural assemblers (107.33 BIF/Kg) and last by wholesalers (100.56 BIF/Kg). The margin shares among the value chain actors were 16.16% for rural assemblers, 12.57% for wholesalers, 36.32% for retailers and 34.95% for farmers. The large gross margin share of retailers is due to lower cost they incur in the marketing.

Table 10: Marketing margins distribution along tomato value chain

Actors chain	Average selling price (BIF/kg)	Average buying price(BIF/kg)	Marketing Margin (BIF/kg)	Margin Share %
Farmers (n= 128)	620.8	-	-	34.95
Rural assemblers (n=5)	664	556.67	107.33	16.16
Wholesalers (n=18)	800	699.44	100.56	12.57
Retailers (n=26)	1291.89	822.69	469.2	36.32

4.6 Profitability Analysis

4.6.1 Gross margin at farm level

The summary of results as presented in Table 11 shows gross margin of tomato per kg. Based on the survey data, the costs of production, transport, marketing as well as losses were used to estimate the gross margin. The mean gross margin of the farmers was 260.06 BIF per kg. The high cost incurred by farmers was the cost of production with an average of 1 001 482.21 BIF representing 58.20% of total cost incurred in tomato production and marketing. This is followed by transport cost of 411930.47 (19.49%), marketing cost of 11878.906 (10.65%) and cost of losses of 94128.91 (4.63 %). The high transport cost seem to be incurred by most of farmers who sell their products in the town market as they incurred product transport cost.

Table 11: Average cost of production and profitability of tomato (BIF/kg)

Variables	Gross margin
Average quantity sold(Kg)	6105.1484
Average selling price(BIF/kg)	620.8
Average quantity losses(Kg)	149.22
Revenue (BIF)	3791376.56
Variable Costs(BIF)	
Production cost	1101482.1
Transport cost	411930.47
Cost of information	11878.906
Marketing cost	335337.37
Cost losses	94128.91
Total variable Cost(BIF)	1954757.7
Gross Margin (BIF)	1836618.828
Gross Margin (BIF/kg)	260.06

4.6.2 Gross margin at trading level

4.6.2.1 Gross margin at rural assembler's level

Table 12 shows the cost and gross margin at the rural assembler level. The study shows that the main cost of rural assemblers is the marketing cost of 30360 BIF. The mean gross margin is 74.44 BIF per kg sold at assembler level.

Table 12: Gross margin at rural assembler's level

Variables	Gross margin
Quantity sold(kg)	1518
Average purchasing price(BIF/ Kg)	597.67
Selling price(BIF/kg)	664
Revenue(BIF)	1 003 140
Variable costs(BIF)	
Buying tomato	845 020
Transport cost	12 520
Cost of information	5100
Marketing cost	30 360
Total variable Cost(BIF)	893 000
Gross Margin (BIF)	110 140
Gross Margin (BIF/kg)	74.44

4.6.2.2 Gross margin at wholesaling level

The results as presented in Table 13 show the average gross margin at wholesalers' level. The results reveal that tomato wholesalers operating in rural area earn low mean gross margin compared to the urban wholesalers with 29.72 BIF per kg for rural wholesalers and 86.99 BIF per kg for urban wholesalers.

Cost incurred in marketing and transport cost were observed to be high in urban than rural area. This is explained by the fact that most of urban wholesalers travel long distance to reach urban market thus cost of transport. During the transportation of tomato, losses were observed to be high from urban wholesalers because of the transportation from rural to urban. These findings imply that the gross margins were related to the prices from the

producer to the market, mainly due to the increase of transport costs as the produce was moved from producers to the market place.

Table 13: Gross margin at wholesaler's level

Description	Rural	Urban	Total
Average quantity sold(kg)	855.72	5029.55	3406.39
Average purchasing price (BIF/Kg)	634.28	740.91	699.44
Average selling price (BIF/ kg)	701.42	862.73	800
Revenue(BIF)	615 392.86	4 390 136.36	2 846 488.89
Variable Costs(BIF)			
Buying tomato	557 000	3 781 340.91	2 527 430.56
Cost of transport	8528.57143	113 690.909	72 794.44
Cost of information	571.43	4818.18	8989.145
Cost of marketing	6657.143	13 254.55	10 688.89
Cost losses	16 828.57	35 022.73	32 052.78
Tot variables costs(BIF)	589 585.71	3 948 127.27	2 642 027.78
Profit margin(BIF)	25 807.14	442 009.09	280 152.78
Profit per kg(BIF/kg)	29.72	86.99	64.72

4.6.2.3 Retailers' gross margin

The findings from the analysis of the profit margin received by retailers in urban and rural area is shown in Table 14 and which reveal that, retailers at urban market received highest gross margin per kg (408.48BIF per Kg) than rural retailers (153.71 BIF per Kg). The variable cost of selling tomato are transport cost, communication cost (price information), market cost. Since most of rural farmers purchase tomato directly from producers, the buying prices are relatively low than urban retailers.

Table 14: Retailers' gross margin

Description	Rural (n=10)	Urban(n=16)	Total(n=26)
Average quantity sold(kg)	601.77	797.08	
Average purchasing price(BIF/ Kg)	776.36	996.98	822.69
Average selling price/Kg	862.51	1522.04	1291.89
Average quantity losses (Kg)	14.77	52.85	36.74
Revenue(BIF)	599 953.12	1 175 014.13	941 076.156
Variables costs(BIF)			
Buying tomato	470 000	683 200	593 000
Cost of transport(BIF)	6945.45	22 600	15 976.92
Cost of information	4363	3046.67	3603.85
Cost of marketing(BIF)	10000	19 666.67	15 576.92
Cost of losses(BIF)	16 148.76	80 563.57	53 311.15
Tot variable costs	449 143.636	841 259.598	681 468.84
Gross margin(BIF)	92 495.27	365 937.22	258 389.806
Gross per kg(BIF/kg)	153.71	408.48	312.58

4.6.3 Comparison of gross margin between actors along the tomato value chain

Table 15 shows the comparison of the gross margin by farmers, urban and rural traders along the chain. Independent t-test was carried out to find whether the variations of gross margin earned along tomato chain between different groups were statistically significant. The results reveal that the variation in gross margin among actors along the chain is statistically significant at $p < 0.05$ level with F- value 18.024. The findings show that the difference in gross margin received farmers and wholesalers, farmers and rural assemblers, rural assemblers and retailers, wholesalers and retailers' gross margin was statistically significant at 0.05. Therefore, there is no significant difference in gross margin between farmers and retailers' profit, rural assemblers and wholesalers' profit.

Table 15: Comparison of mean gross difference along the chain

Actors	Mean Gross Margin Difference(BIF/Kg)	Sig.
Farmers Vs wholesalers	195.34	0.000*
Farmers Vs rural assemblers	185.62	0.001*
Farmers Vs retailers	52.51	0.664
Rural assemblers Vs wholesalers	9.72	0.997
Rural assemblers Vs retailers	238.13	0.000*
Wholesalers Vs retailers	247.86	0.000*

F- Value= 18.024 , * the mean difference is significant at 0.05 level

4.7 Econometrics Results

4.7.1 Statistical test

Regression analysis was used to assess the socio economic characteristics that influence the profitability of tomato at the farm level. The dependent variable was profit margin and the independent variables were sex, education level of education, household size, land under tomato production, membership of organization, experience, income from others crops, access to market information, access to credit, location of the producer to the market, and contact with extension agents.

The regression parameters were estimated by multiple linear regression model method. The existence of multi- collinearity was checked by calculating the Variance Inflation Factor (VIF). The results show that there is no multi-collinearity among included variables as VIF of each predictor was less than 10 (Table 4 in appendix). For heteroscedasticity test, there was presence of heteroscedasticity in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. Robust OLS analysis with heteroscedasticity consistent was estimated to overcome that problem.

4.7.2 Factors influencing profitability at farm level

Table 16 presents the factors that influence the profitability of tomato at farmer level in the district and were statistically significant $p < 0.05$ and $p < 0.1$ with F value of 25.3. The results indicate 67.9% of the variation of the regression model is explained by factors hypothesized to have an effect on farmers' gross margin while 32.1 % was due to variables not included in the model as indicated by the R^2 value. The estimated F statistic is significant at 1 percent level indicating that the model is adequate for the use in further analysis.

The findings indicate that out of eleven coefficient only four variables namely education level of household head, land under tomato production, experience and member of organisation were statistically significant at 1% and 5% level. The four variables were found to influence tomato profit at farmer's level. This implies that farmers mean profit margin increase with an increase in the magnitude indicated by their respective coefficients all else being equal.

Table 16: Regression Results for tomato farmer in Rugombo District (n=128)

Variables	Coefficient	Robust S.E.	Expected Sign	p-value
Constant	5.176	0.49		0.000
Sex	0.026	0.642	-ve / +ve	0.680
Education level	0.134	0.474	+ve	0.006**
Family size	0.021	0.048	+ve	0.663
Land under tomato cultivation	0.153	0.057	+ve	0.008*
Member of organization	0.176	0.066	+ve	0.009**
Experience	0.191	0.061	+ve	0.002*
Income from others crops	-0.014	0.034	-ve	0.672
Market information	0.18	0.14	+ve	0.181
Access to credit	0.03	0.08	+ve	0.672
Distance to market	0.035	0.038	-ve	0.358
Extension contact	0.03	0.082	+ve	0.672

** and *denote the statistical significance at 5% and 1% level, respectively.

Education level shows a positive and significant effect on tomato profit with significance level at 5%. Apparently, if tomato farmers are educated, the mean amount of profit increases by 0.134 BIF per kg other factors remaining constant. This is also in line with previous study conducted by Xaba and Masuku (2013) found education level affected significantly and positively profitability of vegetables in Swaziland.

Land under tomato production was found positive and statistically significant at 1% level with expected. The positive sign of coefficient implies that the larger the land size allocated for tomato production the larger the quantity produce and thereby increase the

profit. Increase in the land under tomato production by one hector increase the profit of tomato per kg by 0.153 BIF others factors keeping constant. Similarly, Ayoola (2014) found that the farm size influences tomato profit positively and significantly.

Farming experience has significant effect on farmers' profit with expected positive sign at 1 % significant level. On average, if tomato farmers increase one year in experience, the amount of tomato profit increase by 0.043 BIF per kg per season if other factors remain constant. The finding are similar to the study of Ebarle *et al.* (2015) who found a significant and positive effect on vegetable profit.

With regard to organisation membership, the results show that being a member of organisation has significant effect on farmers' profit with expected positive sign at 0.05 significant level. The positive sign of coefficient implies that, if tomato farmers is a member of organisation, the mean amount of tomato profit increase by 0.043 BIF per kg per season if other factors remain constant. This means that social groups play an important role in facilitating exchanges of information and ideas on the marketing of tomato.

4.8 Constraints of Tomato Production and Marketing

The nature of tomato value chain activities in the study area suggests that the chain faces a number of constraints herein presented as production and marketing constraints of tomato value chain.

4.8.1 Production constraints of tomato value chain

The most tomato production problems in the study area for 128 farmers are disease and insects, shortage and high price of inputs, product perishability, lack of infrastructure, inadequate market, inadequate training and extension services, price fluctuation and

uncertainty, high transport cost, individual marketing and inadequate financial services (Table 17).

Control of diseases and insect is mentioned by a proportion of 88.3%. Uncontrolled diseases and insect result in low productivity. The most important inputs for tomato production are improved seeds, fertilizers and insecticides. About 93% of farmers experience low supply of inputs like improved seeds. This is mainly caused by the lack of seed production enterprise rendering farmers' input sources to be highly informal. Also, there is shortage of fertilizers subsidy by government leading to high price of fertilizers from private traders. Apparently, 96.4 % of farmers faced the tomato perishability and did not have adequate market for the product. They did not have access to storage facilities (100%) for the product. If farmers can have access to other market channels such as chain stores, processing industry and export market, they can earn more profit.

Table 17: Tomato production and marketing constraints at farm level

Constraints	Frequency (n=128)	%
Production constraints		
Lack of storage	128	100
Individual marketing	127	99.8
Product perishability	124	96.4
Inadequate financial services	119	93
Shortage of inputs and high price	119	93
Inadequate market	116	90.6
Price fluctuation and uncertainty	116	90.6
Diseases and insects	113	88.3
Inadequate training and extension services	113	88.3
High transport cost	98	80

Furthermore, farmers produce tomato when everyone else is producing as they do not have any unit of transformation and storages. Therefore, they end up selling at low price because they do not have postharvest handling technologies.

Price fluctuation and uncertainty is also one of the problem faced by farmers in the study area. About 90.6% of the sampled farmers considered price fluctuation and low price as their marketing problem (Table 17). More than 88.3 % of farmers did not access to adequate training and extension services. Farmer's inadequate knowledge and skills lead to poor production techniques. In addition, inadequate finance leads farmers to acquire inadequate inputs.

4.8.2 Traders constraints of tomato value chain

The problems identified by traders in the value chain are summarized in Table 18. Accordingly, lack of value chain supporters and storage were pointed as the main problem they face (100%) followed by high transport cost (92.85%), lack of finance (91.43%), supply shortage (74.28%), administrative problem (62.85%) and price fluctuation (50%).

Table 18: Traders constraints

Marketing Constraints	Frequency(n=70)	%
Lack of value chain supporters	70	100
Lack of storages	70	100
High transport cost	65	92.85
Lack of finance	64	91.43
Shortage of supply	52	74.28
Administrative problem(tax)	44	62.85
Price fluctuation	37	50

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary and Conclusion

The study aimed at analyzing tomato value Rugombo District. Moreover, the study intended to achieve the following specific objectives: (i) To map and characterize the structure of value chains actors along the tomato chain in study area, (ii) To determine profit and profit distribution among actors along the tomato chain; and (iii) To determine socio-economic and institutional factors influencing the profitability of tomato at farm level.

Different analytical techniques were used to address the objectives. The first objective (to map and characterize the structure of value chains actors along the tomato chain in study area) were analysed used descriptive statistics and value chain mapping approach. Gross margin and marketing margin analysis were used to estimate profit and profit distribution among actors along the tomato chain. To analyse the factors influencing the profitability of tomato at farm level, the multiple linear digression model was used.

Finding in this research reveals that, producers, input suppliers, rural assemblers, wholesalers, retailers, consumers and support services were the main actors of the tomato value chain. The actors operation constitute six strands of tomato value. Out of the six strands, it was found that the strand with farmers who sell tomato in the town markets through urban commission agents dominate the concentration of the chain with 70.08 % of total tomato sold in the chain. In addition, the tomato value chain is characterized by the lack of value addition, weak horizontal and vertical coordination among actors in the chain.

The difference in market prices along the chain was found to be statistically significant. Retailers were found to enjoy high market margin (36.2%), followed by farmers (34.95%), rural assembler (16.16%) and finally wholesalers (12.57%).

As for the profit margin distribution along the chain, urban retailers obtain highest gross margin along the chain with 408.48BIF per kg followed by farmers with 309.484 BIF per kg per season. The rural retailers gain 153.71 BIF per kg while in urban area wholesalers gain 86.99 BIF per kg of sold tomato. The lowest gross margin is observed at the rural wholesalers and rural assemblers' levels with 29.72 BUF per kg and 74.44 BIF per kg respectively. The findings in the research indicate that the variation in the mean gross margin was statistically significant at $p < 0.05$ in different actors along the chain. It was hypothesized that there is no significant variation in profit among the various actors in the tomato value chain. Apparently, we fail to reject the null hypothesis because the profit obtain by the rural wholesalers and assemblers was low along the chain.

The results of multiple regression model indicates that education level of household head, land under tomato production, member of organisation and farming experience variables were positively and significantly affected the profit of tomato farmers while the variables sex, income from other crops, access credit, distance to market, extension service, market information and family size were found none significant on profit. Therefore those variables do not have an impact on profit margin of tomato in study area.

The overall tomato value chain is constrained by number of production and marketing factors which include lack of storage, individual marketing, product perishability, inadequate finance, shortage of inputs and high price, inadequate market, price fluctuation and uncertainty, inadequate training and extension services, diseases and insects, high

transport cost, lack of value chain supporters and administrative problem (tax, government support).

5.2 Recommendations

To upgrade actors' activities along the tomato value chain in Rugombo, the following are recommendations from this study:

First of all, the study observed that the major source of tomato seed was private traders; there were no formal seed multiplication enterprise or organized government organization that supply quality seed to farmers in the study area. Therefore, the value chain supporters should promote and encourage the production and dissemination of quality seed systems in tomato sector.

Also, government should strengthen the provision of training on proper management of crops including controlling of diseases and insects, growing varieties capable of resisting insect/ pest and disease and harvesting and post harvesting practices as an important component in tomato sector development.

Moreover, formal or informal institutional arrangements at farm and trader level should be encouraged through which farmers and traders can collectively access different markets that are offering good prices like cooperatives. Strengthening primary cooperatives financially, with different facilities and skills on cooperative management can be one way to improve tomato sector since these cooperatives can supply inputs and finally purchase the product for sale to distant areas at premium price to benefit the respective farmers. In addition, tomato producers' co-operative societies should be formed for the better performance and achievement.

To improve the tomato marketing system immediately, the government should establish processing unit. This will not only reduce postharvest losses and raise income of producers but also help in providing greater satisfaction to the consumer and minimize the price fluctuation. Also, storage facility should also be provided in different market to improve the overall marketing system. Proper transportation facilities should be provided to transport tomato to the market.

Finally, Government should encourage partnership between researches institutions, agricultural universities, NGO's and private industries to address constraints and link vegetable farmers to markets.

REFERENCES

- ADISCO, Appui au Développement Intégral et à la Solidarité des Collines (2012). La commercialisation des produits agricoles (Marketing of Agricultural Product). 32pp. [http://www.laboress-afrique.org/ressources/assets/docP/Document_N0862.pdf] site visited on 12/11/2017.
- Arah, I. K. (2015). Diversity and Development An overview of post-harvest challenges facing tomato production in Africa. African Studies Association of Australasia and the Pacific (AFSAAP) 37th Annual Conference, Dunedin – New Zealand, 25-26 November 2014.
- Arthur, H., Loris, S. and William, F. (2001). What is the Difference between Productivity and Profit? Economics Branch, Dept. of Natural Resources and Environment. [<https://nla.gov.au/nla.cat-vn1523968>] site visited on 09/06/2018.
- Attaie, H. and Fourcadet, O. (2003). *Guidelines for Value Chain Analysis in the Agri-Food Sector of Transitional and Developing Economies ESSEC*. Business School France, MBA in international Agri-Food Management. Food Agriculture Organisation of the United Nations (FAO). 80pp.
- Ayoola, B. J. (2014). Comparative economic analysis of tomato (*Lycopersicon esculenta*) under irrigation and rainfed systems in selected local government areas of Kogi and Benue States, Nigeria. *Journal of Development and Agricultural Economics* 6(11): 466-471.

- Bamber, P. and Gereffi, G. (2014). Burundi in the Agribusiness Global Value Chain: Skills for Private Sector Development. 91pp. [<https://www.researchgate.net/publication/265333130>] site visited on 12/2/2018.
- Bidogeza, J. C., Sefa, A., Endamana, D., Tenkouano, A. and Kane, G. Q. (2016). Value chain analysis of vegetables in the humid tropics of Cameroon. The 5th African Association of Agricultural Economists Conference, Addis Ababa, Ethiopia. [<http://www.aaae2016.org/>] site visited on 2/3/2018.
- Brown, G. W. (2009). Value chains, value streams, value nets, and value delivery chains. *Business Process Trends* 2009; 1-12.
- Bryman, A., Bell, E., Hirschsohn, P., Dos Santos, A., Du Toit, J., Van Aardt, I. and Wagner, C. (2014). *Research Methodology – business and Management Contexts*. Oxford University Press, Cape Town. 424pp.
- Cathelijne, V. M., Ousmane, C. and Kerstin, H. (2007). Agricultural Value Chain Development in West Africa - Methodological framework and case study of Mango in Benin. AAAE Conference Proceedings. pp 49-52.
- Chagomoka, T., Drescher, A., Glaser, R., Marschner, B., Schlesinger, J. and Nyandoro J. G. (2015). Vegetable production, consumption and its contribution to diets along the urban - rural continuum in northern Ghana. *African Journal of Food Agricultural Nutrition and Development* 15(4): 10353-10367.
- Chagomoka, T., Sefa, A. V. and Pitoro, R. (2014). Value Chain Analysis of Traditional Vegetables from Malawi and Mozambique. *International Food and Agribusiness Management Review* 17(4): 59-86.

- Cunningham, D. C. (2001). The distribution and extent of agrifood chain management research in the public domain *Supply Chain Management: An International Journal* 6(5): 212-215.
- Daniel, B. (2015). Economic analysis of Irish potato value chain in Njombe urban and Wanging'ombe districts, Tanzania. Dissertation for Award of MSc Degree of Science in Agricultural and Applied Economics of Sokoine University of Agriculture. Morogoro, Tanzania. 100pp.
- Debello, M. J. (2007). Econometric analysis of horticultural production and marketing in Central and Eastern Ethiopia. A PhD Dissertation for Awards Degree of Doctorate at Wageningen University, Wageningen, the Netherlands. 120pp.
- Ebarle, E. J. N., Sarmiento, J. M. P., Aguinaldo, R. T., Concepcion, S. B., Montiflor, M. O, Real, R. R. and Bacus, R. H. (2015). Analysing the factors affecting the profitability of vegetable farmer clusters in Southern Philippines. *Acta Horticulture* 17(1103): 115-120.
- Faße, A., Grote, U. and Winter, E. (2009). *Value Chain Analysis: Methodologies in the Context of Environment and Trade Research*. Discussion Paper No. 429. Gottfried Leibnitz University of Hannover, Institute for Environmental Economics and World Trade. 63pp.
- Food and Agriculture Organisation of the United Nations (FAO), (2009). *Agricultural Management, Marketing and Finance Service (AGSF)*. Rural Infrastructure and Agro-Industries Division. Rome. 73pp.

- Food and Agriculture Organisation of the United Nations (FAO), (2014). Cadre Stratégique pour le Développement de l'Horticulture au Burundi (Strategic Framework for Horticulture Development in Burundi). Ministère de l'agriculture et de l'élevage et la FAO. Burundi-Bujumbura. 100pp.
- Gereffi, G., Humphrey, J. and Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy* 12(1): 78-104.
- Gujarati, D. N. (2004). *Basic Econometrics*. Fourth Edition. New York: McGraw-Hill. 1024pp.
- Hailu, A. (2016). Value chain analysis of vegetable: The case of Djere district, West Shoa zone, Oromia national region at state of Ethiopia. *International Food and Agribusiness Management Review* 17(4): 56-86.
- Hergert, M. and Morris, D. (1989). Accounting data for value chain analysis. *Journal of Strategic Management* 10(12): 175-188.
- Jaffee, S. (1995). *Transaction Costs, Risk and the Organization of Private Sector Food commodity systems. Marketing Africas High-Value Foods: Comparative Experiences of an Emergent Private Sector*. Dubuque. Kendall/Hunt Publishing Company. 502 pp.
- Jakpa, M. M. (2015). Value Chain and Economic Analysis of Honey Production in Nkwanta North and South Districts of the Volta Region. Dissertation for Award of MSc Degree of Philosophy in Agricultural Economics at Kwame Nkrumah University of Science and Technology. 113pp.

- Jeke, B. P. (2011). Analysis of tomato (*lycopersicon esculentum l.*) value chain and gross margins in Chipata district of Zambia. Dissertation of Award of MSc Degree of Science in Horticulture at University of Malawi. 116pp.
- Joosten, F., Dijkxhoorn, Y., Sertse, Y. and Ruben, R. (2015). *How does the Fruit and Vegetable Sector contribute to Food and Nutrition Security?* Wageningen, LEI Wageningen UR (University and Research Centre), LEI Nota 2015-076. 58 pp.
- Kahan, D. (2010). *Farm Business Analysis Using Benchmarking*. Food and Agricultural Organization of United Nations. Rome. 158pp.
- Kaplinsky, R. and Morris, M. (2000). *A Handbook for Value Chain Research*. International Development Research Centre, Ontario, Canada. 109pp.
- Karim, R. and Biswas, J. (2016). Value stream analysis of vegetable supply chain in Bangladesh: A case study. *International Journal of Managing Value and Supply Chains* 7(2): 41-60.
- Karuku, G. N., Kimenju, J. W. and Verplancke, H. (2016). Farmers' perspectives on factors limiting tomato production and yields in Kabete, Kiambu County, Kenya. *East African Agricultural and Forestry Journal* 82(1): 70-89.
- Kothari, C. R. (2008). *Research Methodology, Methods and Techniques* (2nd edition). New Age International Ltd., New Delhi, India. 417pp.
- Kula, O., Downing, J. and Field, M. (2006). Value chain programme to integrate competitiveness, economic growth and poverty reduction. *Small Enterprise Development* 17(2): 23-35.

- Kumar, A., Singha, H., Kumara, S. and Mittal, S. (2011). Value Chains of Agricultural Commodities and their Role in Food Security and Poverty Alleviation - A Synthesis. *Agricultural Economics Research Review* 24: 169-181.
- Kumi, E. (2017). Value chain analysis of tomato in the Kpone-Katamanso district of Ghana. Dissertation for the Award of MSc of Philosophy Degree in Agricultural Economics at University of Ghana. 110pp.
- Lusthaus, C., Adrien, M. H., Anderson, G., Carden, F. and Montalvan, G. P. (2002). *Organizational Assessment*. A framework for improving performance. Inter-American Development Bank Washington, D.C. International Development Research Centre Ottawa, Canada. 202pp.
- Mabuza, M. L., Ortmann, G. and Wale, E. (2014). Effects of transaction costs on mushroom producers' choice of marketing channels: implications for access to agricultural markets in Swaziland. *South African Journal of Economic and Management Science* 17(2): 01-13.
- Mango, N., Mapemba, L., Tchale, H., Makate, C., Dunjana, N. and Lundy, M. (2015): Comparative analysis of tomato value chain competitiveness in selected areas of Malawi and Mozambique. *Cogent Economics and Finance* 3(1): 1-15.
- Mason, C. H. and Perreault, W. D. (1991). Collinearity, Power, and Interpretation of Multiple Regression Analysis. *Journal of Marketing Research* 28(3): 268-280.

- Masunga, A. W. (2014). Assessment of socio-economic and institutional factors influencing tomato productivity amongst smallholder farmers: a case study of Musoma municipality, Tanzania. Dissertation for Award of MSc Degree of Science in Agricultural Education and Extension of Sokoine University of agriculture. Morogoro, Tanzania. 77pp.
- Mekonnen, G. (2015). Value chain analysis of cow milk: The Case of Laelay Maichew Woreda, Central Zone of Tigray, Ethiopia. Dissertation for Award of MSc Degree of Agribusiness and Value Chain Management at Aksum University. 112pp.
- Mendoza, G. (1995). Primer on marketing channels and margins. In: *Prices, Products and People Analyzing Agricultural Markets in Developing Countries*. (Edited by Scott, G. J.), Lyenne Reinner Publisher Ltd., New York. 424pp.
- Mitchell, J., Keane, J. and Coles, C. (2009). *Trading Up: How A Value Chain Approach Can Benefit The Rural Poor*. Overseas Development Institute: COPLA Global. 82pp.
- Monograph of Rugombo District (2006). Ministère de la Planification du Développement et de la Reconstruction Nationale. Programme d'appuis à la gouvernance, Cibitoke, Burundi. 92pp.
- Morris, M. J., Mvumi, B. M., Riwa, W. H. and Stathers, T. E. (2005). Post-harvest innovation to improve food security in Tanzania and Zimbabwe. In: *Proceedings on Learning Alliances for Scaling up Innovative Approaches*

in the Water and Sanitation Sector Workshop. 25 November 2004. Delft, Netherlands. 99pp.

Muiruri, M. P. D. (2015). Mapping of the honey value chain and analysis of changes in gender roles and factors influencing women empowerment among beekeepers in Kitui county, Kenya. Dissertation for Award of MSc of Science Degree in Agricultural and Applied Economics at Nairobi University. 102pp.

Niyongere, C., Mbonihankuye, C., Mutshail, G. and Yamuremye, A. (2015). *Utilisation of Pesticides in Smallholder Horticulture Production Pinpoints the Need for Cropping System Changes in Burundi*. Institute of Agronomic Sciences of Burundi. International Society for Horticulture Science (ISHS). pp213 - 220.

Osana, E. D. (2011). An analysis of the mango fruit in Embu. A Dissertation for Award Degree of Master of in Agricultural and Applied Economics of the Nairobi University. Nairobi, Kenya. 102pp.

Parvin, M. M. (2017). Farmer's profitability of tomato cultivation in the socio-economic context of Bangladesh: A study at Rangpur District. *International Journal of Applied Research* 3(6): 09-15.

Phatela, M. R. and Ajuruchukwu, O. (2015). An Analysis of Institutional Factors Influencing Vegetable Production amongst Small-Scale Farmers in six vegetable projects of the Nkonkobe Local Municipality. *Journal of Agricultural Science* 7(6): 184-196.

- Pietrobelli, C. and Saliola, F. (2008). Power relationships along the value chain: multinational firms, global buyers and performance of local suppliers. *Cambridge Journal of Economics* 32(6): 947-962.
- Porter, M. E. (1985). *Competitive Advantage Creating and Sustaining Superior Performance*. Free Press, New York. 570pp.
- Poulton, C., Kydd, J. and Doward, A. (2006). Overcoming Market Constraints on Pro-Poor Agricultural Growth in Sub-Saharan Africa. *Development Policy Review* 24(3): 243- 277.
- Rich, K. M., Baker, D., Negassa, A. and Ross, R. B. (2009). Concepts, applications, and extensions of value chain analysis to livestock systems in developing countries. Contributed paper prepared for presentation at the International Association of Agricultural Economics Conference, Beijing, China. August 16-22.
- Ruben, R., Boselie, D. and Lu, H. (2007). Vegetables procurement by Asian supermarkets:a transaction cost approach. *Supply Chain Management: An International Journal*, 12(1): 60–68.
- Sanogo, I. (2010). *Market Analysis Tool - How to Conduct A Food Commodity Value Chain Analysis. Working Report*. World Food Program and VAM food security analysis. 30pp.
- Scarborough, V. and Kydd, J. (1992). *Economic Analysis of Agricultural Markets: A Manual*. Chatham, UK: Natural Resources Institute, ODA. 166pp.

- Shepherd, A. W. (2007). *Approaches to Linking Producers to Markets: A Review of Experiences to Date*. Agricultural Management, Marketing and Finance Occasional Paper 13. Food and Agriculture Organization of the United Nations, Rome. 80pp.
- Sturgeon, T. J. (2008). *From commodity Chains to Value Chains: Interdisciplinary Theory Building in an Age of Globalisation*. Industry Studies Working Paper: No.2, Cambridge: Massachusetts Institute of Technology. 39pp.
- Sudman, S. (1976). *Applied Sampling*. New York: Academic Press, Inc. 422pp.
- Trienekens, J. H. (2011). Agricultural Value Chains in Developing Countries: A Framework for Analysis. *International Food and Agribusiness Management Review* 14(2): 51-82.
- UN, United Nations (2016). *Country Profile*. Economic Commission for Africa. 37pp.
- UNIDO, United Nations Industrial Development Organization (2009). *Agro-Value Chain Analysis and Development*. The UNIDO Approach. United Nations Industrial Development Organization, Vienna. 1-37pp.
- United Nations International Labor Organization, (2009). *Guide for Value Chain Analysis and Upgrading*. [<http://www.value-chains.org/dyn/bds/docs/detail/545/6>] site visited 12/04/2018.
- Van den Berg, M., Boomsma, M., Cucco, I., Cuna, L., Janssen, N., Moustier, P., Prota, L., Purcell, T., Smith, D. and van Wijk, S. (2009). *Making value chains work better for the poor: a tool book for practitioners of value chain*

analysis. Making markets work better for the poor (M4P).
[<https://www.msm.nl/resources/uploads/2014/05/MSM-WP2014-11.pdf>]
site visited on 10/04/2018.

Vision Burundi 2025 (2011). Ministry of Planning and Communal Development/
Forecasting, Unit United Nations Development Program in Burundi.
101pp.

Vyizigiro E. (2012). Vegetables growth in Burundi. [[https:// www. slideshare.net/
Vyizigiro/vegetables-growth-in-Burundi](https://www.slideshare.net/Vyizigiro/vegetables-growth-in-Burundi)] site visited on 4/2/2018.

Waziri, M. (2013). Cassava and sweet potato value chains in Mvomero and Kongwa
districts in Tanzania. A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of Master of Science in Agricultural
Economics of Sokoine University of Agriculture. Morogoro, Tanzania.
186 pp.

Wongnaa, C. A., Mensah, S. D., Ayogyam, A., Kyre, L. A. and Antony, Z. K. S. (2014).
Economic analysis of tomato marketing in Ashanti region, Ghana. *Russian
Journal of Agricultural and Socio-economic Sciences* 2(26): 3-13.

Xaba, B. G. and Masuku, M. B. (2013). Factors Affecting the Productivity and
Profitability of Vegetables Production in Swaziland. *Journal of
Agricultural Studies* 1(2): 37-52.

Yousuf, A. (2017). Transaction costs: a conceptual framework. *International Journal of
Engineering and Management Sciences* 2(3): 131-149.

APPENDICES

Appendix 1: Expected sign of explanatory variables

Variables	Variables description	Unit	Expected sign
SEX (X_1)	Sex of household Head (Dummy: 0 =Female, 1= Male)	Dummy	(+/-)
EDUC(X_2)	Level of education household Head	Categorical	(+)
HSIZE(X_3)	Number of family member	number	(+)
Land (X_4)	Land under tomato cultivation	ha	(+)
ASSMEMB(X_5)	Association members(0=Non, 1=Yes)	Dummy	(+/-)
EXPER(X_6)	Years staying on farm production of tomato	Years	(+):
DISTMARK(X_7)	Distance of the tomato producer households to the nearest market	Km	(-)
MARKINFO(X_8)	Market information (0=Non, 1=Yes)	Dummy	(+/-)
ACCREDIT(X_9)	Access to credit (0= Non, 1= Yes)	Dummy	(-/+)
INCCROP(X_{10})	Income from other crops	BIF	(-)
EXTSERV (X_{11})	Extension services(0=Non, 1=Yes)	Dummy	(+/-)

Appendix 2: Sources of inputs use

Inputs used	Sources	N⁰ of farmers	%
Seeds	Agro-dealers	82	64.1
	Individual Farmers	46	35.9
Fertilizer			
Organic	Farmers themself	8	10.94
	Neighbors	14	6.25
Inorganic			
UREA	Agro-dealers	59	46.1
	Individual Farmers shop	69	53.9
DAP	Agro-dealers	72	56.2
	Individual Farmers shop	56	43.8
Mix organic and inorganic		22	17.19
Insecticides	Market	40	31.2
	Farmers shop	88	68.8

Appendix 3: Cost incurred in tomato production

Variables	Mean	Minimum	Maximum	S.E.
Land for tomato production (ha)	0.21	0.013	0.5	0.129
Cost of Seeds (BUF)	29421.09	4500	760000	1.6
Cost of Fertilizers (BUF)	61882.03	7800	155000	36774.992
Cost of insecticides	369907.81	28000	980000	369907.81
Quantity produced	6254.37	360	16800	3916.55
Quantity losses (kg)	149.22	0	600	125.621
Quantity sell (kg)	6105.15	320	16480	3835.554
Selling price (kg)	629.395	325.0	1000	110.001

Appendix 4: Variance of inflection factors

Vif		
Variable	VIF	1/VIF
EXT	2.87	0.348069
ASSM2	3.32	0.4308225
EXP_ln	2.25	0.443517
EDUC	2.23	0.448761
MARKINFO	1.47	0.681238
DISTMARKOr ~ n	1.42	0.705600
SIZLANDFOR ~ n	1.39	0.719970
SEX	1.19	0.843400
ACCREDIT	1.16	0.862391
INCCROPS_ln	1.09	0.915345
HSIZE_ln	1.07	0.93111502
Mean VIF	1.68	

10. What are the incomes from others crops?

Crops	Income(BIF)
1	
2	
3	
4	
5 others specify	

Section B: TOMATO Production and Input use

11. Nursery preparation

Activities	Times	Cost (BIF)
1. Nursery installation		
2. Land preparation		
3. Earth treatment		
4. Nursery seedling		
5. Watering		
6. Phytosanitary treatment		
7. Nursery surveillance		
8. Transport		
9. Others(specify)		

12. What type of tomato varieties did you plant?

.....

13. What quantity of seed did you

plant?.....(kg)

14. Cost of seed (BIF)

15. What was the size of land you planted for tomato during the last

season.....(Ha)

16. Who is the owner of the land

(a) Own land

(b) Leased

17. If leased how much per acres (BIF)

18. If own specify your land asset

19. Land asset

Size	Year of acquisition	Acquiring price(BIF)	Life span	Disposable price(BIF)
1.				
2.				
3.				

20. Method of field preparation

(a) Hand (.....)

(b) Others.....

21. Did you apply animal manure? 1. Yes [.....]

2. No [.....]

22. What was the source of the animal manure

(a) Bought 1. [.....] (b) From own crow 2. [.....]

(c) Others specify

.....

23. If bought how much per bag of 50kg (BIF)

24. Did you apply fertilizer

(a) Yes 1. [.....]

(b) No 2 [.....]

25. If yes what type and quantity did you apply?

Types	Quantity (Kgs)	Cost(BIF)
1.		
2.		
3.		

26. What was the source of the fertilizer and seed?

(a) Bought

(b) Other

specify.....

27. If bought where you did buy from?

1. Agro agent within the community [.....] 2. Agro dealer in town [.....]

3. Others specify

.....

28. Did you apply insecticides?

29. If yes, how many times, what types and quantity?

Types	Many times	Quantity (l)	Quantity(Kgs)	Cost(BIF)
1.				
2.				
3.				

40. Did you get information about marketing of tomato? 1=Yes/ 0=No

41. If yes, how did you get market price information of tomato?

(a) Organisation []

(b) Colleagues in the market []

(c) The commission agents []

(d) Other (specify)[]

42. Do you incur any cost to acquire that information? 1= yes 0= No

43. If yes how

much?.....(BUF)

44. Who sets the price for the tomato when you selling?

.....

45. How do you transport your tomato to the market? (Track=1, bicycle=2, Heads=3, Others= 4(specify) [.....])

46. How much did you pay for transport per basket to the point of sale

(a) At the farm (BIF)

(b) Assemblers

(c) Wholesalers

(d) Retailers (local market)

(e) Others (specify)

47. What are others cost of marketing related activities of your tomato/quantity?

Item	Quantity(Baskets)	Cost(BIF)
Grading		
Packaging		
Market fees		
Storage fees		
Others(specify)		

48. Did some tomato damaged during transport? 1= Yes /0= No [.....]

49. If yes what quantity damaged

50. Did you pay any taxes on quantity sell?

51. If Yes how much did you pay per Basket?.....(BIF)

52. Are there any lending institutions who give loans for production and marketing?

53. Yes=1, No=0 [.....]

54. If yes, who are they? 1)..... 2).....

55. What are eligibility criteria? 1)..... 2).....

56. Do you get any support from the government or any institution? 1. Yes 2. No

57. What kind of support do you get?

1= Grant, 2= Loan, 3= Subsidy, 4= Extension, 5= Training, 6= Information [.....]

58. Mention the challenges you faced during tomato production and marketing?

Problem	Yes=1/ 0= No	What do you think are the causes of the problem	Possible solutions
Diseases and insects			
Shortage of inputs and high price			
Lack of infrastructure			
Inadequate market			
Inadequate training and extension services			
Individual market			
Storage problem			
Perishability of product			
Inadequate finance			
High marketing costs(transport)			
Price fluctuation			
Others (specify)			

Thank you very much for your time and the information you have given me, it is very helpful to me to know how your tomato production and marketing is doing.

Section B: TRADE PRACTICES

14. Please indicate the quantity and source of the tomato you trade

Quantity of tomato collected (NO Basket)	The source	From where the Tomato bought	Buying Price(BIF)
	Options: 1.Producer [] 2. Rural collector [] 3.Wholesaler [] 4. Urban collector [] 5. Others (specify).....	Options: 1.The Farm [] 2.The collection area [] 3. Local market []	1.----- 2.----- 3.-----

15. Information on basket use to pack tomato

Number of basket	Price bought (BIF/ basket)	Life span

16. What determines the choice of whom to buy your produce from?

- (a) Price [] (c) Fair scaling []
(b) Proximity [] (d) others (specify) -----

16. Who sets the price you buy the tomato?

- (a) Myself [] c)The Market []
(b) The seller [] (d) Negotiation []
(c) Other (specify)

17. Did you know the market prices before you bought the tomato? 1. Yes [] 2. No []

18. If yes, how did you get market price information of tomato?

- (a)From organisation [] (b) Colleagues in the market []
(c) The commission agent [] (d) Other (specify) []

19. Do you incur any cost to acquire that information? 1= yes 2= No

20. If yes how much?(BIF)

21. Please indicate where you sell the tomato after acquisition?

To whom do you sell to	Quantity sell	The selling market point	The selling price
1.			
2.			
3.			

22. Did you sell the same day you transported the commodity to 1= Yes [] 2= No []

23. If no, how many days did it take you to sell?

.....

24. Where did you spend the night

(a) Friend [] (c) Lodge/Guest house [] (b) Others specify

22. If is lodge how much do you pay per day? ----- (BIF)

23. Do you have a storage facility for tomato? 1= Yes [] 0= No []

24. If yes, please indicate the type of storage facility you use

(a) Modern (Refrigerators & cold rooms) []

(b) Traditional storage []

(c) Other (specify) -----

25. What are the marketing costs incurred?

Cost type	Cost amount in BIF
1. Transport	
2. Packaging	
3. Loading/ off- loading produce	
4. Market charges	
5. Cost of covering the Basket, (if any)	
6. City council levy	
7. Taxes	
8. Others(specify):	
	Total =

26. What is the quantity of tomato do you loss during marketing?

Causes	Quantity(N ⁰ Basket)
1.	1.
2.	2.
3.	3.
4.	4.

Section C: Marketing Services

27. Are any there any lending institutions who give loans to marketers? (Yes=1, No=2, don't know=3) [.....]

28. If yes, who are they? 1).....

2).....

29. What are eligibility criteria? 1).....

ii).....

30. Any support you receive from the government institutions on tomato marketing?

1 = Yes [...]

2 = No [...]

31. If yes, what type of support?

.....

32. Any suggestions to the government on improving tomato market?

.....

33. If you are to receive assistance in tomato marketing, in what would you like assistance?

.....

34. Any last remarks on the interview?

.....

35. Are there problems in tomato marketing? If yes what are the problems, and your suggestion to overcome each problem? Please specify below

Problem	Yes=1/ 0= No	What do you think are the causes of the problem	Possible solutions
Shortage of supply			
Price fluctuation			
Lack of storage			
Unfavorable market place			
Lack of finance			
Lack of support			
Storage problem			
Perishability of product			
Inadequate finance			
Others (specify)			

Thank you very much for your time and the information you have given me, it is very helpful to me to know how your tomato marketing is doing.

10. Who set the price of tomato purchased?

1= Buyer 2= Seller 3= Both 4= others (specify).....

11. What are the constraints hindering consumption of tomato?

Problems	1= Yes/ 0=No
1. supply shortage	
2. Lack of market information	
3. Income shortage	
4. Product perishability	
5. Lack of storage at home	
6. High price of product	
7. Others (specify)	

Thank you very much for your time

Appendix 8: Checklist for key informants interview

Date:

Name of interviewee

Name of Organisation

Participants:

1. What is the role of your organisation in tomato value chain?

.....
.....

2. What is your intervention in tomato production and marketing?

.....

3. What is your plan in creating the environment and establish the infrastructure and policy environment which are need to facilitate the tomato sector.

.....
.....
.....

4. What do you think as challenge for your intervention in agricultural (tomato) sector?

.....
.....

5. Propose the key thinks that can improve the contribution of your organisation in tomato production and marketing.

.....
.....

6. Add any other information you think can improve tomato value chain in study area.

Thank you very much for your time