Strategies for development of the value chain that contributing to the onion farmers' income through the integration of red bulb onion curing practices at farm level.

Case of Red bulb onion value chain in Rubavu District, Rwanda

Research project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfilment of the requirements of the Degree of Master in Agriculture Production Chain Management, specialisation in Horticulture Chains.

By

INEZA HERVE
Van Hall Larenstein University of Applied Sciences
The Netherlands
September 2018

van hall larenstein
university of applied sciences

Strategies for development of the value chain that contributing to the onion farmers' income through the integration of red bulb onion curing practices at farm level.

Case of Red bulb onion value chain in Rubavu District, Rwanda

Research project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfilment of the requirements of the Degree of Master in Agriculture Production Chain Management, specialisation in Horticulture Chains.

Supervisor

ARNO DE SNOO

Author
INEZA HERVE
Van Hall Larenstein University of Applied Sciences
The Netherlands
September 2018

Acknowledgement

My sincere gratitude goes to the Royal Netherlands Government through the Netherlands Organization for International Cooperation in higher Education (NUFFIC) for offering me the scholarship to pursue the Master in Agriculture Production Chain Management. Express gratitude to Government of Rwanda through NAEB that allows my absence to the office in order to get chance of pursuing my Master's degree courses.

Special thanks to the unwavering support, patience and guidance of my supervisors Arno de Snoo and Albertien Kijne. My sincere thanks to the course coordinator Marco Verschuur and Van Hall Larenstein staff for valuable critical comments during the selection of this research topic and coaching throughout the course.

Finally, I would like to extend much appreciation to all my colleagues at VHL and all my friends for providing me with a great experience, many special moments, help and company which ultimately allowed me to accomplish this project And last but not least special appreciation to my family for their love and support through both the good and bad times.

Thank you!

Dedication

This research work is dedicated to the Almighty GOD for the strength enabling me to complete my course and to beloved members of Uwacu Family for their incomparable support during my study.

Contents

List of Figures

List of Table

List of Picture

List of Appendices

Acronyms

CI	Confidence Interval
CICA	Agricultural Information and Communication Centre
DRC	Democratic Republic of Congo
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
Ha	Hectare
ITC	International Trade Centre
Kg	Kilogram
MINALOC	Ministry of Local Government for Rwanda
NAEB	National Agricultural Export Development Board
NGO	Non Governmental Organization
OCIR CAFE	Rwanda Coffee Development Authority
OCIR THE	Rwanda Tea Development Authority
PASP	Postharvest and Agribusiness Support Project
RBO	Red Bulb Onion
RHODA	Rwanda Horticulture Development Authority
RPHLR	Reducing Postharvest Losses in Rwanda
Rwf	Rwanda francs
SACCO	Savings and Credit Cooperative Organizations
SPAT	Strategic plans for agricultural transformation
UN	United Nation
US$	United State of America dollar

Abstract

This study intended to investigate the possibilities of red bulb onion curing practices at farm level in order to provide useful advice to stakeholders on strategies for value chain development that contributing to the onion farmers' income. Survey, case study and desk review were used as research method to find out the current situation of red bulb onion value chain and possibilities of implementing onion curing practices at farm level both in Rubavu district. A number of tools SPSS, Microsoft excel, chain map, SWOT, PESTE and stakeholder matrix were used to analyse data collected.

The findings indicate that red bulb onion value chain in Rubavu district is characterised by weak small farmers' organizations that not appropriately support their members. It is also characterised by lack of chain coordination and weak relationship among the actors, absence of strategies and policies to drive the value chain as well as poor information sharing among stakeholders. Fluctuation of market prices, onion shelflife and cost of production are the main risks that farmer facing in the decision making. Number of stakeholders including NAEB, RAB, AGRITERRA, PASP, RPHLR, PSDAG and SACCOs convey their support to onion farmers however research findings showed that their level of involvement currently still insufficient to bring the positive change to the red bulb onion value chain.

The absence of postharvest activities in the red bulb onion value chain including grading, curing and storage practices at farm level were identified; lack of appropriate infrastructure, little knowledge to the curing practices were highlighted as main challenges. Farmers have showed their willingness to go for curing practices however it requires strong farmers' organization to take responsibilities of the activity. Different factors indicate that curing practice can be possible; considering present situation for the existing farmers' organizations, average distance from farm to collection centres, good status of the roads as well as different chain supporters that bring technical expertise; infrastructure and financial supports prove that curing practice is possible. Stability of farmgate prices, market assurance and increase of value shares of onion farmers are positive outcome of the implementation of curing practices within red bulb onion value chain.

The recommendation of this study show that the successful development of red bulb onion value chain in Rubavu will need the improvement of communication through the stakeholders which therefore upgrade the chain coordination; enhance the capacity of the farmers' organizations in order to facilitate the chain integration of red bulb onion farmers and improving strong chain relations of chain stakeholders to build a sustainable onion value chain.

Key words: *Postharvest, Curing, value chain development and farmers' income.*

I. Introduction

1.1. Overview of horticulture subsector in Rwanda

Rwanda is located in East Africa bordering Republic Burundi, Democratic of Congo (RDC), Tanzania and Uganda. The country has the total land area of 26,338km^2 around 2,470Ha with 73% area occupied by the agriculture (FAOSTAT, 2018). The agricultural sector continues to be of critical importance for economic development, poverty reduction, and to enhance food and nutritional security in Rwanda. Agriculture employs 70 % of the labour force, and the country's solid growth record and macroeconomic stability provide a solid foundation for agricultural investment. The country has committed to generating sustained agricultural growth, increasing the share of the national budget allocated to agriculture from 3% in 2006 to above 10% in 2015. These investments appear to be paying off, with annual agriculture growth averaging over 6% since 2007 (USAID, 2018). More than 77% of rural households own one-third of the total arable land in the country with an average of 0.37 hectare of land (Bucagu et al., 2015). Agriculture constitutes the second biggest component of the country's Gross Domestic Product (GDP); Contribution of Agriculture to GDP at current market prices raised at 33% in 2015 (NISR, 2016).

Horticulture in Rwanda was considered as subsistence in the past years however people start realizing that horticulture production can earn more income that other traditional export crops include tea, coffee and pyrethrum recently with new visionary policies such as "Vision 2020" and "Strategic plans for agricultural transformation (SPAT)" in Rwanda which describe road map for the development of horticulture in general moreover horticulture has local marketing advantages than other export crops (Harmony, 2014). Horticulture is targeted in transform of Rwanda's economy to facilitate in a rapid increase in growth and a significant reduction in poverty targeted by vision 2020 strategy mainly in rural area. By 2020 it is expected that the country will reach middle-income status with per capita GDP of US$ 1240 from US$ 220 in 2000 (MINECOFIN, 2013).

Horticulture as business sector in Rwanda still on his infant stage however, the country has a full potential to develop a vibrant horticulture industry, especially due to its favourable climate, fertile soils, and an abundant labour force. Exploring horticulture potential in Rwanda has a number of benefits. First, horticulture can serve as tool to poverty alleviation since it is a labour intensive industry. Within horticulture, rural poverty is tackled via farmer participation in cash crops such as flowers, fruits and vegetables, as well as via on-farm jobs in pack houses and in value added activities. Second, horticulture can enhance export diversification and therefore contribute to the Rwanda's current need to break away from traditional export crops such as coffee and tea, and hence the sector can become a sizeable export contributor to export receipts. Third, horticulture has a unique opportunity to increase Foreign Direct Investment (FDI), bringing know-how and market linkages while transferring knowledge to the local economy (Deloitte, 2013).

1.2. National Agricultural Export Development Board (NAEB)

The development of horticulture in Rwanda to be successful as mentioned in Vision 2020, it will require an integrated supply chain approach focusing on production and processing, transportation, and direct marketing through dedicated contracting arrangements (MINECOFIN, 2013). In order to realize different targets set by agriculture policies and strategies, the National Agricultural Export Development Board (NAEB) was established in 2010 and given the responsibilities of realizing the agricultural policies and strategies for export commodities, stakeholders facilitation through the development of agriculture export value chains; improving quality; increase investments and expending the market of Rwanda agricultural products (NAEB, 2018). Horticulture development responsibilities was started by Rwanda Horticulture Development Authority (RHODA) a special in 2005 later on in 2011, were merged with Rwanda Tea Development Authority (OCIR THE) and Rwanda Coffee Development Authority (OCIR CAFE) to form NAEB (Harmony, 2014).

1.3. Brief onion production in Rwanda district

Onions are one of the most popular vegetable in the world originally domesticated in the mountains of Turkmenistan and Northern Iran and has been cultivated for more than 4,000years (Brewster, 2008). The onion (Allium cepa L., from Latin cepa "onion"); also known as the bulb onion or common onion, is a vegetable that is the most widely cultivated species of the genus Allium. The common onions are generally available in tree colour varieties which are yellow, white and red onion. Hunt (2016) mentioned other members of the genus Allium that are also widely valued as food crops including garlic (Allium sativum. L), leek (Allium ampeloprasum. L), chives (Allium schoenoprasum. L), and Japanese bunching onions (Allium fistulosum. L). in Rwanda red onion variety dominate the production as well as the market (Kilimo Trust, 2017).

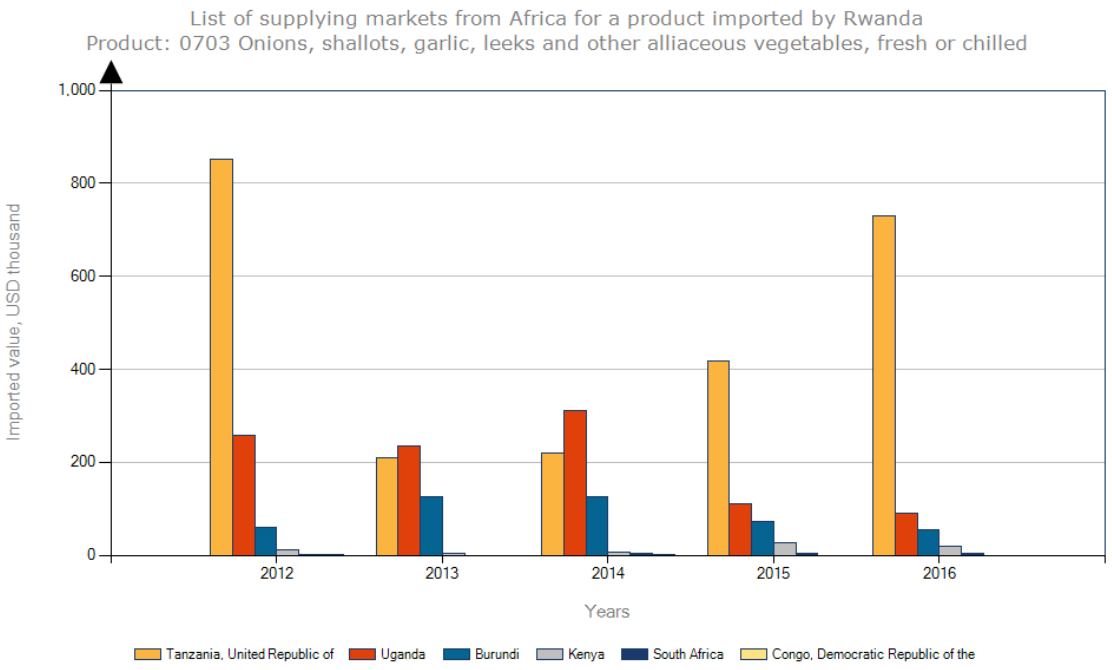
1.3.1. Production

In Rwanda, generally production of onions was gradually increased in last ten years in terms of harvested area from 1.6 thousands ha in 2007 to 2.9 thousands ha in 2016 while the production increased from 8 to 14.5 thousand tons in the same period however the yield has been dropped these last five years from 6.8 to 5.0 tons per hectare (FAOSTAT, 2018). The cause of yield drop is not clear however due to onion price at market farmers may take decision to decrease the cost of production by not using or reduce quantity of fertilizers and pesticides in their agriculture practices.

Horticulture including onion has a big land competition challenges from different practices. The national crop consolidation and specialization programs are the source of much of competition that horticulture farmers face, among those programs considered as competing for land with horticulture, maize stands out as the major competing crop at 35.4%, followed by bean growers 10.6% and potato 5.4%, pasture for livestock and wetland protection are relatively minor compare to three mentioned crops (PSDAG, 2015).

Onion harvest is happening in two main seasons which are following two rainy seasons in Rwanda; pick harvesting season in July to September and the second season happened in January until March (Kilimo Trust, 2017). In low onion seasons, Rwanda outsource from bordering countries mainly Uganda and Tanzania to get enough for market requirements; year 2015 and 2016 respectively 62.5% and 81% of import value shares were occupied by only Tanzania (ITC, 2018).

Figure 1: Trends of Onions & shallots imported by Rwanda



Source: ITC, 2018

In the other countries such as Vietnam, onion is harvested within a short period of time but is consumed all year round. Thus, onion is usually stored for some time. For seasonal agricultural products, storage must be done because of the need to meet demand in non-harvest season, make prices stable and set up a strategic reserve in case of crop failure (Thuong et al., 2016).

Onion are produced within whole country though it is very difficult to get specific data about red bulb onion; available reports mentioned horticulture in general like horticulture survey done in 2014 indicating that East, South and West provinces contribute respectively 32%, 29.5% and 20% of the total acreage covered by horticulture in 2013. Considering the individual district in the same year 2013, Kamonyi in South province was leading with 11% followed by Rubavu in West province 9.6% of total acreage (Turatsinze et al., 2014).

In addition to locally produced, Rwanda every year imports considerable quantities of onions to supplement its local production. According to ITC (2018), formal onion import was valued around 1.2 million of US dollar in 2012, dropped in half just the following year 2013 however in 2016 the formal onion importation was again raised to 0.9 million US dollar. It is also important to notice that formal import and export in Rwanda horticulture occupied more or less 30% of the total shares; there exists considerable cross border exchanges between Rwanda and bordering countries in horticulture sector which is very hardly to capture the real data (BNR, 2015). Depend on the existing kind of data in onion value chain, it is very difficult to determine the exact quantities consumed on a certain period, ITC (2018) also does not reported on formal imported quantity in last 3 years however it is mentioned that 2.9millions of tons were imported in 2012; the same challenge on onion quantitative data have been

stressed out by PSDAG (2015). Traders interviewed in Rwanda noted that importation of is based on low seasons but also onions from Tanzania are chosen because of their superior quality: well dried medium sized and with a long shelf life (Kilimo trust, 2017).

1.3.2. Onion farmers

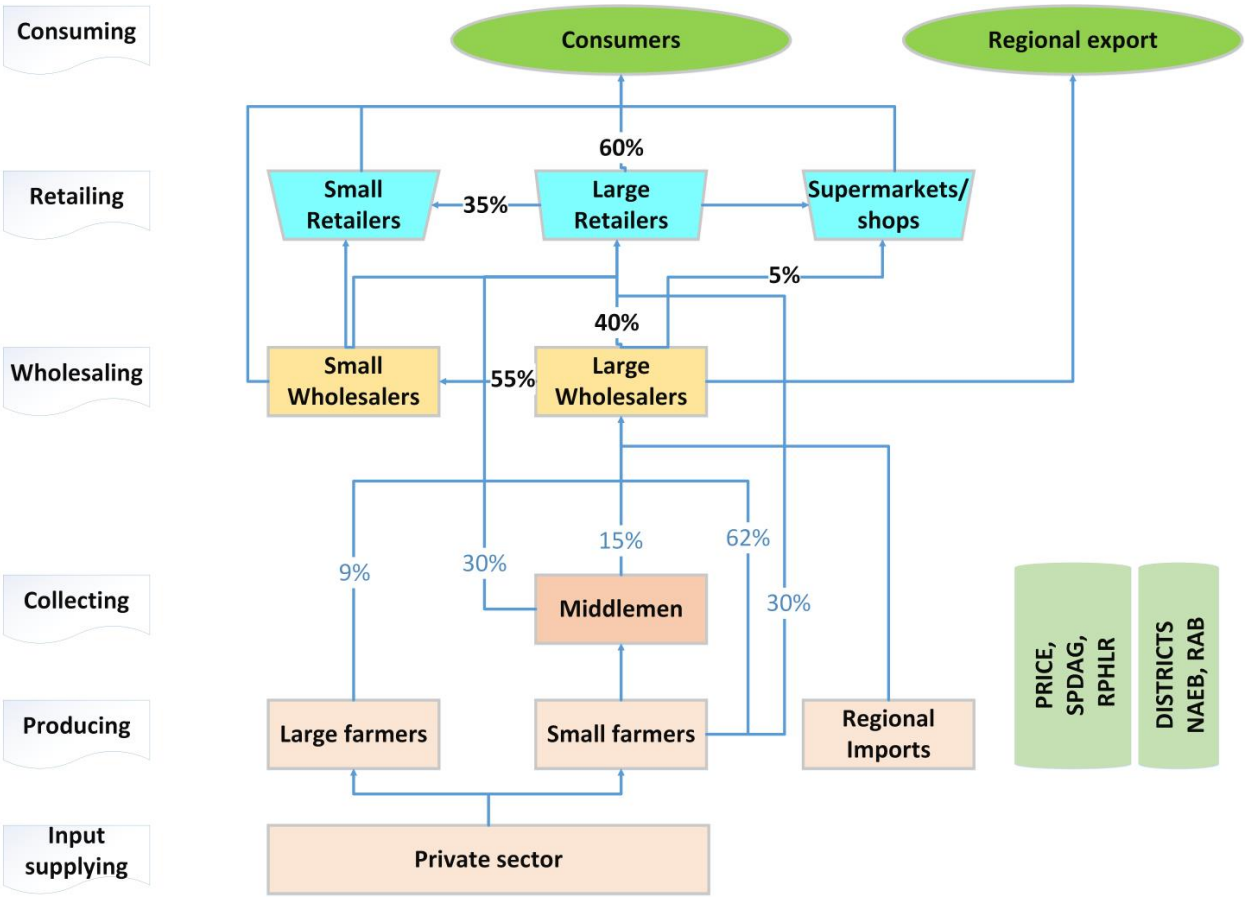
Onion Farmers are small producers, alike horticulture sector in Rwanda, Generally agriculture farming include horticulture, is done through small farmers characterized by owning average of 0.5 hectare of land. Due to having small plot of land it induces strategies of forming farmer organizations. The number of farming organizations has gradually increased since 1960, but over 90% of the existing ones were formed since the year 2000, and about 50% have been established since 2010. Today, these organizations are in forms of cooperatives, associations and private companies and are engaged in both production, processing, and marketing activities related to horticulture. Around 1,150 organizations involved in horticulture sector was counted in Rwanda with around 97% of total organization are in horticulture production; considering the sex of membership 56.5% are female (Turatsinze et al., 2014). Dispute to the high number of farmers organizations, it is very common to find that agriculture and postharvest practices are done individually by farmers due to inadequate functioning of the existing organizations; nowadays farmers organizations tend to function in social ways just collecting membership fees, health insurance contributions and other social activities than aggregating production, marketing collectively or improving collective bargaining power (Harmony, 2014). It is also observed that the smallholder farmers do use small piece of their land to produce the reasonable quantity that they can manage themselves in terms of marketability as well as postharvest handling (Harmony, 2014). Actually onions farmers still use production driven approach whereby they just produce without any information on market other than their last season performance. Farmers' organizations which should help out in production planning and marketing of their produce are very weak and almost not functioning. Kilimo Trust (2017) mentioned that the red bulb onion value chain still in an informal status and 70% of wholesalers outsource from the farm gate thus the red bulb onion farmers in their capacity struggle to get market of their produce or trying to manage the small stock of excess products which do not get the clients. The issue of inadequate functioning of farmers' organizations was highlighted by Rwanda Minister of Agriculture when she mentioned about the land consolidation strategy adopted in 2007 in order to speed up the realization of vision 2020 will not work if there are no strong farmers' organizations in horticulture to facilitate the valorisation of production output (Mukundente, 2017).

1.3.3. Market segmentation

Red bulb onion businesses still largely operating on informal way, only 50% of wholesalers and 30% of retailers are registered (Kilimo trust, 2017). Apart from the considerable red bulb onion demand in local market especially in capital city Kigali, it has also observed that certain red bulb onion quantities are sold in bordering countries mostly in Uganda. ITC (2018) recorded 125Tons in 2013 and 50 tons in 2016 exported to Uganda formally. Huge quantity are moving to RDC informally

The study conducted by Kilmo Trust (2017) noted that more than 70% of wholesalers procured from farm gate other source are from traders and middlemen; major customers for wholesalers are other fellow wholesalers 55%, retailers 40%, individual customers and supermarket both occupy around 5% of shares; on the retailing side, 60% and 35% of production sold to individual consumers and fellow retailers respectively. The sources of red bulb onion for traders are 5% from fellow traders to wholesalers and 36% to traders. The red bulb onions come from direct to farmers occupy 62% and 30% respectively to wholesalers and retailers. Middlemen contribute 15% to wholesalers and 32% to traders. 9% is sourced from large farmers to wholesalers.

Figure 2: Onion value chain in Rwanda

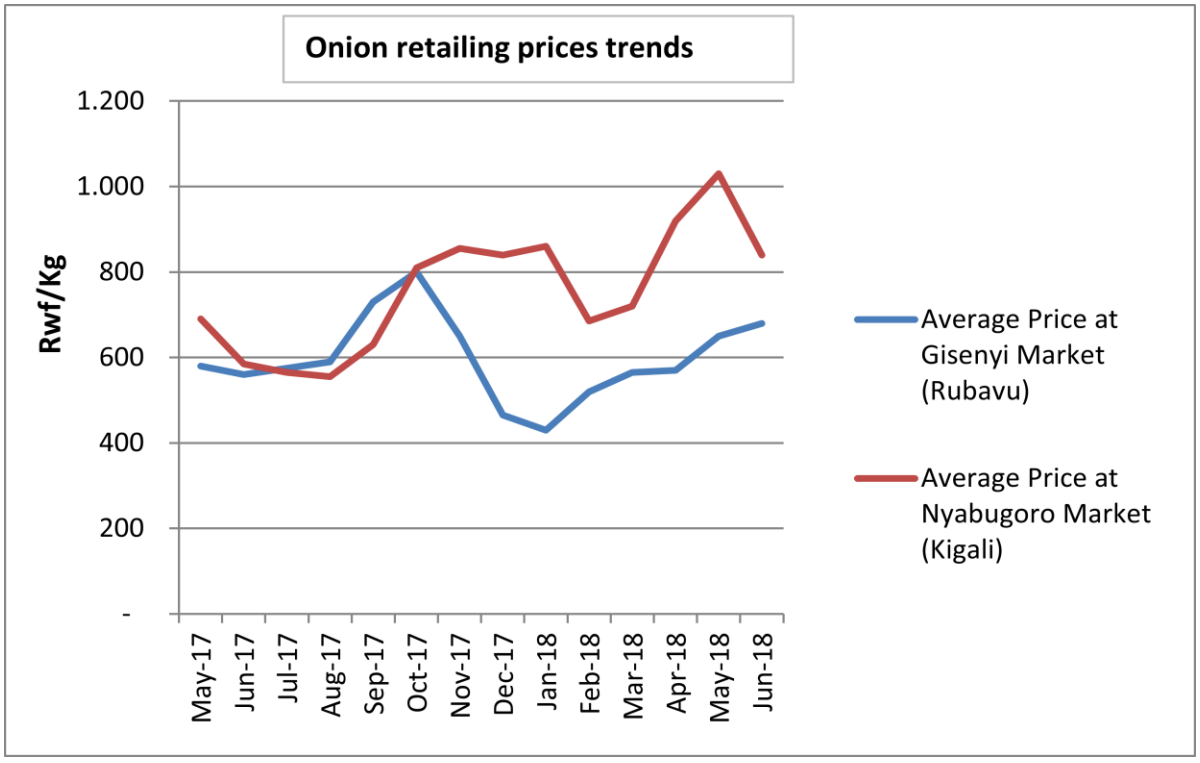


Source: Kilimo trust, 2017

1.3.4. Retailing price trends

Agricultural Information and Communication Center (CICA) has started a program of gathering retailing market price information and disseminate to the population in a sense of make farmers aware of weekly retail price trends of the their production which will further helps them to take right decision in negotiation with their clients. The analysis of last fiscal year 2017-2018 data has shown that retailing price of onions in different Rwandan market keep changing every week (CICA, 2018). Considering two markets Gisenyi and Nyabugogo of Rubavu and Kigali districts respectively (see the figure No3) demonstrate that generally onion retailing price remained in the range between Rwf 450/kg to Rwf850/kg however records have showed that there is certain periods prices raise even up to Rwf1,300/kg.

Figure 3: Onion retailing prices trends in Rwanda



Source: CICA- MINAGRI

1.4. Justification

In Rubavu district and indeed elsewhere in Rwanda it is hardly to find different horticulture crops treated separately thus the limitation on literatures about onion value chain (PSDAG, 2015). According to Turatsinze et al. (2014) the onion is the second horticulture crop sold per volume (15%) after tomatoes in Rwanda; and Rubavu district comes to the second place within the hole country that have large horticulture cultivated area Turatsinze et al. (2014).

Onion value chain has become an alternative agriculture enterprise of smallholder famers and has continued to expand by volume as well as acreages is the last decade (FAOSTAT, 2018) however challenges of price fluctuation, inadequate market information and lack of alternative for the excess production are characterizing the onion chain. Various strategies brought by different supporters of horticulture in the past have not really places much emphasis on value chain approach rather farmers continue to work in production driven system. The value chain strategies are market driven and private led, this makes different stakeholder in a particular chain to be efficient and effective.

This study will provide insight to the horticulture and particularly red bulb onion value chain in Rubavu district. The objective of government is to develop horticulture sub sector into a business cases in order to contribute to the economy, alleviation of poverty and creating jobs and NAEB is one of government entities that has responsibility to lead government to the target, therefore the results of this study will provide useful information that the stakeholder can use to develop strategies in red bulb onion value chain development. The direct actors in red bulb onion value chain will use findings to increase efficiency and profitability. There is no published research that has been conducted in regards to red onion value chain in Rubavu. This justifies therefore, the relevance of undertaking the research in that area.

1.5. Problem statement

Red bulb onion farmers in Rubavu district are operating on small scale with a low level of production and high risk production due to different challenges including lack of knowledge gap in onion value chain, seasonality, low access to information and poor relations between chain actors; currently farmers do not have any power to the control of price. Onion production is consider as priority to reduce the poverty especially in rural areas however it is not clear on what postharvest technologies at farm level can positively influence onion farmers' income as well as creating opportunities enhancing the value chain development.

Problem owner is National Agricultural Export Development Board

National Agricultural Export Development Board 'NAEB' is a government organisation that has mission to boost the Rwandan economy through the increase of agriculture export and diversification exportable agriculture commodities; horticulture, coffee and tea are three main subsectors (see section 1.2).

1.6. Research objective

The overall objective of this research is to investigate the possibilities of red bulb onion curing practices at farm level in order to provide useful advice to stakeholders on strategies for development of the value chain that contributing to the onion farmers' income

1.7. Research questions

Q.1. what is the current situation of red bulb onion value chain in Rubavu district?

1.1. What are the current systems of red bulb onion production?
1.2. What are existing postharvest practices?
1.3. What are current actors and chain relations in red bulb onion value chain?
1.4. What are characteristics of existing red bulb onion market?
1.5. What is the economic perspective of red onion farming in Rubavu district?

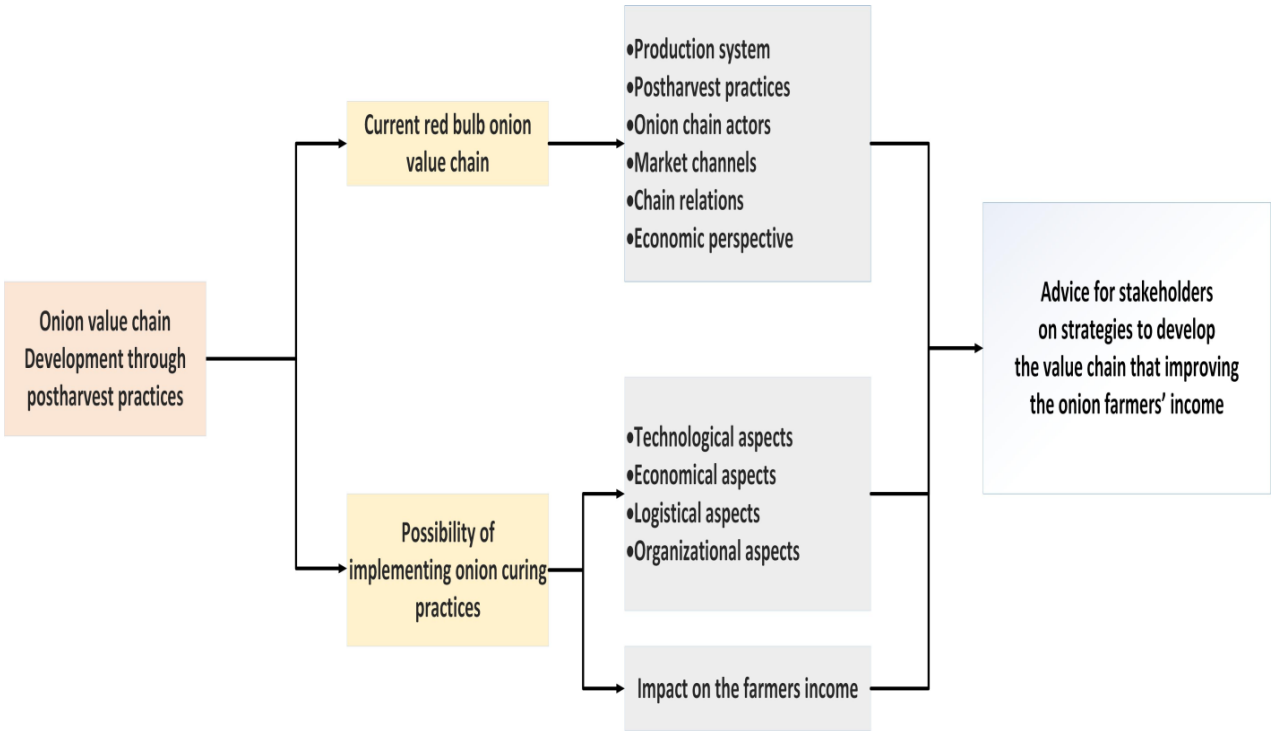
Q.2. what are the possibilities of implementing onion curing practices at farm level in Rubavu district?

2.1. What are technological requirements in curing practices?
2.2. What are economical factors influencing curing practices?
2.3. What are logistical requirements for curing practices in Rubavu district?
2.4. What are organizational structures affecting the curing practices in Rubavu district?
2.5. What are the impacts of onion curing practices to the income of red bulb onion farmers?

1.8. Conceptual framework

This research has used the value chain development as core concept to study the red bulb onion value chain. Value chain analysis was one of dimension utilised to characterize the current situation in regard to production, postharvest, stakeholders and relationship. Farmers' integration and strengthen their relations within value chain can be achieved if farmers could take up new activities and improve the organization. Possibility of implementing onion curing practices as dimension was helped to examine the requirement and importance of curing practices in the red onion value chain.

Figure 4: Conceptual Framework



Source: Researcher

1.9. Definition of main terms

Onion Curing practices: refers to the practice directly following harvest, of allowing the external layers of skin and neck tissue to remove the excess moisture or dry out prior to handling and storage.

Postharvest practices: refer to the stages of crop production immediately following harvest, including curing, cleaning, sorting, grading and packing. The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Postharvest treatment largely determines final quality, whether a crop is sold for fresh consumption or as processed.

Farmers' income: refer to profit and losses incurred through the operation of a farm. It is a summary of income and expenses that occurred during a specified period.

Farmer organization: an economic organization that improves smallholder farmers to collaborate, coordinate to achieve, economies of scale in their transaction with suppliers of inputs, buyers, access inputs, information channels and raise level of knowledge in agriculture skills and value addition.

Value chain development: By "Value Chain Development" we mean an improvement of cooperation between stakeholders of a particular sector and the coordination of their activities along different levels of a value chain with regard to the following "five triggers" system efficiency, product quality and specifications, product differentiation (competition), social environment standards and enabling business environment. The ultimate goal is to increase the competitiveness of this sector on the (international) market (ILO, 2007).

II. Literature review

2.1. Introduction to the research study

The study will undertake to find out how the integration of curing as postharvest practices can improve the market competition of onion produced in Rwanda and promote the farmers' integration within the value chain. The development of value chain approach helps to analyze the position of farmers within a value chains and how they can take advantage to improve their income and livelihoods (KIT et al., 2006). Helping farmer to be involved in a wide range of activities including production is one of the ways to support farmers' integration (KIT et al., 2006)

2.2. Onion curing practices

Curing of onion refer to the process of removing the excess moisture from outer layers of bulb prior to storage. The dried skin provides a surface barrier to water loss and microbial infestation which helps in preservation of main onion edible tissue in a fresh state (Opara, 2003). Curing is a process intended to dry off the neck and outer scales of the bulb (Bayat et al., 2010; Maw et al., 2004)

Apart from long term storage, curing practices helps to control the onion shrinkage during subsequent handling, to reduce the occurrence of sprouting, and to not allow the crop to ripen before fresh consumption (Geyer et al., 1999). Opara (2003) argued that the process of onion dehydration is sometimes called 'curing', but for the researcher the word 'curing' for onion drying is rather inaccurate since no cell regeneration or wound healing occurs during the process as in other root crops such as yam and cassava.

2.2.1. Types and importance of onion curing

Curing is an important postharvest treatment required to store bulbs for longer time, the curing process can occur at any stage from harvest to marketing whenever the conditions around the bulb become favourable to remove moisture from the bulb (Maw et al., 2004). The process of curing onion bulbs are mainly classified into two categories, 1. Natural curing: accomplished by holding the produce at high temperature and high relative humidity for several days while harvesting wounds heal and a new, protective layer of cells form. 2. Artificial curing: drying onions by forcing heated air around them (Kitinoja, 2002). Curing onions either in the field or with heated air helped increase marketability (Kitinoja, 2002; Opara, 2003)

2.2.2. Onion curing process- Conditional factors

- Temperature is the main influencing factor in the onion curing process; the recommended temperature of natural curing is 28^0C (Barbara, 2013) while the range of 35-45^{o}C have been observed to be the standard conditions for blowing dry air around the onions in artificial curing (Opara, 2003; Kitinoja, 2002).
- Relative humidity should be controlled during the curing process, 60 to 75% is recommended (Kitinoja, 2003).

- Size of bulb also matters in the speeding or delaying the curing process (Barbara, 2013), the more uniform onion products are the better curing process running well.
- Maturity of onion influence also the time for process; immature onion take long period to dry the neck and outer layer than matured onion (Kitinoja, 2003)

In traditional small-scale operations, onion curing is carried out in the field in a process known as "windrowing". It involves harvesting the mature bulb onions and laying them on their sides (in windrows) on the surface of the soil to dry for 1 or 2 weeks (Opara, 2003). Obviously, successful windrowing is weather dependent and therefore cannot be relied upon for large scale commercial onion production business. The harvested production of onions may also be placed in trays, which are then stacked at the side of the field to be cured. In some regions, bulb onions may also be tied together in bunches which are then hung over poles in sheds to cure naturally (Opara, 2003).

The harvested onion production can also be taken straight from the field and dried artificially either in a store, shed, barns, or in a purpose-built drier. Under this method, onions are laid on racks and heated air is rapidly passed across the surface of onions night and day (Opara, 2003). Curing is considered complete when the necks of the onions have dried out and are tight and the skins shriek when held in the hands. For this method crops can be stored in bulk but it can also be applied to bags, boxes or bins.

Onions in Vietnam are harvested within a short period of time but are consumed all year round. Thus, onion is usually stored for some time. For seasonal agricultural products, storage must be done because of the need to meet demand in non-harvest season, make prices stable and set up a strategic reserve in case of crop failure (Thuong et al., 2016).

2.3. Chain development

Value chain development is a vital and central concept in value chain analysis. A farmer or group of farmers can derive more value from the chain by investing in increased efficiency and innovations of process or final product and collaborating with other stakeholders (Miller and Jones, 2010). Value chain development is all about making the consumer at the end of the chain happy; it is therefore a market-oriented approach. It is important to understand that all stakeholders along a particular value chain need to cooperate and coordinate their activities to satisfy the needs of the end consumers (ILO, 2007).

2.4.1. Value chain

The value chain is described as any activity necessary to get a product or service throughout the different phases, from resource extraction, production and manufacturing, to consumption and finally disposal after use (Kaplinsky and Morris, 2001). Besides physical flows, which can be assessed by material flow accounting or environmental lifecycle assessments, the value chain perspective also includes other aspects such as information and monetary flows, power between actors involved as well as their positions within socio-economic structures including judicial or cultural framework conditions.

Kilimo Trust (2017) mentioned about key actors in red bulb onion in Rwanda which include onion farmers individually or organization, traders, wholesalers, different types of retailers and consumers. The presence of the above key actors qualifies the red bulb onion value chain to be analysed in value chain wise.

2.4.2. Vertical integration

KIT et al. (2006) described the vertical integration as a strategy for developing the chain. It involve farmers in new activities either upstream or downstream e.g. production; processing or trading. Adding activities implies adding costs and risks and may require technology, finance, human resource development and organization. Vertical integration may occur for several reasons including stable supplies, better quality control, improved information flow, scheduling and reduction in price risk.

Introducing the curing practice as one of onion postharvest practices is good strategy to improve quality for market, enable the storage of excess product and stabilizing farm gate price; curing practices are good example for vertical integration within red bulb onion value chain.

2.4.3. Chain relations

KIT and IIR (2008) mentioned that all stakeholders in the value chain may benefit more if farmers and traders accept to improve their relationship. The business relation between the various actors in the value chain is defined as 'Chain relations'. Within a considered value chain, the relationship can be appeared in different kind of forms however strong chain relations should be characterized by the presence of strong organizations; trust relationship among the players and relations relatively stable (KIT an IIR, 2008), same authors were described how it can be achieved as below mentioned:

- Organization of the chain actors to team up in order to strengthen their skill and technology, upgrade products and services, study customer demands, access to finance and increasing their bargaining power.
- Creating mutual understanding through respect for roles and needs of other chain actors.
- Specializing in every actor roles to deliver better products and services in order to strengthen the value chain
- Coordination of the chain relationships and interactions through continual communication between the chain actors. The coordination can be steered by direct actors such as farmers and traders but it may also supported by chain facilitators or service providers
- Development of chain partnerships through a shared vision to improve the performance of their businesses.

The development of red bulb onion should not focus only on the small farmers' vertical integration; more have to be done to develop a resilient value chain. Organization of different chain actors mainly farmers and traders should be prioritized; having a common interest and defining the coordination of the chain are some activities that should be planned accordingly. Therefore red bulb onion value chain is well fitting in the chain relation concept.

2.4.4. Market institutions

According to KIT and IIRR (2008), market institutions are rules, policies and various forms of organization across the business sector that shape the way farmers interact by enhancing stability and order in the way they transact their business. Informal regular pattern of behavior and social customs are also institutions. The effective functioning of value chains depends on trust with makes trade more efficient. Stronger market institutions can be achieved through:

- The setting up and maintaining quality standards which will help trade become more efficient.
- Market information systems that provide enough and precise information that helps in decision making
- Influence of sector policies by business organizations that will address pertinent issues, trade tariffs, permits and taxes.
- Business support services like financial services provision, transport, research and development must be available and effective.

III. Research Methodology

The research methodology presents the case study area, research design and how data has been collected and analyzed. Qualitative and quantitative approaches have been utilized through desk research to obtain secondary data and field research through the use of survey, interviews and observation to different value chain stakeholders. The research was carried out in three months include two months for data collection in Rubavu district of Rwanda; table 3 detailed about work plan and time frame.

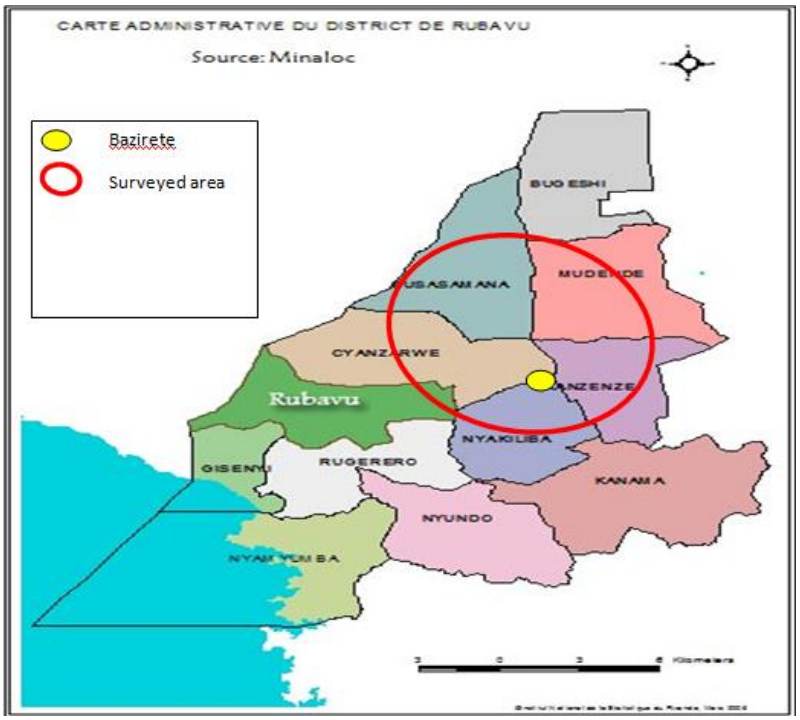
3.1. Description of study area

The research was conducted in one district among 30 districts in Rwanda.

3.2.1. Rubavu District,

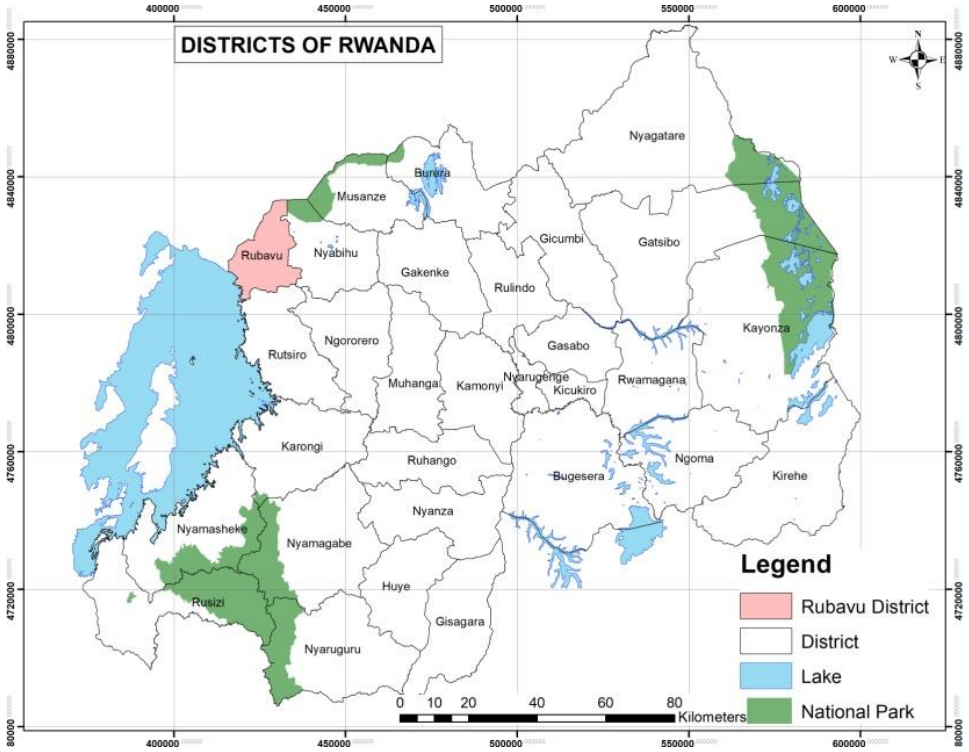
Ruvabu district belongs to West Province and located to North West of the country with 12 administrative sectors also, the district has 388km^2 and bordering Republic Democratic of Congo (RDC). A lot of commercial activities have been observed between Rubavu and RDC. The climate of Rubavu characterized by the temperature range between 12.5^{0}C – 23.8^{0}C, altitude of 1,877 m and average precipitation of 1,377mm. Bazirete is one of the important horticulture regions in Rwanda. Name "Bazirete" itself was borrowed from Swahili mean "bring them all"; the region was started to be called so in 90's when travelling people, mainly Congolese; stop their vehicles near the road to buy different kinds of horticulture products include onions, carrots, cabbages and green leafy vegetables. In Broader sense, Bazirete is not just that simple collection site, look at the origin of those products; they are coming from around 15km average distance. Within Rubavu district survey has focused to farmers located in administrative sectors around Bazirete market (see figure No 2).

Figure 5: Rubavu District Map



Source: MINALOC

Figure 6: Rwanda Map

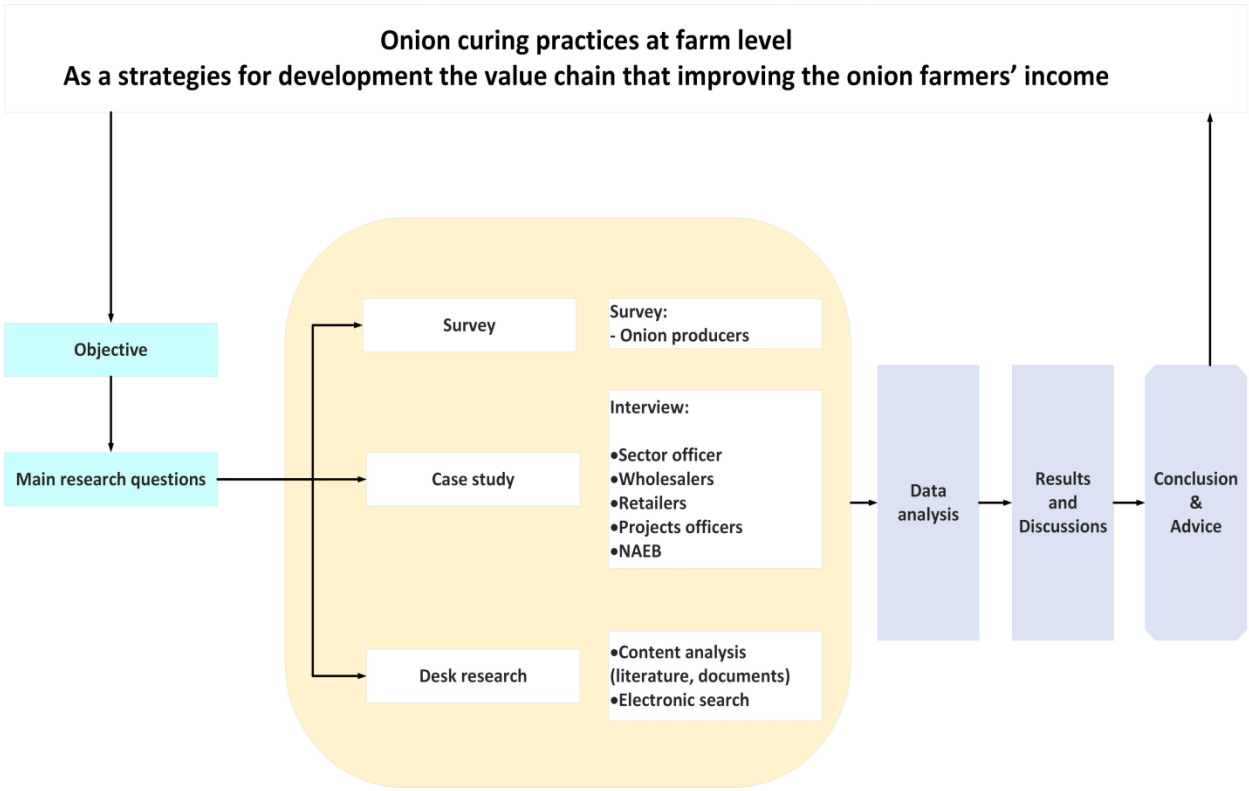


Source: MINALOC

3.2. Research Strategy

Research strategy is describing methods and tools that used in data collection during the research; source of information as well as the tools which have been used to analyse data.

Figure 7: Research framework.



Source: researcher.

3.2.1. Desk research

To obtain literature and secondary data on the red bulb onion value chain a desk study have been conducted; the information was gathered from libraries, latest books on the internet, journals and annual reports of relevant stakeholders including but not limit Rwanda government institutions, NGOs and UN organizations.

3.2.2. Survey of red bulb onion farmers

The structured questionnaire with closed questions mainly related to the current production practices, exist and the possibility of implementing the curing practices at farm level; was developed to be used in a survey to red bulb onion farmers. The farmers' selection have be done with the help of Districts cash crops and sector agronomists as the extension service provider more involved with farmers and well know the area. A total sample size of 40 farmers was used in order to get sufficient results which can be analyzed by using relevant statistical tools. Farmers have been randomly selected within horticulture regions of Rubavu Districts.

3.2.3. Case study

Different stakeholders were target in this research case study to get in-depth information on the red bulb onion value chain. The data were collected by using, checklist with open ended and observations. The conducted interviews are described as follow:

- **Interview with Onion wholesalers**

Four onion wholesalers were interviewed to gather information on functioning of wholesaling activities in general. Questions was mainly focused on onion seasonality, origin of red bulb onion products, cost and selling prices, quantity and quality needed and challenges.

- **Interview with Onion retailers**

6 different retailers were randomly selected in different open markets and small shops in Kigali and the interview was focusing on red bulb onion seasonality, cost and selling prices, quantity and quality needed and challenges

- **Interview with Sector Agronomists**

Sector is the hub of policies implementation and agriculture extension services. The interview with sector agronomists were focused on the role of district in facilitating onion chain development, implementation of crop intensification (land allocation and priority crops), existing strategies for farmers' integrations and their opinions on possible onion curing practices at farm level.

- **Interview with Projects**

The interview of supporting projects (AGRITERRA, PASP and RPHLR) has been conducted to obtain information on the types of services they offered to farmers, farmers' challenges; weaknesses of locally produced onion value chain their opinions on possible onion curing practices at farm level and possibility to improve their market competition**.**

- **Interview with NAEB**

NAEB has mission to boost the Rwandan economy through the increase of agriculture export and diversification exportable agriculture commodities. NAEB contribute to the long term plans and strategies; offers technical advisory, extension services, sharing information and support in the organization of horticulture sector. The interview was focused on the service offered to onion value chain, challenges and opportunities as well as the main stakeholders in value chain.

3.2.4. Data analysis

Quantitative data collected from the survey were coded and analyzed using Microsoft excel and SPSS statistic tool. Both descriptive and inferential statistics were used to analyze the situation. On the other hand, qualitative and quantitative data gathered from interview and survey have been analyzed by using different tools include chain map, stakeholder matrix, SWOT and PESTE.

3.2.5. Limitation of the study

- Due to inadequate of onions farmers' organizations observed in secondary data. Data collection was focused on individual farmers therefore the views of value chain at farmer's organizations level was not captured in this research.

- Available secondary data on quantity are not distinguishing red onion bulbs from other Allum onions; there is limitation of getting specific data for red bulbs onions.

- Limitation was on comparison of between different surveyed sectors due to inequality in number of farmers interviewed during survey.

- Cost and benefit: Due to unavailability of curing technology in place; it was a challenge to the researcher to get information that could help in judgement of curing practices as a new technology compare to the current system.

Table 1: Research operationalization.

The below table is summarising method, tools that researcher will use to collect data and source of information for respective sub question of this research.

Targeted Questions	Method	Tool	Targeted Stakeholder
Q.1. what is the current situation of red bulb onion value chain in Rubavu district?			
1.1 What are the current systems of onion production?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers
1.2. What are existing postharvest practices?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers Sectors, Projects, NAEB
1.3. What are current actors and chain relations in red bulb onion value chain?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers Sectors, Projects, NAEB
1.4. What are characteristics of existing red bulb onion market?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers, NAEB.
1.5. What is the economic perspective of red onion farming in Rubavu district?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Sectors, Projects, NAEB
Q.2. what are the possibilities of implementing onion curing practices at farm level in Rubavu district?			
2.1. What are technological requirements in curing practices?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Projects, NAEB
2.2.What are economical factors influencing curing practices?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Projects, NAEB
2.3. What are logistical requirements for curing practices in Rubavu district?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Sectors, Projects, NAEB
2.4. What are organizational structures affecting the curing practices in Rubavu district?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers, NAEB.
2.5. What are the impacts of onion curing practices to the income of red bulb onion farmers?	Survey Case study Desk research	Questionnaire Semi structured interview	Smallholder farmers, Wholesalers, Retailers, Sectors, Projects, NAEB

IV. Results of research

A. Findings of survey with red bulb onion farmers in Rubavu district

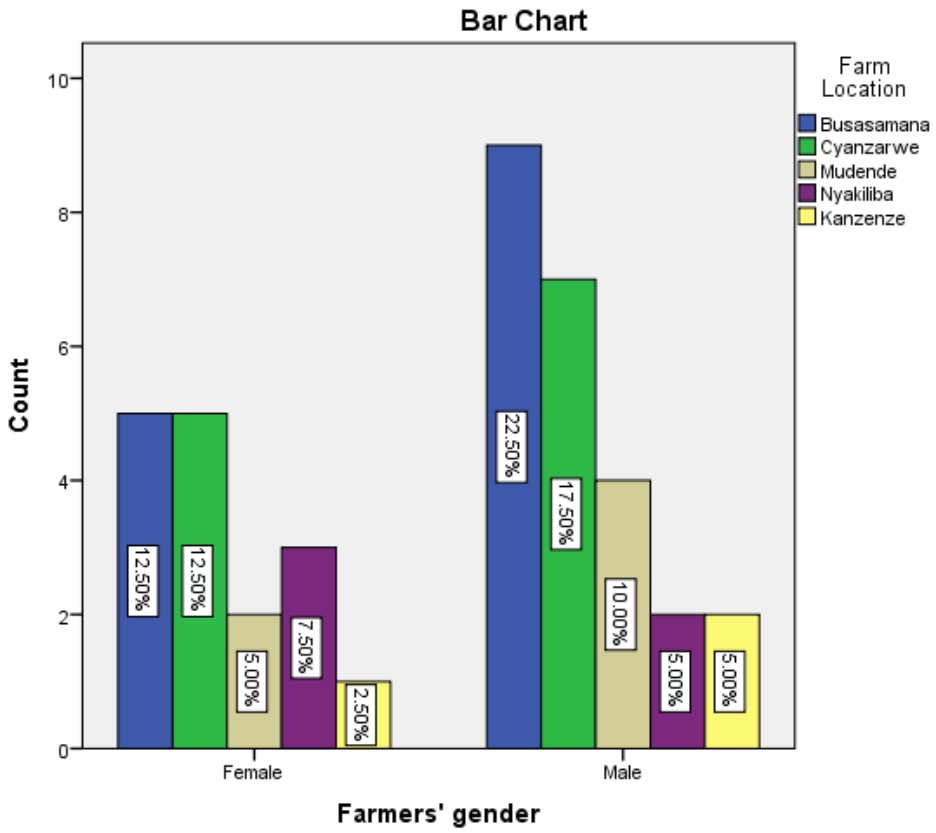
This section is describing the research findings from a conducted survey in Rubavu district. The samples size was 40 red onion farmers randomly selected. The high producing regions within Rubavu were considered while conducting the survey.

4.1. Respondent Characteristics

a. Gender

The 40 respondents of the conducted survey were coming from 5 different administrative sectors within Rubavu district and the participation rate is represented as follow Busasamana (35%), Cyanzarwe (30%), Mudende (15%), Nyakiliba (12.5%) and Kanzenze (7.5%). Due to random selection, the number of respondents was not equitable within those five sectors. The respondents are characterised by both sex whereby females occupy 40% of the total number of respondents. 63% of women originated from Busamana and Cyanzarwe.

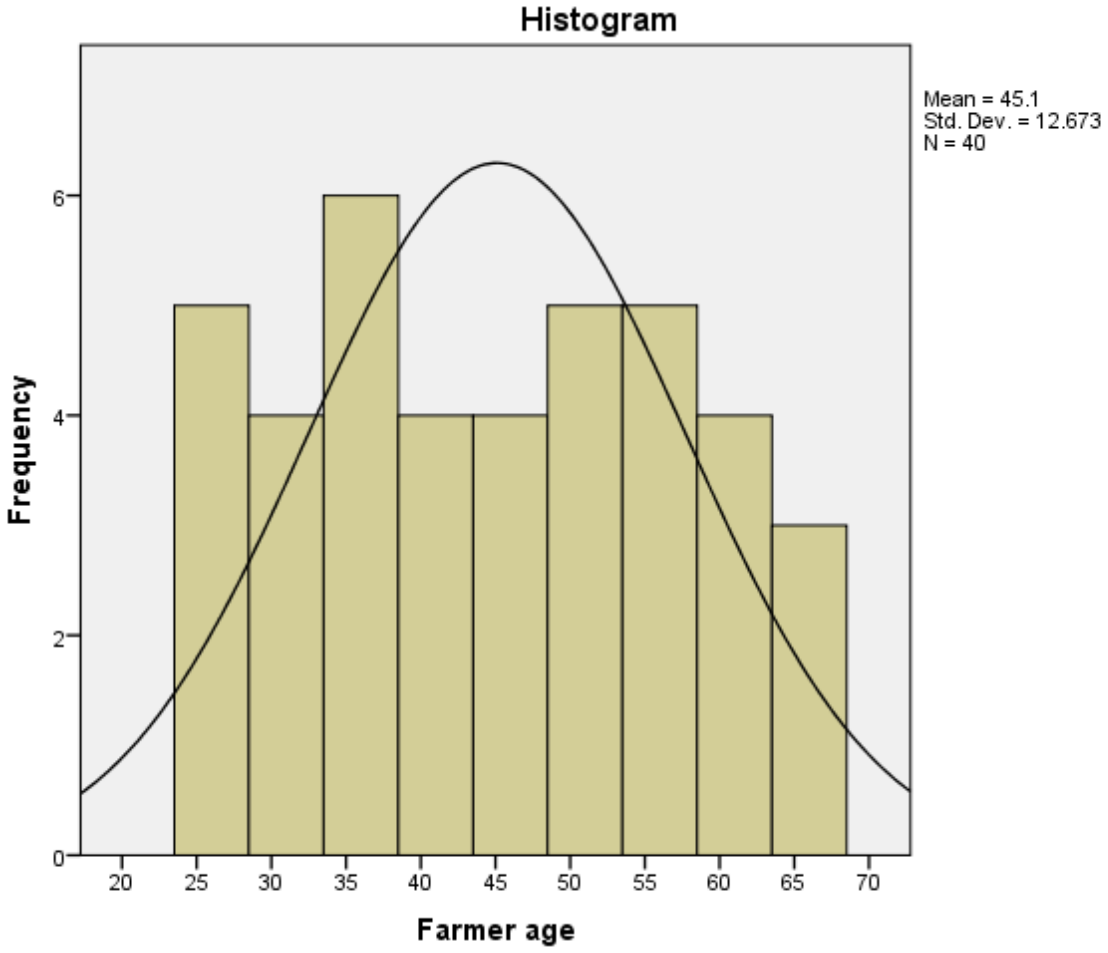
Figure 8: Gender and farm location



b. Ages of Respondents

The respondents' ages were in between 26 and 67 years. The average age of the responded farmers is 45 years in general. The Independent Samples Test was conducted to find out if there is a different in average in age between females and males with 95% confidence interval (CI) of the difference and results shows that p-value (0.041) < 0.05 confirm that the different is significant between female and male average age (see Appendix No 02).

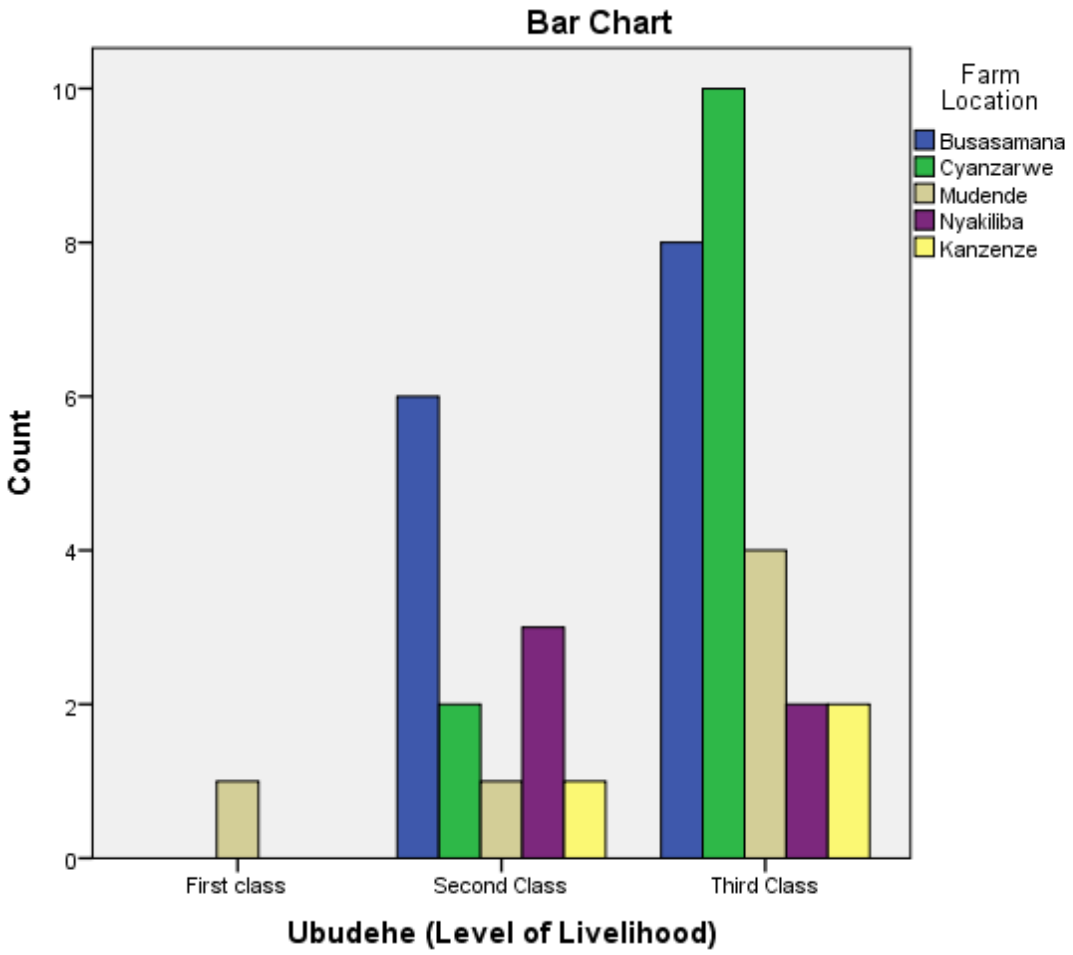
Figure 9: Ages of farmer's histogram



c. Ubudehe "Level of livelihood"

In Rwanda there exists the categorization system of their citizens in according to the level of livelihood from first class of poorest to the fourth class of richest. The study has looked into the categories under which the respondents fall in; and findings show that 65% belong to Third Class of Ubudehe and only 2.5% among the total respondents represent the First Class of Ubudehe. Cyanzarwe sector is more represented in Third Class followed by Busasamana with 39% and 31% respectively. This bring the both assumptions that maybe production onions could not be afforded by poor farmers or onion production is a profitable enterprise which can improve farmers' like.

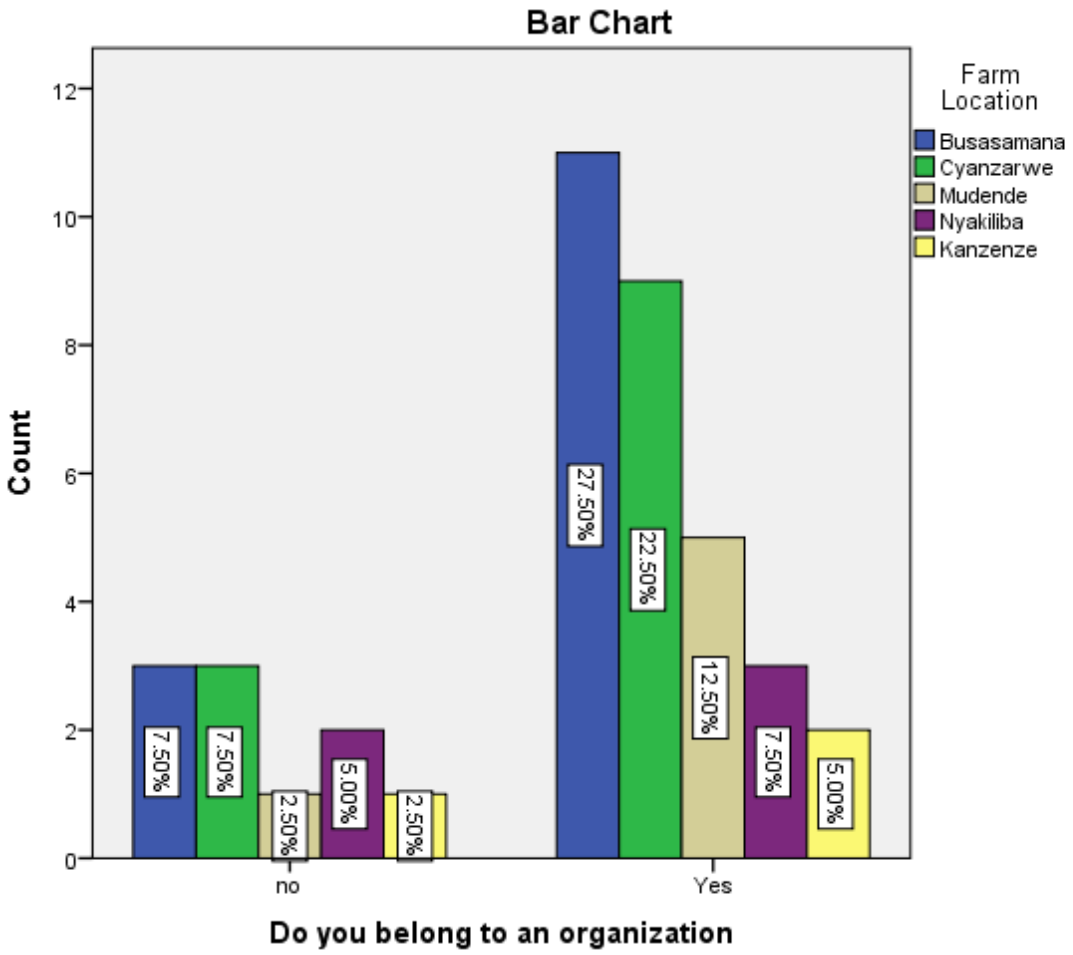
Figure 10: Farmers level of Ubudehe and farm location



d. Participation in farmers' organizations

Regardless to the type of organization, the research was aim at looking if farmers are belonging to the organization. With the figure No 11, results show that 75% of respondents are registered at least to one farmers' organization. Nyakiriba sector has the highest percentage 40% of respondents who do not participate to the farmers' organizations compare to other sectors, it followed by Kanzenze 33%. The reason for these high numbers of individual farmers could be related to the fact that both sectors are bordering the main road Kigali- Goma which gives more opportunities of selling their produces easily and in addition Bazirete market, the famous horticulture market; is constructed in Nyakiriba sector.

Figure 11: status of participation of farmers in the organization



4.2. Current situation of red bulb onion value chain

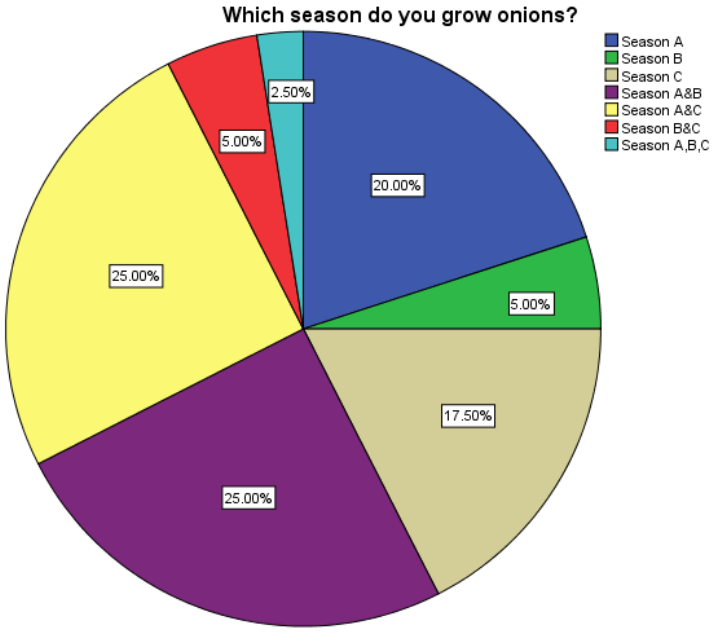
This section is describing the actual status of RBO value chain in Rubavu district resulted from survey findings about production, postharvest practices, actors and relationship status; current onion market and economic perspective of onion in the said district.

4.2.1. Current systems of onion production.

a. Growing seasons

The agriculture year period is subdivided into three main seasons. Season A covers September until December; season B: January- April and season C covers May until August. To get an idea on red onion value chain the research was zoomed into the growing seasons of onion in Rubavu district. Looking at the results presented in the figure No 12, it show that above 72% are growing onion in season A and 50% use season C to grow onions. 57.5% of farmers correspond to those farmers who grow the onion at least in two seasons.

Figure 12: Red bulb onion production periods



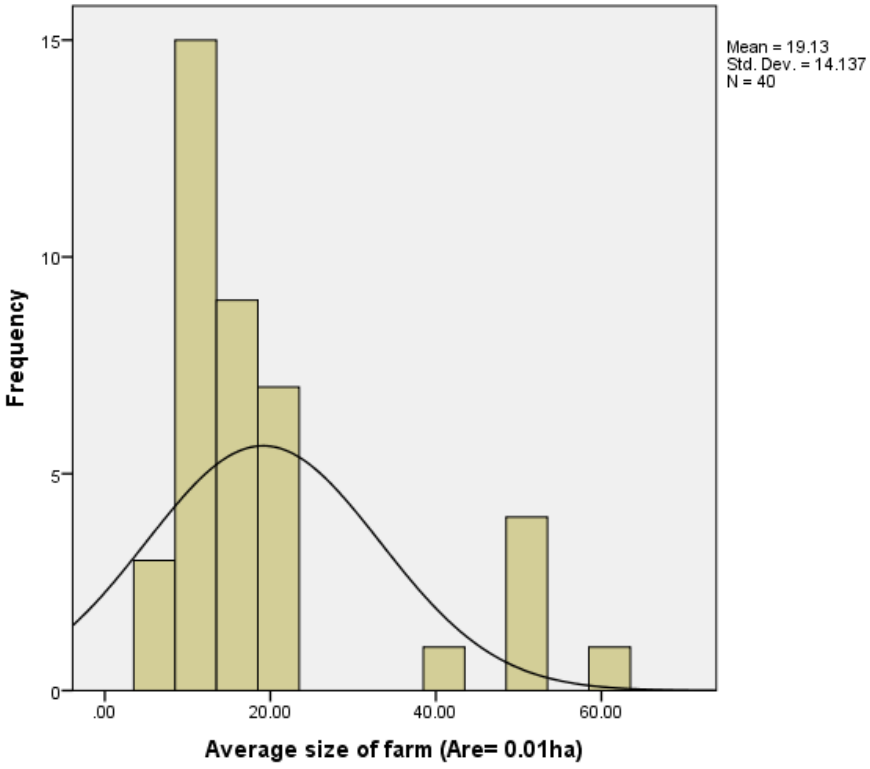
b. Responsibility for season planning

The respondent were requested to select among four stakeholders include farmer him/herself, cooperative, local government (sector or District) and central government from this list who is responsible for onion seasonal planning and all respondents i.e 100% are confirmed that the farmers themselves decides on what they will grow in terms of size of land, quantity and varieties of onions as well as which season he may grow the onion.

c. Average farm size

Individual farmer has the right to decide on the land size that she/he will use for onion production, however the results show that more farmers 85% grow onion on the size of land below 0.2Ha. Oneway Anova has used to test if there is a significant influence of Ubudehe in decision making for average size of farms at 95% confident interval and findings (see appendix 03) confirmed that there is no significant influence p-value (0.474) > 0.05

Figure 13: The average size of farm

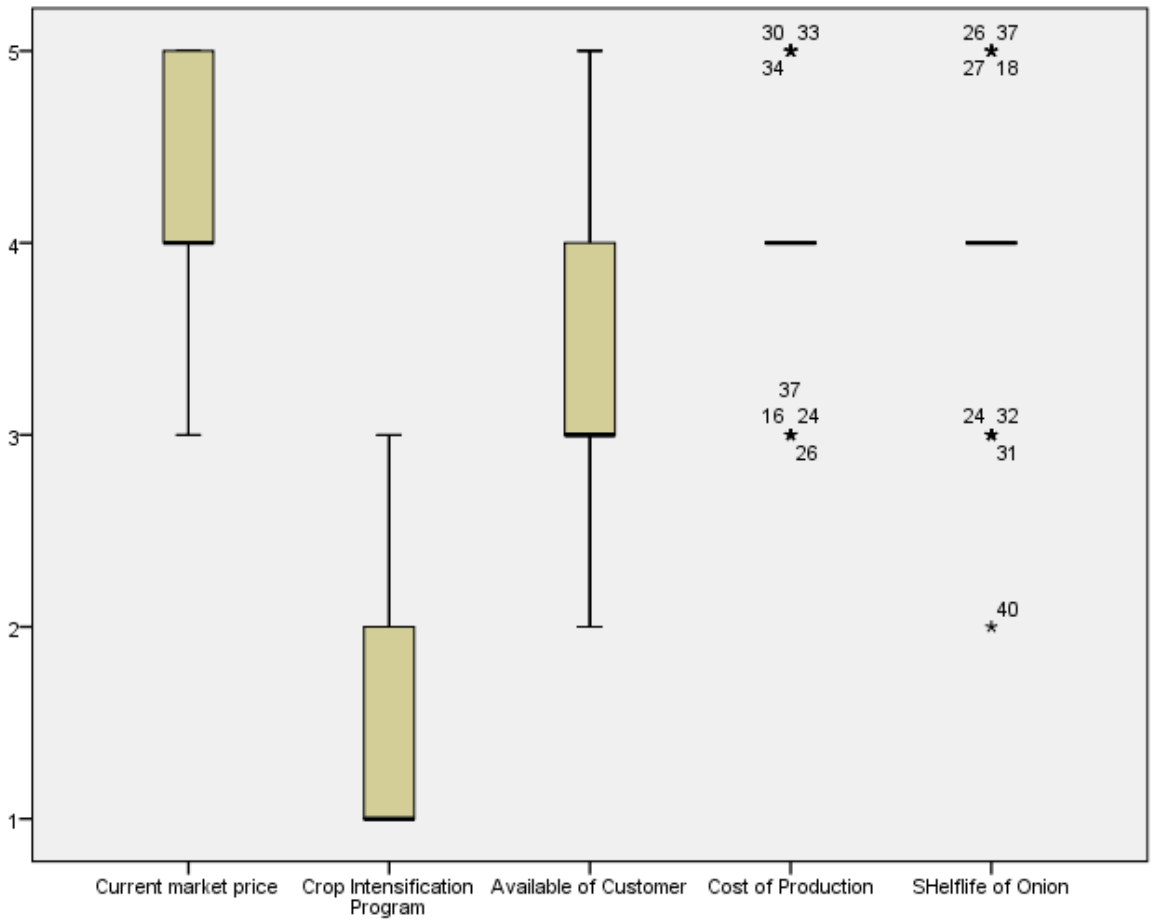


The one way anova test results can also give the confidence to conclude that level of livelihood of farmers do not influence the size of land farmers utilizing in red bulb onion production on the other hand average size of the farm results are in line with the findings of Turatsinze et al. (2014) talked about the land used by horticulture farmers in Rwanda.

d. Factors influencing farmer decision making on the size of farms

By ranking individual factor among the five listed factors and the farmers have given their opinions by giving 1: the least important to 5: very important. The results demonstrate that majority are more influenced by three factors include current market price, cost of production and shelflife of onion produce however the customer availability is also a factor which cannot be ignored as it shows that the majority of ranking 77.5% were in between 3-4.

Figure 14: Influencing factors to the farmer's decision on size of production



e. Average harvest per season

The research also was interested to know the average production hectare that farmer harvest however the farmers could not give relevant answers with the main reason that farmers in the surveyed region do not harvest themselves in general instead they sell non harvested fields to their customers and consequently farmers are not responsible for harvesting. Further results will go in depth about harvesting.

f. Intercropping practices

The respondents from all sectors surveyed had answered 100% that they do not practice the intercropping in the onion field. As farmers are not practicing the intercropping, the respondents could not respond the main intercropped product whereby they were asked to choose the main product among four categories include Irish potatoes, Maize, beans and other vegetables.

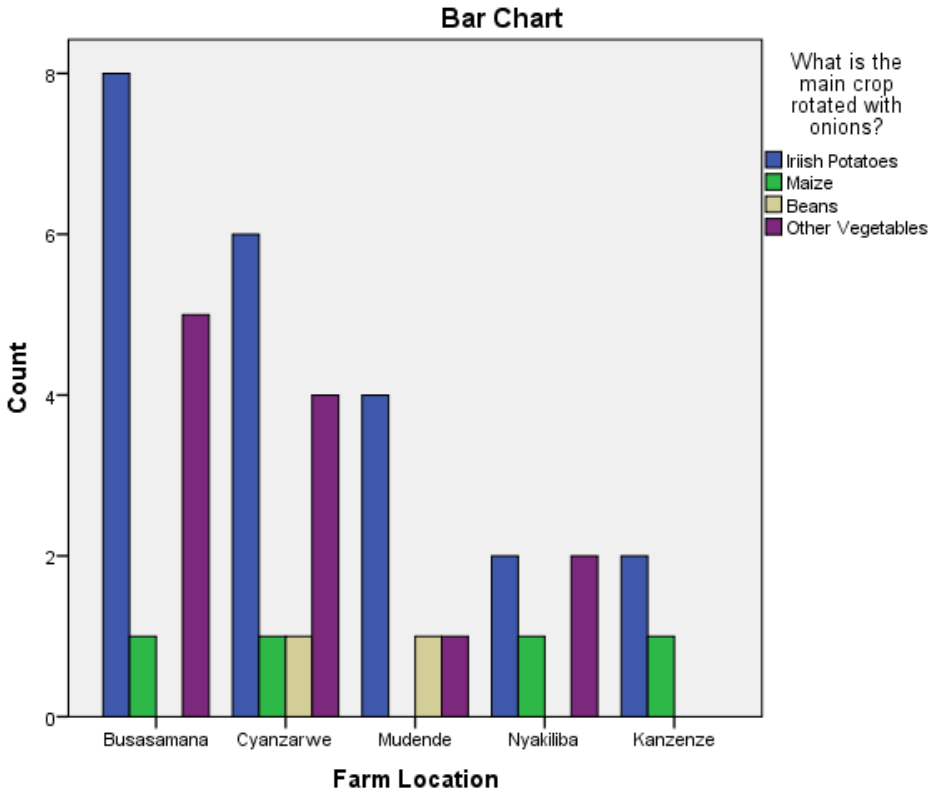
h. Rotation practices

Results indicate that above 97% of farmers do the rotations from onion production to other different crops every season. Some farmers subdivide their farms into many plots others grow just one crop one season and change the crop in the following season.

i. the main rotating crop

From four different categories of crops (Irish potatoes, maize, beans and other vegetables) farmers were requested to select the main category that recurrently in the rotation with onion production. Results demonstrate that 55% of respondents chose irish potatoes as main rotating crop, followed by different categories of other vegetables represented by 30%. Maize and beans are minors, one farmers mentioned that "we do not count bean because this crop grown with the purpose of the family consumption not for cash!".

Figure 15: Status of main rotation crop in different administrative sectors

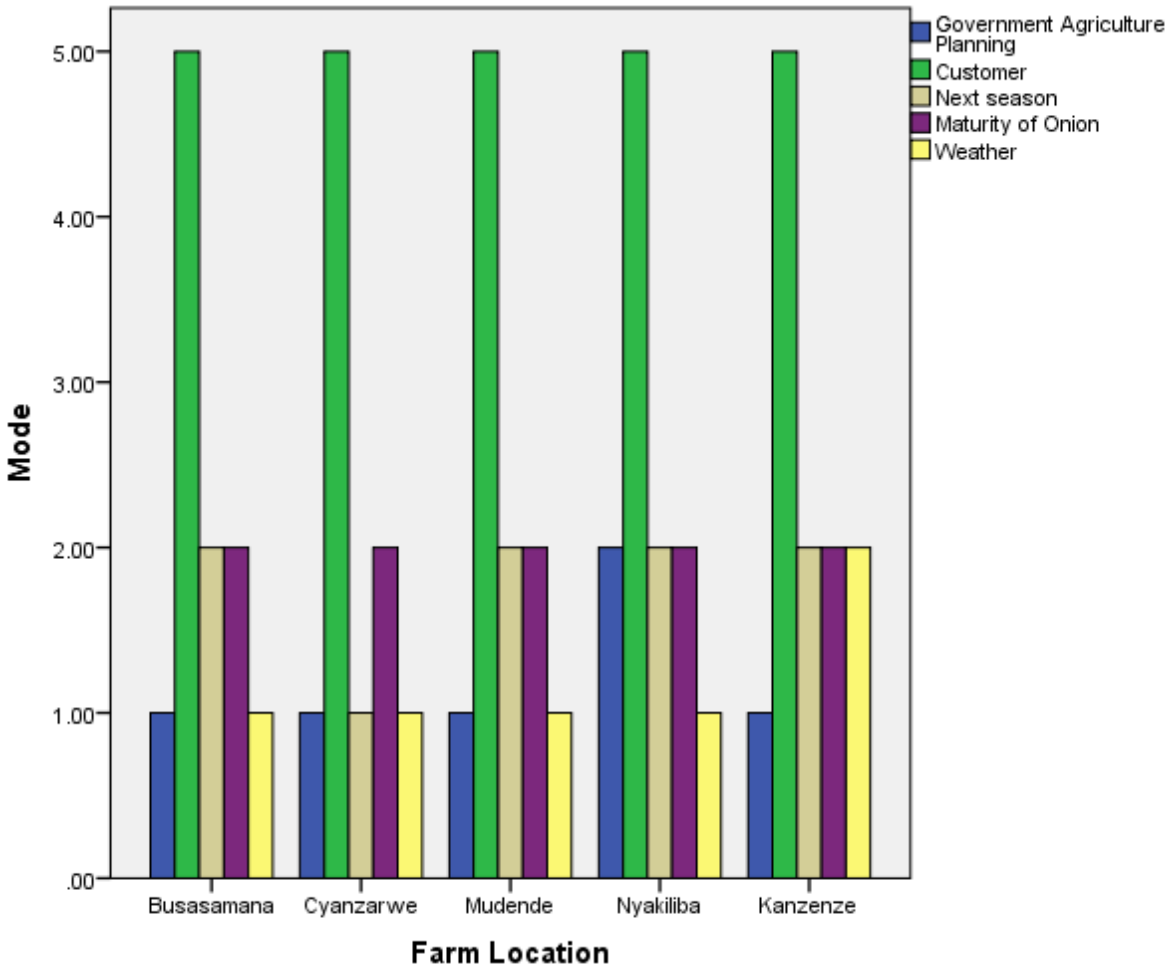


4.2.2. Current situation in postharvest

a. factor influencing the harvesting time

Comparing five factors which can influence the time for harvesting, respondents were ranked them according to what is most important. Findings show that farmers are fully 100% influenced by the availability of customers; least influencing factors are Weather and Government agriculture planning. On the other side the maturity of onion and the start of following season are little a bit influencing famers. Of course it understandable that rotation practices as seen in figure No 16 pushing farmers to prepare their land thus the influence of harvesting.

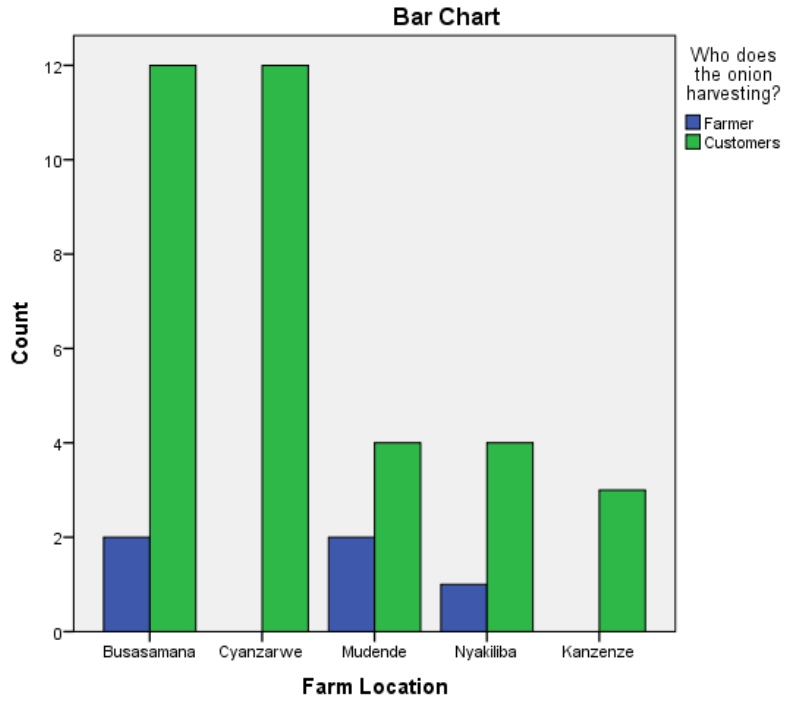
Figure 16: Factors influencing harvesting time



b. Responsible for Onion harvesting

Results demonstrate that 100% of respondents from Cyanzarwe and Kanzenze sectors confirmed that the responsibilities for harvesting are remained with their customers (i.e traders that buy from onion farmers). Busasamana na Nyakiriba sectors, above 80% farmers are leaving the responsibilities to customers respectively. The results here are also on the same line with results on the influence of farm size whereby current market prices is one of more influencing factors as well as factors influencing harvesting time. None of respondents agreed that their organizations some time take responsibility of onion harvesting yet 75% of respondents are belonging to at least one farmers' organization.

Figure 17: overview on stakeholders' responsibilities to onion harvesting

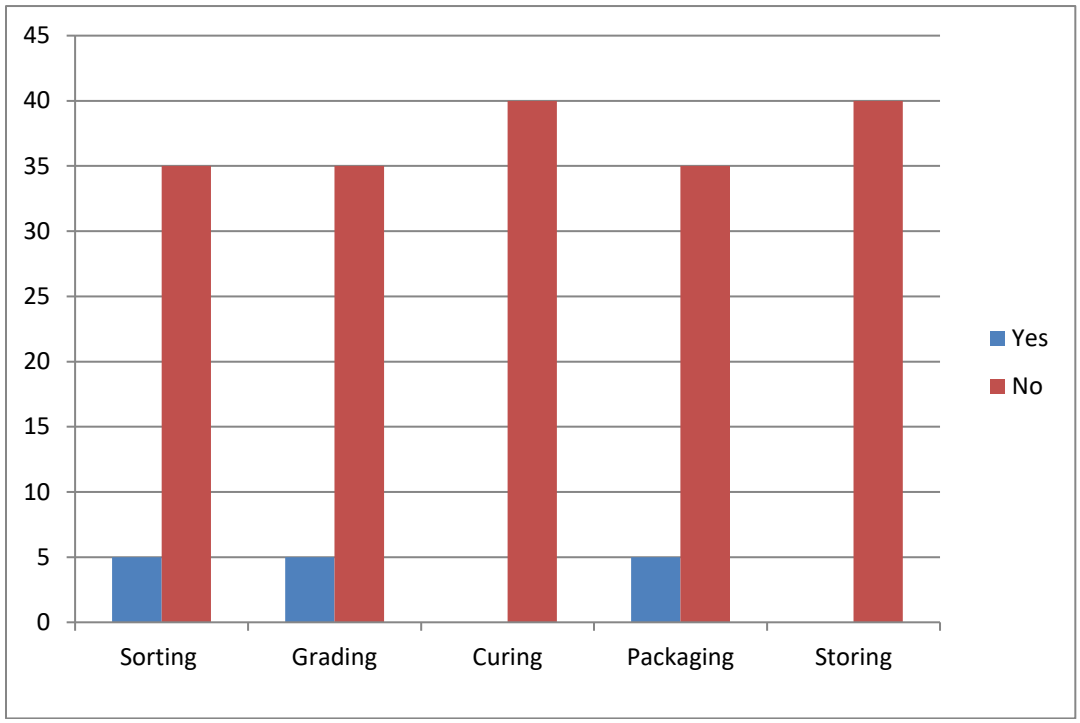


The Independent T- test (appendix 04) was performed to test is there is a significant different in average size of land that farmer using between different groups responsible for harvest. Results show that there no different p= 0.279 at 95% CI. Therefore both smaller and bigger farmers are more prefer to sell non harvested fields

c. Current good practice after harvest

Different best postharvest practices were proposed to the respondents to find out the current situation in the region. The findings demonstrate that 100% of respondents do not cure or store their onions production. Sort and packaging is done by only 13% of total respondents. See figure No...

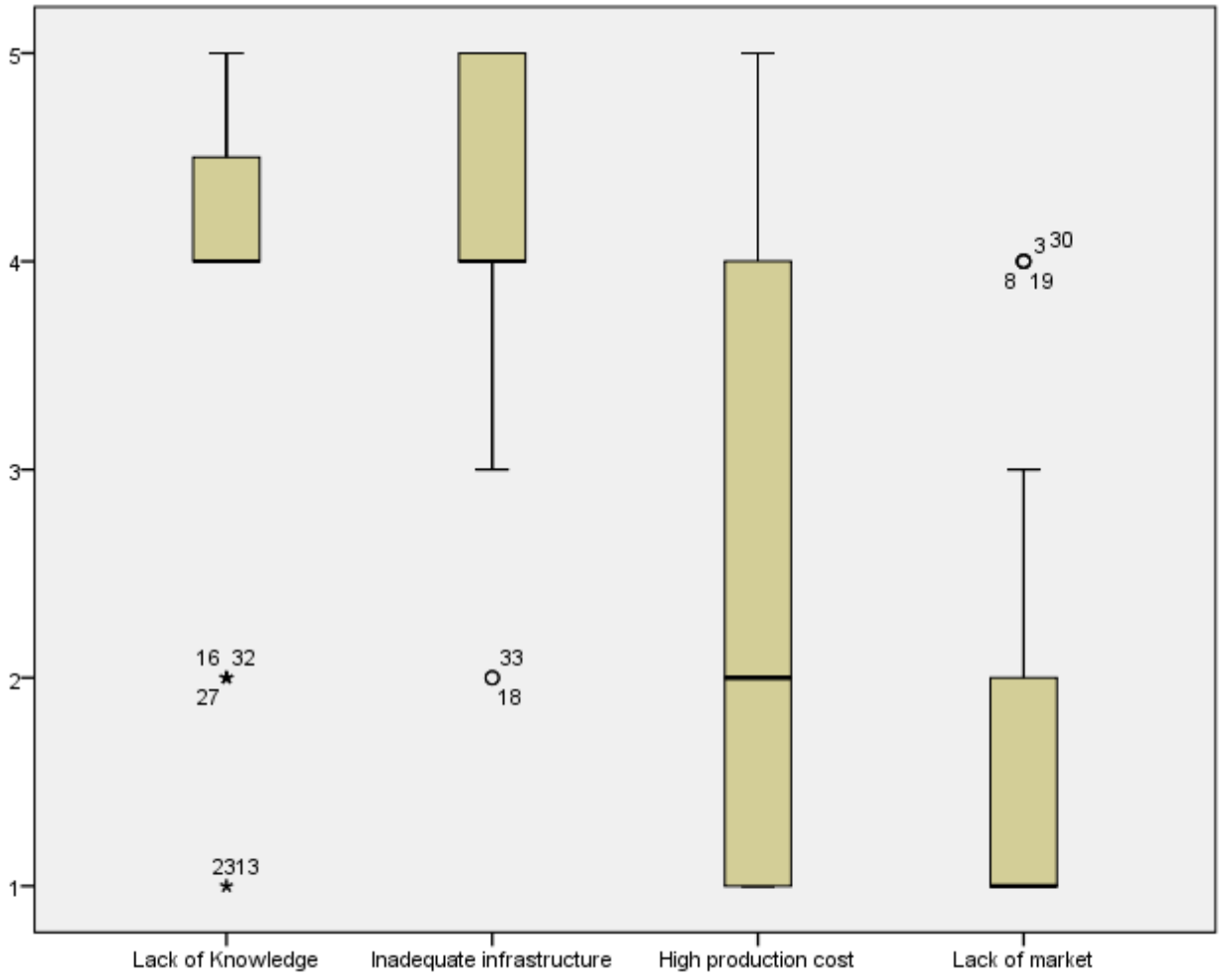
Figure 18: Current postharvest practices



d. challenges to the curing practices

ranking different challenges to the curing practices by giving 1: least important challenge and 5: very important challenge; results show that 82% highlighted that lack of knowledge for better practicing curing onion is one of main challenges moreover 90% of respondents show that infrastructure in place cannot facilitate the curing practices (refer to inadequate infrastructure on figure No 19) and it contribute as a big challenge. Cost of production and lack of market are some of challenges but not really significant.

Figure 19: Overview to the curing practice challenges



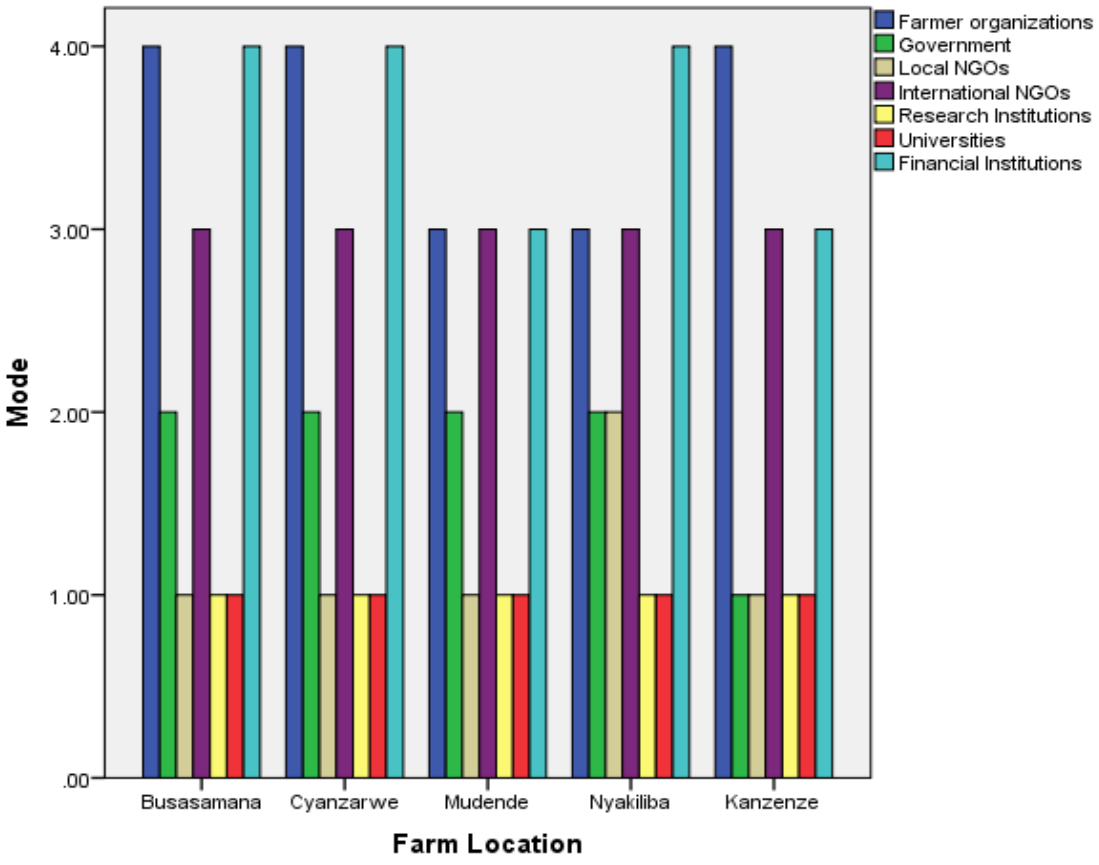
4.2.3. Current actors and chain relations

a. stakeholder involvement

Presenting to the respondents different actors to be chosen in according to their significance of involvement for supporting the sustainability of onion value chain, below figure No 20 summarize the results. Brief the respondents above 80% accept that farmer organizations are significantly involved however their mentioned that the support organizations bring is not really helping the commercialization of onions and it is the same case with financial institutions mainly SACCOs (Savings and Credit Cooperative Organizations). 63% agreed that international NGOs give their support to the chain on average. However Universities, research institutions as well as local NGOs are very absent in the onion value chain.

Dominique a farmer in Busasamana mentioned that "when I grow onion I often approach my SACCO to give me a loan for working capital in my production season and pay back after selling however the interest late still high; it could be better if our cooperative facilitate on the inputs"

Figure 20: Overview of stakeholder involvement in different sectors

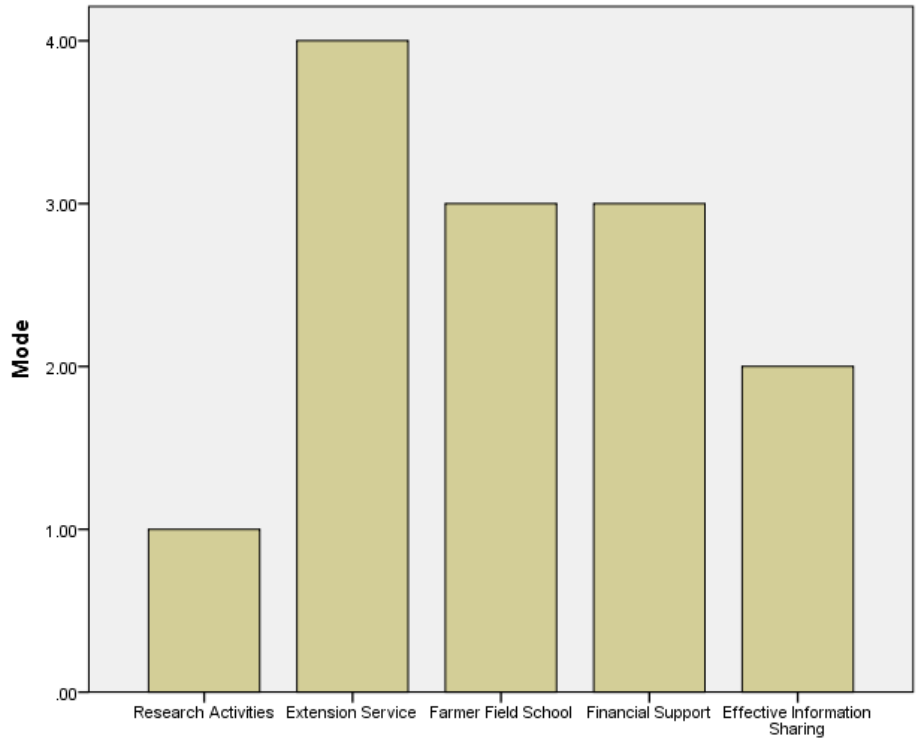


Financial institutions including SACCOs are more ranked by farmer due to the fact that they give farmers short term loan to help in agriculture production.

b. Supporting activities

Respondents were requested to rate (from 1: least important to 5: most important) different supporting activities regarding to how they are concerning with onion postharvest and summary of the results are presented on figure No 21 in summary the extension service is more concerned with onion postharvest compare to others, financial Supports and Farmer Field School program are on average involved in postharvest activities however Researchers and Information sharing programs are yet to support the onion postharvest.

Figure 21: Types activities supporter are involved



C. existing policies and regulation

The research again was interested to know if there is any applicable policy and regulation concerning the onion curing practices in Rubavu district and all respondents give a negative answer that there is no policy or any regulation in place.

d. agreements between farmers and stakeholders

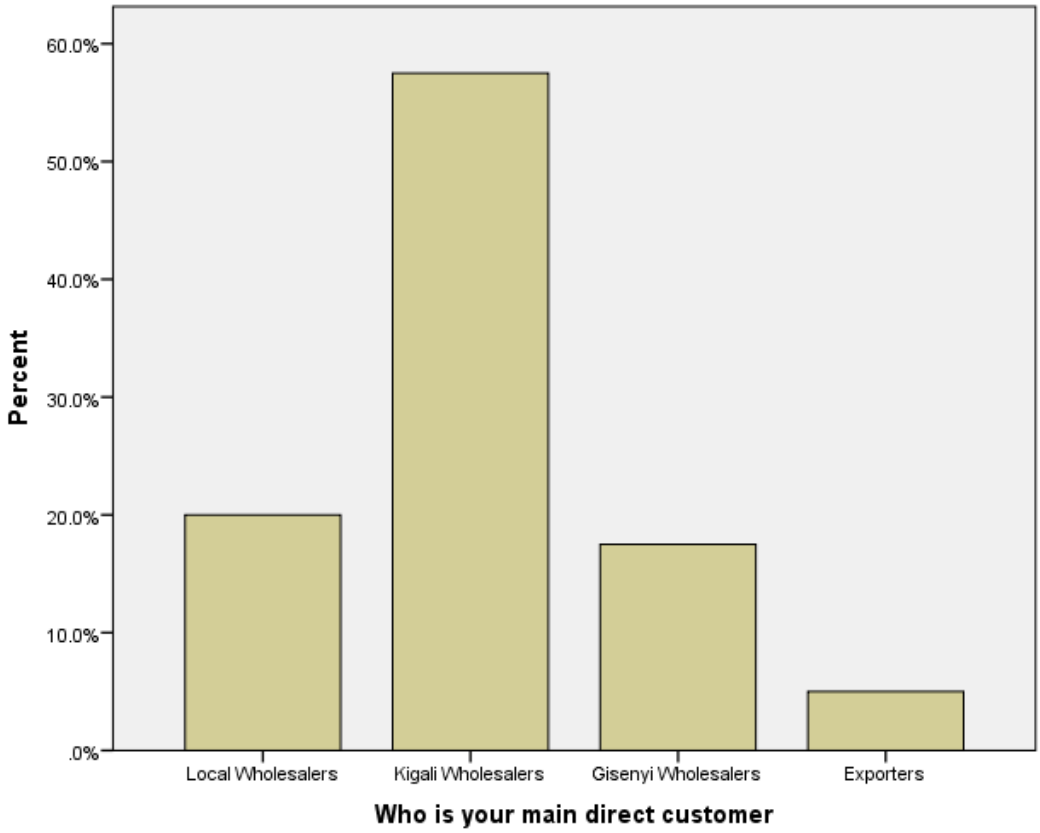
The onion farmers surveyed were asked if there exist binding agreement between them and different stakeholders such as farmer organizations, Governments, local and international NGOs; research institutions, universities and financial institutions. From the results they give, it shows that apart from 23% agreed that they have signed a contract with their farmer organization, no other agreement exist between farmers and any of the above listed stakeholders.

4.2.4. Characteristics of existing red bulb onion market

a. direct customer to the farmer

Among 8 different customers which are Cooperative, middlemen, local wholesalers, Gisenyi wholesalers, Kigali wholesalers*, Exporters, retailers and final consumers; the finding show that only four customers are only reaching direct to the farmers. 58% of respondents sell their onion products to Kigali wholesalers, 20% sell to local wholesalers, 17% goes to Gisenyi wholesalers and only 5% of responded farmers are selling direct to exporters. None of respondents accepted that he direct sell either to cooperative or middlemen. Retailers and final consumers were also on the list of respondents' choice.

Figure 22: Overview of direct customer reaching to the farmer

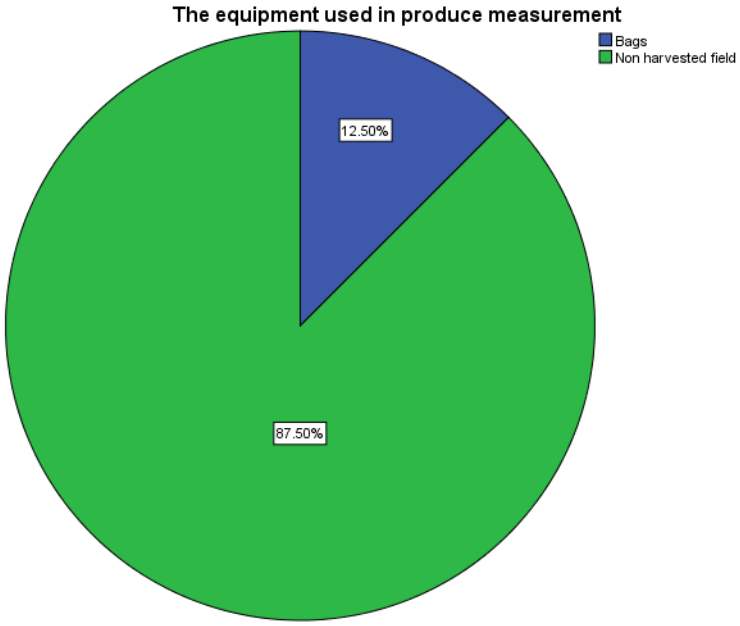


It has also observed that Kigali wholesalers could be wholesalers from other part of the country because after selling farmers are not interested to know where the production will be ended.

b. Measuring equipments

Looking at the measuring equipments that farmers use in order to sell their products, results illustrate that within four measuring systems commonly famers used include tying bunches, using bags, scales and balances, people also negotiate the field ready to be harvested. From those types measurement more spread in research area was that system of selling non harvested fields and findings show that above 87% of respondents using it. The rest 13% use filled bags to negotiate with clients. These results are also corresponding to the abovementioned findings of farmer who practising different postharvest best practices. The Independent T-testing (Apendix No 04) confirms that there no different in average farm size between farmers using bags and those who sell non harvested fields. P=0.279 at 95% CI.

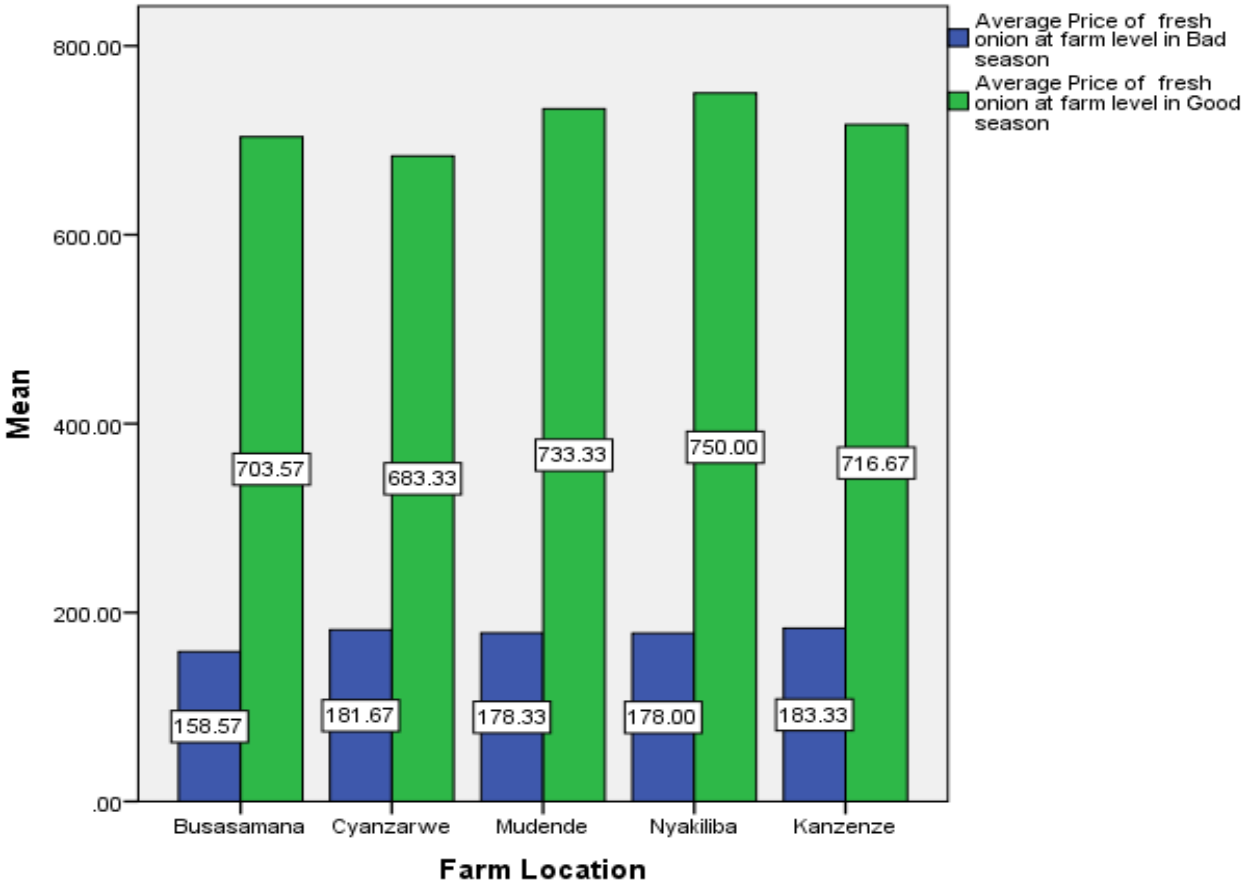
Figure 23: status of measurement equipments used at farm level



c. seasonal average farmgate prices

Figure No 24 gives the image of average prices in different administrative sectors whereby in good season the range is in between 703Rwf/Kg and 717 Rwf/kg. Considering the respondents answers, the average price of onion at farm level when it is good season is 709 Rwf/Kg while the average price when it is bad season falls at 173Rwf/Kg. The respondents fail to give the views on cured onion prices as they are not entering in that business.

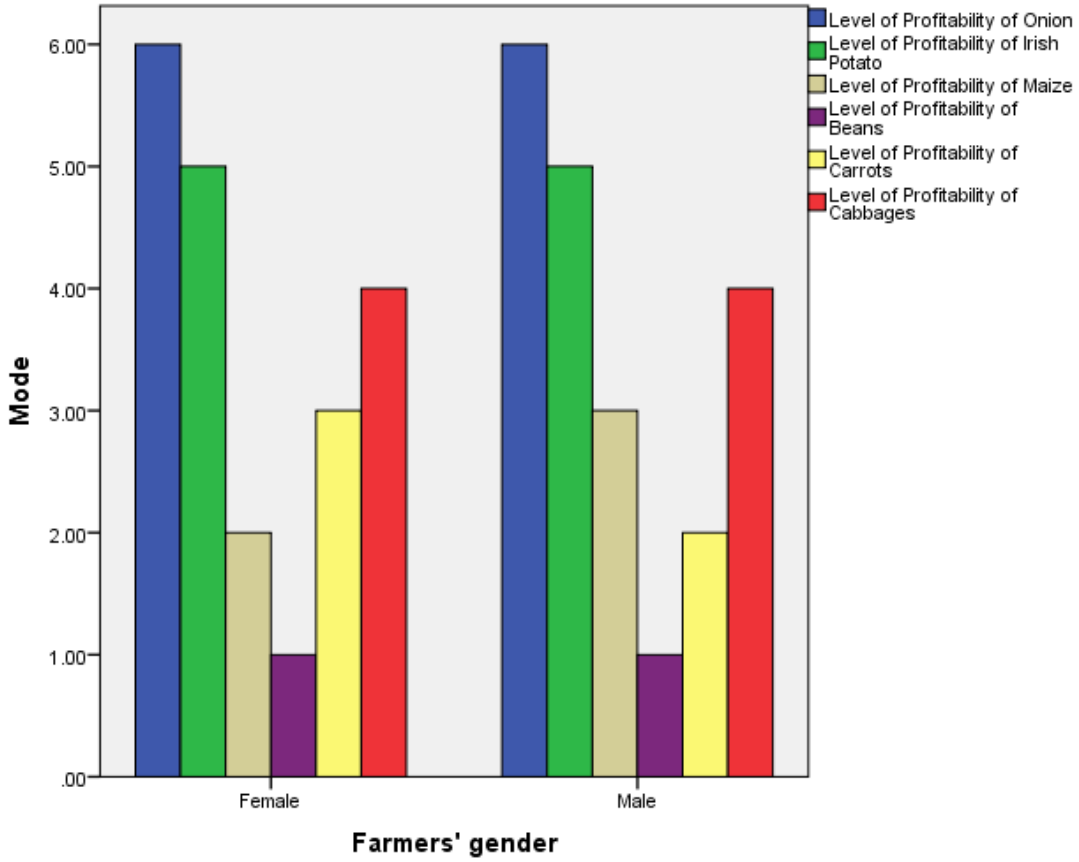
Figure 24: Average farmgate price



4.2.5. Economic perspective

By ranking different enterprises from most profitable to least one, results demonstrate (see figure No 25) that both males and females took Onion farming business as most profitable compare to others, followed by potatoes and cabbage at the third place. The only difference in the ranking is in between maize and carrots whereby females found carrots more profitable that maize and male see it on the other way

Figure 25: Profitability of different agriculture enterprises in Rubavu district



.

4.3. The possibilities of implementing onion curing practices

Below paragraphs are giving insights on different aspects including technological, logistical, organizational aspects that could be taken into consideration in regard to the curing practices and thereafter highlight the impact curing practices to farmers

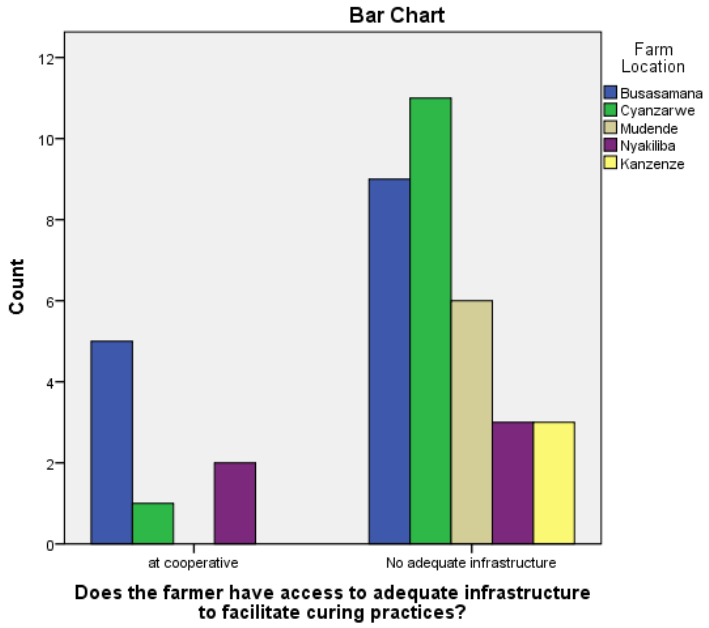
4.3.1. The technological requirements in curing practices

a. Current handling equipments

Comparing three different handling equipments which are plastic crates, traditional baskets and plastic bags that currently might be used by farmers, the findings demonstrate that all respondents are using plastic bags in onion handlings and transport to markets.

b. Access to adequate infrastructure to facilitate curing practices

Figure 26: Access to the curing infrastructure



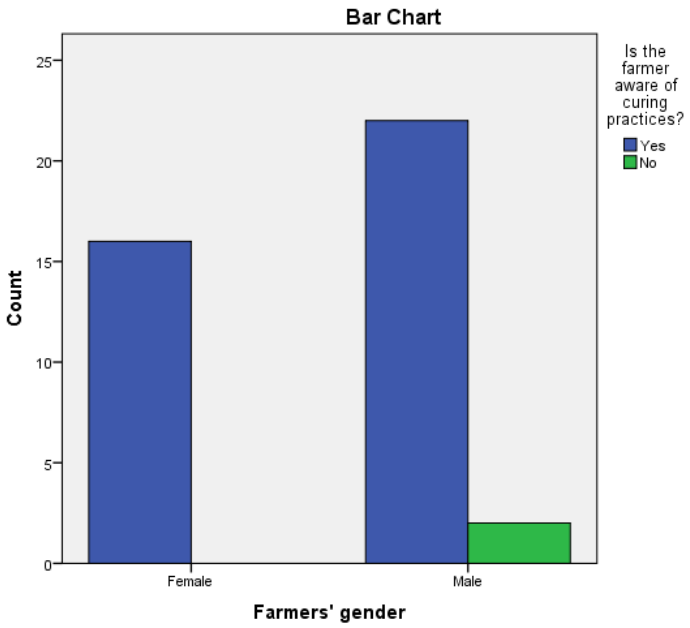
The research was also interested to know if farmers have the access to adequate infrastructures to facilitate curing practices. The infrastructure could be located at farmer house, at cooperative office, a public facility in the regional or no appropriate infrastructure at all; and results showed that only 20% of respondents said that the can access at the cooperative office. 80% responded that they do not have adequate infrastructure at all. None of respondents from Mudende and Kanzenze sectors mentioned that there is any facility around them.

Among the 20% respondents who said that there are some infrastructures for curing at cooperative level, 100% accepted that the facilities have access to electricity however survey showed that these infrastructures do not access to potable water as indicated by 100% no response given by respondents.

c. Awareness of curing practices

100% of females surveyed are aware of curing practices whereas the majority of male are also said they are aware only 8% respond negatively.

Figure 27: Status of curing practices awareness

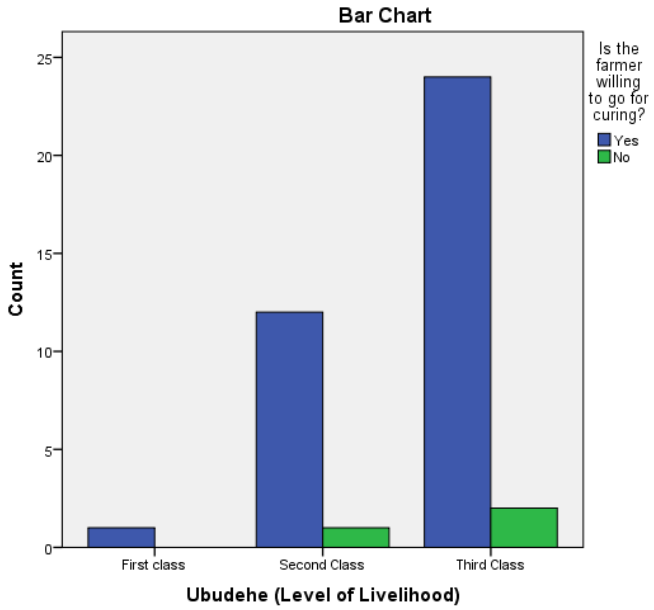


4.3.2. Economical factors influencing curing practices

a. Willingness to go for curing practices

The willingness form the farmers to go for onion practices are very high 93% of respondents show the interest of curing their onion production. Looking at the angles of Ubudehe classes; 100% of the first class as well as 92% of both second and third classes are willing to do onion curing in order to manage their production.

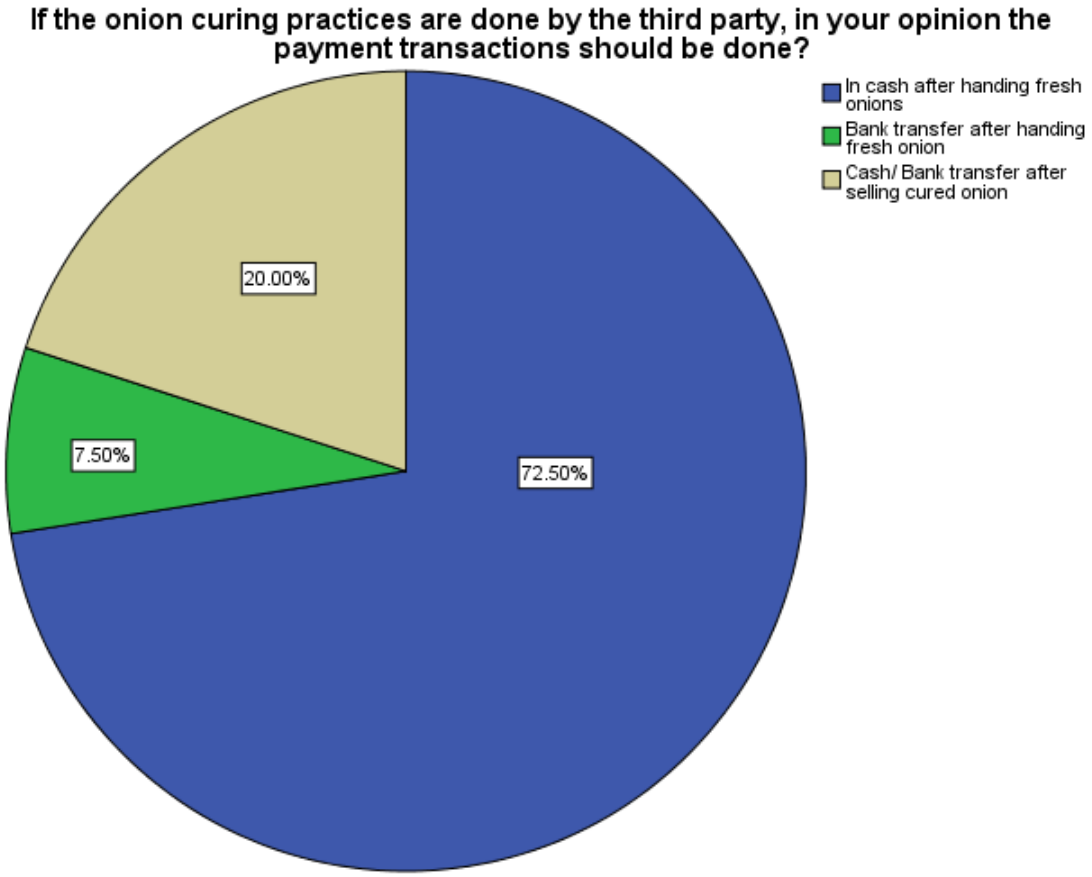
Figure 28: Status of farmer willingness to go for curing practices



b. payment transactions

The results illustrate that majority of respondents 72.5%, willing to be paid at spot when the supply the onion production. However 20% of respondents do not have any issue about payment modalities and they can even wait the payment until the cured onions are sold.

Figure 29: Opinion of farmer on payment procedures

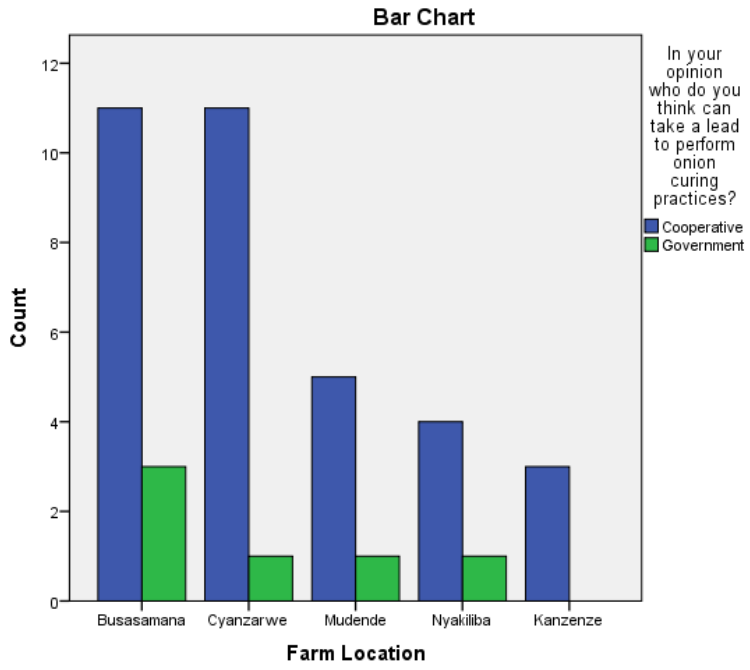


4.3.3. Logistic requirements for curing practices

a. Opinion of farmers to the responsible for curing practices

Consider the following stakeholders: Farmer, farmers' organizations, wholesaler, government and NGOs; farmers' selected one stakeholder whom they feel can lead the onion curing practice. The results show that majority of farmers wishes that cooperative should take onion curing practices; respondents from Kanzenze sector are 100% confident that with cooperative the curing practices will run well, followed by Cyanzarwe 92% of choosing cooperative. On average cooperative were chosen 85% while government has the remained 15% shares; none of respondent give a trust neither to wholesalers nor NGOs.

Figure 30: Farmers' opinions to the responsible for curing practices

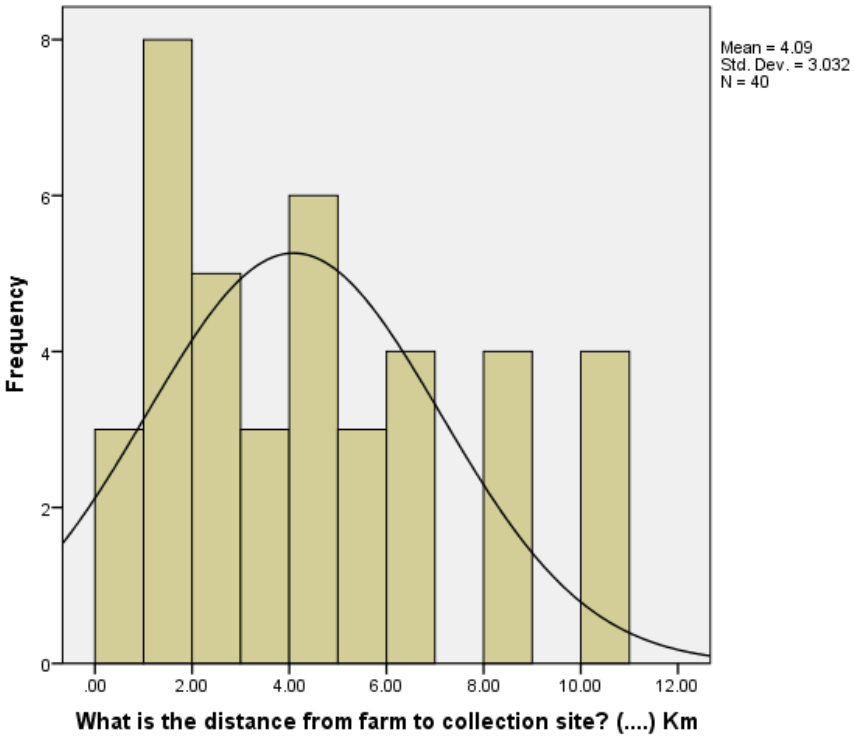


b. Distance from farm to collection sites.

The farmers are located in wide range from their collection sites; the shortest distance is 100 meters while the longer distance is around 10km. The average distance to collection sites is 4km see the figure No 31 and above 60% of respondents' farmers located in less than average distance from their collection centres.

On the other hand majority of the onion farmer are very close to the feeder roads, 97% of the farms are located on approximate of 2km to the feeder roads and 75% emplaced with a kilometre from the road.

Figure 31: overview of distance between farmers and collection sites.



c. status of roads

The surveyed farmers were requested to rank the status of their feeder roads from 1 stand for the very bad status to 4 for very good road. The below table No 32 demonstrate that the road which are used by farmers are not bad in additional to this, 75% of respondents agreed that their road from farms are good and mentioned that those roads are well managed by "umuganda" the community work on public utilities.

Table 2: status of road used by farmers

How are the existing feeder roads?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	10	25.0	25.0	25.0
	Good	30	75.0	75.0	100.0
	Total	40	100.0	100.0	

4.3.4. Organizational structure

To get an idea on farmers as well as the entire value chain of onion in Rubavu district, the survey try to discover different matters by letting farmers respond the following number questions;

a. Regarding to the production ownership, respondents at 100% were confirmed that their farmer organizations do not take responsibility on the production. Farmers look after their production or responsibility took over by their clients.

b. Collective market: though the majority of farmers are belonging to different farmers' organizations, marketing of their production still done individually this is in line with the results which showed that 100% of onion farmers said that their production is sold by individual farmers.

c. looking at how money transaction are currently done by comparing whether it is cash between farmers and customers or cash between farmers and their organization or bank transfer from one of direct customer to farmers; survey results show that 100% of respondents prefer cash payment on spot after selling the product.

d. Considering the organizational status of farmers' clients; the findings demonstrate that all customers who approaching farmers come individually; currently no registered organization or even non registered organization of customers which come to buy products from farmers.

e. looking into the types of agreements between farmers and their customers; farmers 100% responded that there is any kind of agreement between them and their clients whether written or not however they mentioned that some of them keep the contact of their clients so that they can remain in contacts one another.

4.3.5. The impacts of onion curing practices on the income of red bulb onion farmers.

a. Opinion of farmers on average farmgate price for onions

The respondents had given the interesting answers about farmgate price for onions. Observing the below table No 03 it shows that 90% of respondents are satisfied with Rwf 500/kg as farmgate price and slightly below the average 47% we mean, they can be attracted by Rwf 400/kg. From different opinions of respondents about farmgate price, the calculated average price is equal to Rwf 441/ kg.

Table 3: Opinion of farmers on red bulb onion the average farmgate price

- **From your opinion, what the average farmgate price per kilogram can attract you to sign a long term contract.**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	300.00	4	10.0	10.0	10.0
	400.00	11	27.5	27.5	37.5
	450.00	16	40.0	40.0	77.5
	500.00	5	12.5	12.5	90.0
	550.00	1	2.5	2.5	92.5
	600.00	3	7.5	7.5	100.0
	Total	40	100.0	100.0	

b. Cost of red onion production per season

Regardless to difference in season input requirements, ten red onion farmers have randomly picked and requested to calculate the total cost that incur in onion production per season in their farms. Results were converted to give the picture of seasonal total cost per hectare. Below table No 04 illustrate final results. The calculated average cost of red bulb onion production per hectare equal to 1,837,000 Rwf. Farmers have mentioned that onion in general requires high amounts of inputs compare to carrots and cabbages however in normal circumstances farmers cover their cost and make higher profit than other two commodities mentioned. Higher cost also is one of limiting factors to the production of large fields in the surveyed region.

Table 4: Average cost of red bulb onion production

Farmer No	Total Cost/season	Size of the farm	Cost per Ha (Rwf)
1	252,600	0.06	**4,210,000**
2	402,000	0.20	**2,010,000**
3	225,400	0.09	**2,504,444**
4	85,100	0.12	**709,167**
5	297,000	0.60	**495,000**
6	567,500	0.50	**1,135,000**
7	426,700	0.40	**1,066,750**
8	158,900	0.20	**794,500**
9	324,750	0.09	**3,608,333**

B. Findings from case study

4.4. Overview of the conducted interviews

The presented results in this section are from data collected during interview as well as observations with different stakeholders in onion value chain of Rubavu district. Wholesalers, retailers, Sectors agronomists, AGRITERRA, PASP, RPLR and NAEB were interviewed in this research. Results from key informants from projects and government were summarised in two main categories weak and strong points in the red bulb onion value chain.

4.4.1. Interview with onion Wholesalers

Five wholesalers are randomly interviewed to get in depth information about red bulb onion value chain. Looking at their operational areas respondents were in two categories 40% were local wholesalers (operate in Rubavu market) and 60% were from Kigali market. 3 wholesalers were females. Year of experience in the onion wholesaling activities were ranging between 1 to 7 years and 80% have above 3years in the wholesaling activity.

- Short description of onion wholesaling activities

The operations of wholesaling are done in different ways considering the individual market. In Rubavu Wholesalers are those stakeholders who brought onion production in bulk from farmers to Ruvabu market (Mbugangari market), these types people mainly sale their produce to either retailers or DRC Congo onion importers and its slightly different Kigali wholesalers. The majority Kigali wholesalers deal with other semi-wholesalers who are based in different markets within Kigali town on the return the semi-wholesalers sell to retailers or other big institutions such as restaurants and schools. Dealing with retailers is rarely happen mentioned by interviewees.

- Origin and season of red bulb onions

Local wholesalers of Rubavu are only sell the regional grown onion, the confirmed that they always got some onion products to buy from different corners of Rubavu districts however the quantity are very different; much farmers harvest in midi December up to February and also the production raise in July-August period. While Kigali wholesalers are sourcing the produce in different areas mostly Rubavu, Kamonyi and Bugesera in June until midi September; From September to January source the onion largely in Tanzania and Rubavu and Tanzania the the other period.

During visit of Nyabugogo Market in midi August, researcher observed that there were no onions from Tanzania and Semi-wholesalers were trimming their stored onions because some were started to germinate.

Picture 1: Trimming of germinated onions in Nyabugogo

Picture 2: fresh red bulb onions in Kigali

- Red bulb Onion quality and prices

Generally the wholesalers categorise the onion according to their origins and the common categories are Rubavu (sometime Gisenyi), Kamonyi, Bugesera and Tanzania. Main differences between those categories are sizes and status of dryness. Preferred category is Tanzania, Rubavu followed. Prices are fluctuated much depends on the availability of production all respondents mention that. And it is also said that when Bugesera and Kamonyi are in pick season most of the case the price goes down and it rose when onion from Tanzania come in.

- Organizational aspect

80% of wholesalers mentioned that they purchase from individual farmers, sometime we harvest ourselves other time we but harvested onions. 60% don't like the contract because the onion seasons and prices are not predictable; they keep changing day by day said by interviewees.

Payment modalities with onion farmers are 100% by cash otherwise competitors may carry the products; on the other side clients are generally use post pay system thus they pay at the end of the day after selling products.

Researcher remarked that apart from cash transactions; the mobile money transactions are now spread all over. And it is also observed that an actor known as "Chercheur" in Rubavu, is valuable stakeholder in onion chain. This work as a broker keep informing wholesalers where the production or field ready to be sold are located and sometime Chercheur facilitate in price negotiations.

4.4.2. Interview with onion retailers

Six onions retailers from open market or shops were interviewed to get a deep insight on onion value chain, seasonality, origin, quality and prices.

67% of interviewed retailers were the females and respondents were above two year of experience; the most experienced interviewed was 5 year in onion retailing. These retailers are not only deal with onion retailing, but also they mix onion with other kind of horticulture commodities. In addition shops are containing even more that horticulture.

Retailers 80%, working individually they are not registered in different organizations; however they are registered in local government and they are paying some taxes.

Suppliers & Clients

We source the onions in different Kigali wholesaling sites mentioned by respondents, above 80% they often go to Nyabugogo market. The direct suppliers are semi-wholesalers based in big wholesaling markets. Clients are individual people who come to procure for their families.

Red bulb Onion seasonality, origin and prices

Retailers are confirming that the origin of onion commonly known are Rubavu, Kamonyi(sometime Mugina), Bugesera and those from Tanzania. For retailers, onion seasons are much relating them with prices. They know that wholesaling prices get higher when onions productions are low within the country. The interviewees could not identify the seasonal periods because it keep changing within short period of weeks. Average wholesaling price in off season is around Rwf850/kg purchase price whereas price when onions are abundant is Rwf250/kg

Red bulb Onion quality and clients preferences

Mainly onions in retailing market are classified in three classes according to the sizes Big, Medium and Small. Big onions are preferred by institution with large number of consumers or families who prepare salads kind of meals, medium ideal to wide categories of clients. Apart from size, clients like the well dried onions because they have long shelflife as well as attractive look

Researcher noticed that retailers have small informal organizations "Ikimina or societe" not really for the purpose of their job but for helping them to save of money and get easy small amount of loan. With observation also we realized that some retailers had onions that showing signs of degradations or germination.

Picture 3: defected onions

Picture 4: onions in market store start germinating

4.4.3. Interview with Sector agronomists

Busasama and Cyanzwarwe sector Agronomists were interviewed on the service offered by sector as well as district vis a vis the onion value chain.

Role of local government mainly remained on the sensitization, extension services and organizing the agriculture sector in accordance to the centre government priorities. Both sectors do not have any specific program that look after the onion value chain apart from declaring the size of acreages that will be occupied by horticulture in general during the fiscal year.

Strong points in RBO value chain.

- Climate and soil of the region are favourable
- Experienced farmers
- Market opportunities from DRC, Uganda, Kigali and other part of the country
- Government projects and NGOs are willing to partner with horticulture investment projects
- in the region onions are one of the best profiting agriculture enterprises

Weak point within RBO value chain

- Insufficient service provision of the farmer organizations
- Lack of market information sharing system.
- Lack of onion storing technology at farm level

4.4.4. Interview with AGRITERRA Rwanda

The business advisor in AGRITERRA Rwanda Mr. Peter Ntaganda was interviewed and he mentioned that Agriterra is a non government organization with headquarter in Netherlands. In relation with onion value chain, the organization has already started operating in 6 districts of Rwanda including Rubavu to support farmer organizations in different activities such as:

- Capacity building programs include trainings, peer to peer advisory service as well as Agri-pool missions whereby Agriterra facilitate to bring the experts people to the farmers to share the experience. Mainly capacity building concern with empowering farmers with best good agriculture practices.

- Financial support: whereby Agriterra helps to develop the long term action plans of farmers organizations and facilitate in the implementation in both technical and financially

- Support services in the strengthening of value chain; whereby it helps in the improvement of governance, financial management and business development. Agriterra support farmer in identification of buyer and organize match making sessions.

Strong points in RBO value chain.

- Different organizations are present to help horticulture sector including onions chain
- Onion is a cash crop in general, farmers produce onion targeting money
- Long term storage properties.

Weak point within RBO value chain

- Inadequate extension services
- Lack of ownership in the value chain about planning and implementation
- Lack of long term strategy for onion value chain
- Price fluctuation

4.4.5. Interview with PASP project

Postharvest and Agribusiness Support Project (PASP) implemented by ministry of agriculture, aims to develop an efficient system driven by private sector to reduce postharvest losses and ensure food security of staple crops. Project goal is to alleviate poverty, increase rural income and contribute to the overall economic development of Rwanda. The PASP Rubavu district coordinator was interviewed.

Strong points in RBO value chain.

- Availability of financial support in postharvest equipments and infrastructure
- Free and accessible experts in horticulture postharvest extension services
- The country long term strategies aim at transforming the current agriculture into business cases in Rwanda.

Weak point within RBO value chain

- Lack of driving strategy for onion value chain
- Lack of strong farmers organizations in onion value chain
- Inadequate information sharing systems

4.4.6. Interview with RPLR Project

Reducing Postharvest Losses in Rwanda Project is a project sponsored by USAID and implemented by Horticulture Innovation Lab. The project aim at educating people on postharvest and raise awareness of relevant stakeholders in agriculture about the basic postharvest technologies which easily can be adapted by small farmers. The RPLR project offer free training and advisory on postharvest technologies as well as services to the interested stakeholders. The interviewee was Senior Postharvest Speciality at Mulindi station.

Strong points in RBO value chain.

- Onions handling techniques are not sophisticated compare to other horticulture
- Low perishable compare to other horticulture products
- Long storage period properties

Weak point within RBO value chain

- Insufficiency of appropriate infrastructure at the ground
- Insufficient awareness training across the value chain
- Lack of appropriate information about the onion value chain

4.4.7. Interview with NAEB

NAEB has mission to boost the Rwandan economy through the increase of agriculture export and diversification exportable agriculture commodities. Onion value chain and horticulture in general, NAEB contribute to the long term plans and strategies; offers technical advisory, extension services, sharing information and support in the organization of value chains. All the services and supports to value chain should be in line with the straightening the export value chain.

Strong points in RBO value chain.

- In Rwanda horticulture business are in priority
- Existence of many projects offering technical and financial support services
- Onions can be easily handled
- Market opportunity within country and in the region

Weak point within RBO value chain

- Lack of strong farmer organizations in the onion value chain
- lack of long term strategy to guide the value chain
- ineffective value chain coordination among actor and supporters
- lack of enough information on onion value chain
- affordable onion storing technology and equipment at farm level
- poor management of onion production

4.5. Consolidation of Red bulb onion value chain in Rubavu district

This section draw the information in the previous findings gathered from different stakeholders by using survey, interviews and observations.

4.5.1. Stakeholder matrix

The matrix is vision presenting different actors and supporters identified in RBO value chain in Rubavu district, their functions and brief description of stakeholders' activity.

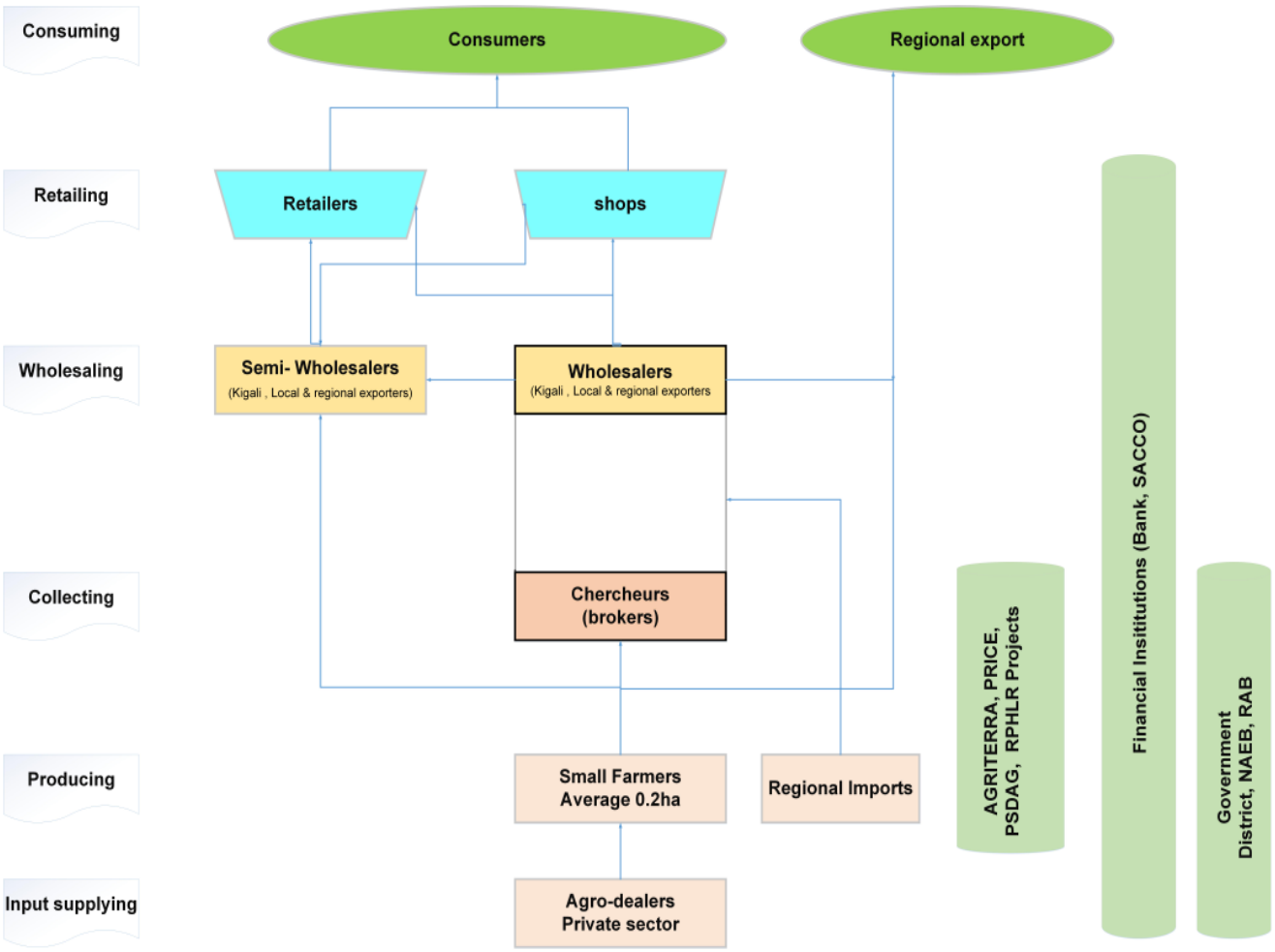
Table 5: Stakeholder matrix

Functions	**Stakeholders**	**Brief description of stakeholders' activity in the onion value chain.**
Input Supply	Private Agro-dealers	Supply all kinds of inputs to the farmers
Production	Small farmers	Producing red bulb onions
Collection	Chercheur (Broker)	-Match making farmers and buyer -Product and market Information sharing
	Wholesalers	- Responsible for harvesting - collections of production - transport
Wholesaling	Wholesalers (Kigali , Local & regional exporters)	Supply onion production from farm to large markets in different region of the country
	Semi- Wholesalers (Local & regional exporters)	Source from wholesalers and distribute onion production to retailers
Retailing	Retailers (open markets retailers & shops)	Selling the onion production to end consumers
Consumers	Individual, institutions, regional markets	End consumers of onion production
Supporters	Government (NAEB & RAB)	- Regulatory services of Value chain - Advisory services - technical and financial support services - Spreading information to stakeholders
	Local Government (District& Sector)	- Sensitization - Extension service on the policy implementation
	Agriterra	- Capacity building - support in production marketing - technical and financial support
	PASP, PSDAG & PRICE project	- Financial support of postharvest equipment and infrastructures - capacity building
	RPLR project	-Postharvest education - Raise awareness on basic postharvest technology

4.5.2. Red bulb onion Value chain in Rubavu district

The chain map below (figure No 33) is giving the picture of the situation of actors and supporters, product channels and different functions currently characterizing the RBO value chain in Rubavu. It was drawn using different data collected in this research.

Figure 32: Current chain map of red bulb onion value chain in Rubavu district



4.5.3. SWOT and PESTE for onions value chain in Rubavu district

Below matrix summarized the research findings from relevant stakeholders into strengths, weakness, opportunities and threat on the other hand results also have classified into political issues, economical, technological, social, and environmental issues.

Table 6: SWOT and PESTE matrix

	Strength	**Weakness**	**Opportunity**	**Threat**
Political	-Government organization responsible for horticulture	- lack of onion value chain strategy - lack value chain coordination	- horticulture is on government priority - existing of Agricultural information center	
Economical	- Onion is a cash crop - onion are produced whole year round - high demand	- insufficient production - postharvest looses - inadequate information flow - absence of low cost technology at farm level	- large market opportunities - onion is profitable business - Strong relation between onion farmers and local financial institutions	- Onion price fluctuation
Social	- majority of farmers belong to organization - experienced farmers	- weak farmer organization -week relation among the stakeholders	- job creation - existing government program for strengthening farmer organization	
Technological	- easy to handle - long shelflife - High production in peak season.	- poor handling - lack of appropriate infrastructure - insufficient extension services - Poor management of onion production	- more technical and financial support - Good feeder roads	
Environment	- productive field - onion are produced whole year round		- favorable soil and climate	

4.5.4. Added value and value share

This section will highlight added value and value share calculated based on findings that researcher was accumulated using desk review, survey and interviews. Prices which will be used are a Range calculated by using higher and lower price.

The calculation

- Value Added = Selling price of the following actor- Previous actor's price
- Value shares = (Added value X 100)/Retail price
- Selling price= (higher price + Lower price)/2
- Average retailing price= Σ Average monthly retailing prices/ number of months

Table 7: current added value and value shares of RBO different actors

	Peak season					Off season			
Chain Actors	**Selling price (Rwf/kg)**	**Added value (Rwf/kg)**	**Value share (Kigali)**	**Value share (Rubavu)**		**Selling price (Rwf/kg)**	**Added value (Rwf/kg)**	**Value share (Kigali)**	**Value share (Rubavu)**
Wholesaler	173	173	31%	40%		709	709	69%	89%
Semi-Wholesalers	250	77	14%	18%		850	141	14%	18%
Retailer (Rubavu)	430	180		42%		800	(50)		-6%
Retailer (Kigali)	555	305	55%			1,030	180	17%	

Due to the system in place of selling non harvested field it is hardly to get an idea of what farmers are gaining in this value chain, it is probably the reason why at wholesalers have slightly high shared value. Retailers of Rubavu are prone to fall in deficit in off season, negative 6% of value shares, however it also seen in value chain map (Figure No 33) that Rubavu retailers prefer to make business direct with wholesalers, no semi-wholesalers in between; that mean retailers can easily raise up their value shares to 12%.(See table No 6).

4.5.5. Impact of proposed farmgate price on the value chain

Using different data aggregated in this research, the analysis come up with a picture of how RBO value chain may perform if farmers take up the harvesting activities into their responsibilities.

a. Impact on value shares.

Table No 7 below demonstrate that farmers can get 56% and 72% respectively in Kigali and Rubavu market if farmers decide to take harvesting responsibilities. Retailers of Kigali has more value shares compare to those from Rubavu however it could have a good reason if we consider the competition of onions from different places coming to Kigali market.

Table 8: Changes of added values and value shares

Proposal				
Chain actors	**Selling price (Rwf/kg)**	**Added value (Rwf/kg)**	**Value share (Kigali)**	**Value share (Rubavu)**
Farmer	441	441	56%	72%
Wholesalers	550	109	14%	18%
Retailer (Rubavu)	615	65		11%
Retailer (Kigali)	793	243	31%	

b. Impact on Return on investment (ROI)

Analysis showed that farmers could get 20% of return on their investment if vertically integrates by taking harvesting. Though research used FAOSTAT data on the average onion yield for Rwanda in 2016, in Rubavu onion productivity could be higher than 5MT/ ha. Moustaffa the chairman of KAIDU cooperative was mentioned that productivity is around 12-15MT/ha for one season (i.e four months).

Table 9: Profits and Return on investment (ROI)

Yield (Kg/ha)	5,000
Total revenue (Rwf/ha)	2,205,000
Average Total cost (Rwf/ha)	1,837,000
Profit (Rwf/ha)	368,000
ROI	20%

V. Discussion

5.1. The current situation of red bulb onion (RBO) value chain in Rubavu district.

a. The current systems of onion production

Red bulb onion production in Ruvabu district is characterized by individual small farmers with average of 45 years of age. 75% of farmers are belonging at least to one farmers' organization however production marketing and sometimes collection still being done by individual farmers (refer to section 4.1.1), this is in line with the Harmony (2014) and Mukundente (2017) findings which brings out about inadequate functioning of horticulture farmer cooperatives. 65% of RBO farmers fall in third class of Ubudehe.

Above average of farmers plant onions at least in two seasons, more on that 72% RBO farmers are using season A and 50% grow the onion production in season C. these results are positively corresponding to the findings of Kilmo Trust (2017) that were discussing the main seasons of onion harvest in Rwanda. The slight difference is that the main harvesting season in Rubavu is midi-December to February which is actually the second season by considering entire country. Rwanda has higher harvested onion production in drought season because various regions use the season C to produce horticulture products including onions (Harmony, 2014; NAEB, 2018).

The responsibility of RBO season planning is still on the side of farmer him/herself therefore the onion production chain still performing on production driven system rather that market demand driven. The results are contradicting the concepts of Kaplinsky and Morris (2001) talking about characteristic of strong value chain; it also corresponds to the interview results that often mentioned about weak farmers organization, poor coordination and absence of relationship between farmers and their clients in RBO value chain. The results also showed that 85% of farmers use below 0.2ha average size of land in production and test confirmed that there is no different of size between farmers in different Ubudehe categories. Results on land size are much corresponding to the findings reported by Bucagu et al. (2015) Harmony (2014) and Turatsinze et al. (2014) .

Regarding to the current good agriculture practices in the RBO farmers in Rubavu districts; they are not using intercropping practices, they all spraying inorganic chemicals and 97% are practicing the rotations every season. The main rotating crop is Irish potatoes at 55% followed by 30% of farmer who rotate onion with other vegetable. High percentage of farmers who need to plant potatoes on time could also be the same reason in which PSDAG (2015) has reported the land completion between horticulture and other crop and report mentioned irish potatoes on the third place of competing crops following maize and beans.

b. Current postharvest practices.

Majority of Farmers in RBO value chain do not have a say on either handling practices or harvesting time because 80% of farmers leave the responsibilities to their Customers, of course these are directly related to the results showing that about 87% sell their production when it still in the field before harvesting same also as results from Harmony (2014) report. Thus the results demonstrating that harvesting time is

more influenced by the presence of customers than other factors (see figure No 16). The above are contradicting with the vertical integration concept defined by KIT et al. (2006).

Contrary to other country such as Vietnam who harvest onion, handle properly and store some quantity to procure their off seasons and stabilize onion prices (Thuong et al., 2016); in Rubavu is not the case; As discussed the above paragraph, most of RBO farmers (80%) do not owning the production from pre-harvesting time and it create the situation whereby farmers could not be interested in different postharvest activities such as sorting, grading, curing, packaging and storage. A small number of farmers (13%) do the sorting and packaging however grading is not always done due to the nature of RBO market which is not selective in regards to the quality. Onion curing is facing lots of challenges and most important are inadequate infrastructure at farm level and lack of knowledge; results which is in line different reports highlighted same changes in horticulture sector (Harmony,2014; Turatsinze et al., 2014; Kilimo trust, 2017). Lacking of curing practices in RBO value chain may lead to the failure of long term storage and control of postharvest losses as its major importance stressed by Maw et al. (2004) and Geyer et al. (1999).

c. Current actors and chain relations in red bulb onion value chain

Apart from direct chain actors farmer, traders and consumers, RBO value chain in Rubavu has number of supporters (Figure No 20) this goes in line with the value chain concept as defined by Kaplinsky et al. (2001). However the supporters' involvements in value chain are arguable, farmers agree (80%) that their organizations are helping in some activity; same results were mentioned by Harmony (2014). Financial institutions mainly SACCOs and international NGOs are also more involved.

Considering the different support activities offered by Chain supporters, it has indicated that Research activities and Effective information sharing still insufficient from farmers' point of view; same results were found in the interview conducted; extension services are too much but not appropriate. The absence of formal agreements between different actors and memorandum of understanding with supporter are other characteristics resulted from the research; this is in line with findings of Kilimo Trust (2017). However strong chain relations requires the chain actors to team up, specializing in every actor roles and share common vision (KIT an IIR, 2008).

d. Characteristics of existing red bulb onion market.

After farmers, the RBO product goes to four categories of Wholesalers and large number of farmers (58%) deals with Kigali wholesalers. It also observed that the so called Kigali wholesalers could also coming from other different part of the country but farmers were not sure of the destination of onion product, results are in line with Kimo Trust (2017) reported that 70% of wholesalers source production from farm gate. Then the product flows to retailers and consumers. Results showed that there are no contracts between these actors and payment is at spot. In transaction, it has been identified that farmers and their clients do not have standard measuring equipments or defined product quality attributes. Results are also related to the findings of Kilimo Trust (2017) mentioning that onion chain in Rwanda still largely operating in an inform way. Lack of policies and long term strategies to drive onion value chain were also highlighted by both farmers and interviewees and it is contradicting the strong market institutions in value chain according to KIT an IIR (2008).

e. The economic perspective of red onion farming in Rubavu district.

From the farmers' point of view, Onions are more profitable than irish potatoes, maize and other number of horticulture products (see figure No 25). However it was mentioned that onions require immense inputs relative equal or more that potatoes, higher than other crops. Farmers also don't real count beans and maize somehow because these are produced to procure food for the families while horticulture produced mainly for cash in this region. The results goes inline within MINECOFIN (2013) and Deloitte (2013) who think that horticulture could be one of economic pillar in Rwanda.

5.2. The possibilities of implementing onion curing practices at farm level in Rubavu district.

a. technological requirements in curing practices

Being perform the onion curing process successfully condition like temperature, relative humidity, maturity index and best handling of onion production should be observed (Kitinoja, 2003; Barbara, 2013). Considering RBO value chain in Rubavu; Farmers (80%) do not access to the appropriate infrastructure that enabling them to trait and keep their production in safe. Handling of onion production is still being done poorly. Inappropriate infrastructures as one of main challenges to the curing practices have been confirmed by survey farmers and majority of interviewees idem to the findings of Harmony (2014); Turatsinze et al. (2014); Kilimo trust (2017). However supporting projects are reporting that their main targets are for supporting horticulture farmers in the required infrastructures and equipments as quoted by interviewees as well as MINECOFIN (2013) and NAEB (2018) further more farmers in Rubavu are aware of the importance curing practices.

b. Economical factors influencing curing practices

Increasing the shelflife of onions and improving the long term storage conditions in order to manage the production, control price stability and supplying seasonality are the main purpose of value chains that have integrated curing practices in their systems; this is in the same line with findings of Thuong et al.(2016) reported the case of Vietnam. In RBO value chain it has showed that farmers are not practicing the curing and it is the same situation to wholesalers who in most cases do harvesting red bulb onions. However farmers (92%) showed the interest to go for curing practices.

Considering the high cost farmers inject in onions production; it could be one of the main reasons farmers do sell production without any delay; very little information of market and fluctuation of onion prices might be also influence farmer to surrender all responsibilities to wholesalers and reduce risks of looses on farmers. Results also has showed how farmers tried to manage the risks on them, this is the case whereby farmers (72%) want to be paid in cash after handing fresh onions and only 20% of farmers are fine to wait their payment until cured onions are sold considering that curing was done by a third party stakeholder. Absence of contract among RBO value chain stakeholders has also reported in previous sections. The situation of farmers in RBO value chain of Rubavu district demonstrated how the chain integration of farmers is weak in reference to the concept described by Kaplinsky and Morris (2001).

c. Logistical requirements for curing practices in Rubavu district.

Majority of onion farmers are willing to work with their organization in order to introduce curing practices in their chain; other stakeholder which can be trusted by farmers (less that 20%) is the government. Around 60% farms are located in a located on 4km average distance from the existing collection sites. Feeder roads used by farmers in the region are generally in good conditions and regularly maintained by Umuganda community works. Lack of coordination in the value chain stressed by interviewees and lack of common interest for direct chain actors could be the challenges to reach to the strong chain relations KIT an IIR (2008).

d. Organizational structures affecting the curing practices in Rubavu district.

Survey and interviews have showed that both farmers and their customers are still working individually; lack of communication and absence of agreements between farmers and buyers. This is in line with results of Kilmo Trust (2017). Capacity of single farmer, who is growing 0.2ha of onion as viewed in previous results, could not have any impact on the RBO value chain; farmer organizations and supporters in general are struggling to help out the onion value chain however lack of coordination and having same vision is still lacking as recurrently back in the challenges. These results are not good indication for a strong value chain in both relations and market institutions (KIT an IIR, 2008).

e. The impacts of onion curing practices to the income of red bulb onion farmers

The results have demonstrate such big different between off (709Rwf/Kg) and peak (173Rwf/Kg) onion harvesting seasons and in reality the mentioned price is not what farmers get contrary it is the price that wholesaler can accept if you buy from him at the farm. Because of farmer's low capacity to manage the risk and high cost of onion production (1.84 Million Rwf/Ha/ Season), majority of farmers decide sell their production field before harvesting thus real price farmers get as well as the measurement they use in bargaining are unknown. These are signs of value chain with weak vertical integration (KIT et al. 2006).

Regarding to the opinion of farmers to the average price (Average: 441 Rwf/Kg) that can attract them to sign a contract with buyers, the findings showed that is much similar to the results from farmgate price (see table No 3). Calculated value shares based on research findings about prices across the chain (table No 6), it illustrate that wholesalers have immense value shares 69% and 89% in Kigali and Rubavu markets respectively compare to other chain actor in off seasons. Looking at the retailing onion prices trends (Figure No 3), it shows that the periods whereby low prices in Rubavu and Kigali are recorded are corresponding to the harvesting periods in Rubavu district therefore this could lead farmers to sell the production without any condition if they do not have other options to their production.

VI. Conclusion and Recommendations

This section summarise the drawn conclusions derived from analysed data of the secondary data, survey, interviews and observations; and finally present the possible recommendations that can help to develop a resilient value chain.

6.1. Conclusions

The study was conducted to found out the possibility of red curing practices at farm level and come out with strategies for value chain development that contributing to the onion farmers' income. The following conclusions presented in this chapter were derived from analysed data of the survey, interviews, observations and secondary data.

Red bulb onion farmers in Rubavu district are small farmers who use 0.2 ha average land for onion production and majority belongs to the farmers' organizations. Considering Rwanda social economic classes, RBO farmers have good classes of Ubudehe however weak farmers' organization and inadequate collaboration between farmers and traders identified.

RBO production is largely done during season A and on average proportion in season C. Farmers strive to get it done because currently there is not much facilitation they gain from other stakeholders. Role of farmer organizations is not clear, lack of coordination of the chain and weak relations between farmers and other chain actors are some of big challenges that characterising the RBO chain in Rubavu district. The market prices, onion shelflife and cost of production are factors that influencing farmers to take a decision on the size of land he may use. Onion fields do not intercropped however the rotations are performed every season with mainly irish potatoes or other vegetables.

Though the onion value chain has different stakeholders; the level of involvement still insufficient to bring positive change to the chain. More supports are on capacity building and local financial institutions that give small loan to the farmers however the red bulb onion still need improvement in the information sharing, organization and coordination.

Onion production enterprise is considered the best profitable by farmers compare to various other enterprises in the region; however absence of polices and regulations concerning the sector and lack of agreements between farmers and buyers (their customers) increase risk to farmers. Therefore Farmers (83%) leave to their buyers all responsibility to the postharvest include harvesting, handling and transport the production to reduce some of risks. this prove the weak farmer's integration in both activities and management of the chain.

Although the farmers are aware of the importance of curing practices, there is no such practice done in Rubavu at the moment, lack of appropriate infrastructure as well as little knowledge to the curing process are the main challenges identified. Farmers willingness (92%) is very high go for curing practices however the adoption will work if the new technology is only leading by farmers' organizations or government according to farmers. Average distance from farm to collection centres (4km), good status of the road, existing farmers' organizations and present supporters proves the feasibility of onion collection and curing practices can happen however the organizational structure of the chain has demonstrated many weaknesses.

The impact of curing practices to farmers is that it can stabilise the periodic onion farmgate prices and assured market which thereafter will increase the value share of the farmers and the Return on investment.

The outcome of interview with Enablers and supporters of red bulb onion value chain were confirming that support in terms extension services, training and support of postharvest infrastructures are available for onion farmers. Environmental conditions, long term storage on onion and farmers experience are other strong points in the value chain. Market opportunity within country and in region is also a supporting indication to the development of RBO value chain. However interviews with stakeholders, highlighted number of weaknesses that should be addressed. These include weakness of farmers' organizations, defining a long term strategy for RBO value chain, improving coordination of value chain and of course farmers need more infrastructures, capacity building and assurance of market and good price.

6.2. Recommendations

The research has illustrated a number of red bulb onions value chain weaknesses that hindering the successful development of the chain; fortunately the farmers, chain enablers and supporters respectively have shown high level of willingness to contribute to the mainstreaming of value chain. In order to contribute to the RBO value chain development; the following recommendations which are subdivided in three outcomes were suggested:

- **Upgrade the chain coordination by improving the communication through the RBO value chain stakeholders. Following activities can be implemented:**

  - *Defining long term goals and strategy headed by NAEB:*
    NAEB is in good position to lead the interactions of different stakeholders with the intension of setting goals and strategies as well as priority activities which at the end will guide value chain targets.

  - *CICA with the help of NAEB, RAB and District should facilitate in the dissemination of information:*
    The dissemination of relevant information about the onion value chain should be well managed. NAEB, RAB, CICA and Districts should take responsibilities to spread information not only about retail prices but also production, seasonality and market demands to the chain actors to help in right decision making.

  - *District can help in coordination of supports form different value chain stakeholders:*
    Support services should be well coordinated at district level in order to limit the chances of duplication of the efforts and unnecessary supports which are not contributing to the development of the chain. A need assessment report should be produced by the district regularly.

❖ **Enhancing the capacity of the farmers' organizations in order to facilitate the chain integration of onion farmers:**

- *Support farmers' organizations in postharvest infrastructures jointly between PASP, PSDAG, NAEB and farmers organizations themselves:*
  Building capacity of farmers and/ or their organizations should not only target the trainings; farmers need appropriate infrastructures that allow them to handle and keep excess quantity in better condition. Collection house bearing the capacity of curing and storing onion for a certain period must be supported to the farmers' organizations by relevant stakeholders (PASP, PSDAG, and NAEB). Management may be done by farmer's organizations or a joint venture of farmer and chercheurs (onion brokers).

- *Financial institutions and Agriterra should help in availability of working capital:*
  Channel to farmers' organizations to get financial support to serve as working capital should be open to them. This can be done through making available the easy loans in SACCOs or other local financial institutions with no or little interest rates as well as technical support to help in financial management for the farmers' organization later on the service may expend to wholesalers.

❖ **Upgrade the chain relations of RBO stakeholders to build a sustainable onion value chain**

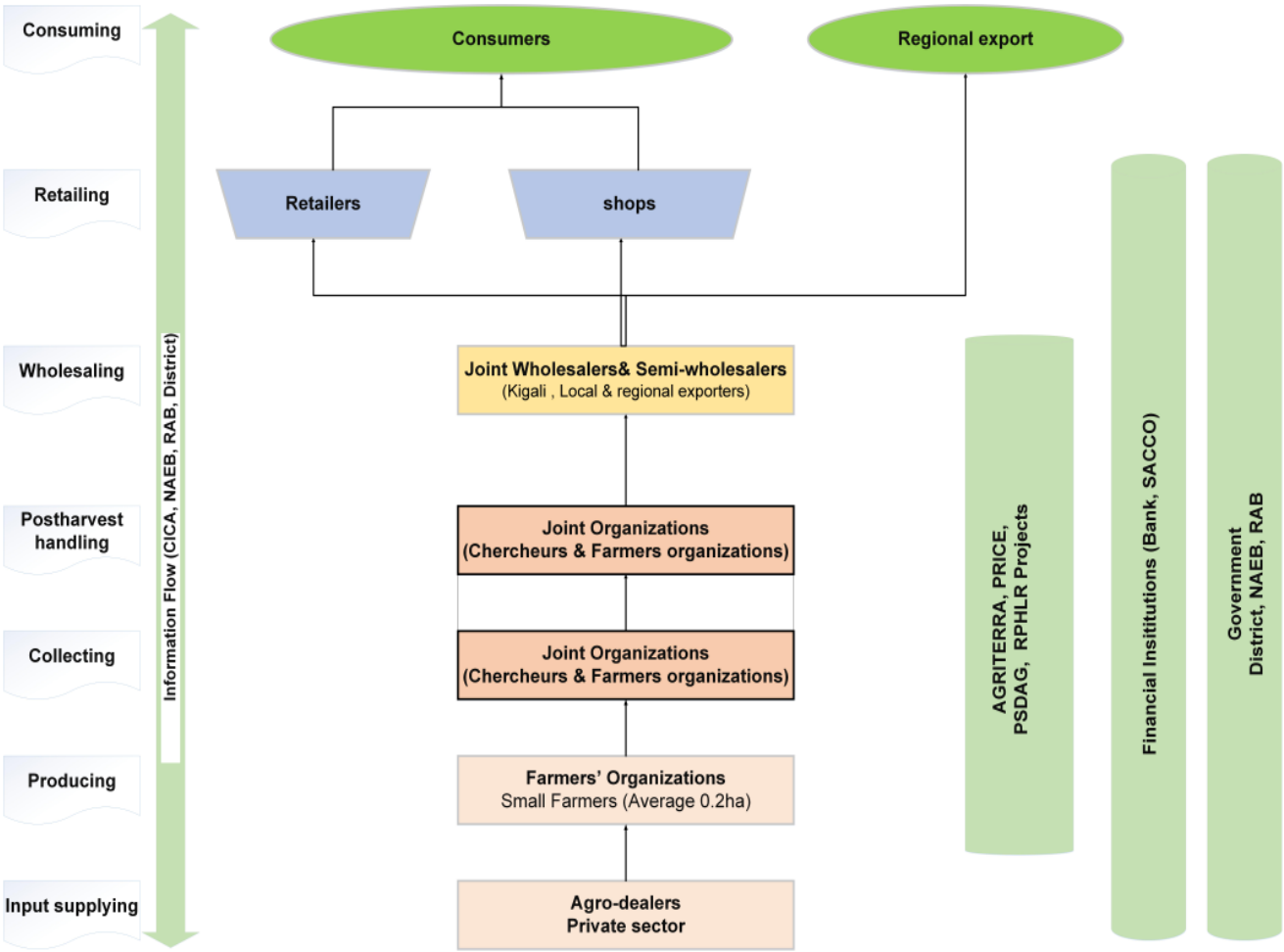
- *Initiating the organizations of Wholesalers and Chercheurs:*
  Best thing is that farmers' organizations are in existence already, when they start collecting and look for market of their members will positively impact on farmers and organization relationship. Onion wholesalers also it will be the time to start organizing themselves either in cooperatives or companies. Chercheurs are crucial actors in Rubavu so I suggest that they may either be part of farmers' organizations or make join companies with farmers' organizations more serve the chain.

- *District should host a regular onion stakeholder meeting:*
  Regular stakeholders meetings at district level should be facilitated the agenda that could help the chain to discuss matters that can improve the actors' efficiency; evaluating their goals and visions.

- *Facilitated by NAEB, all stakeholder should agreed upon the market institutions:*
  The strong relationship between all stakeholders will also serve as the backbone for the introduction of best market institutions to lead the value chain although the basic market institutions like standard measurement and size grading should be introduced at the beginning to facilitate the transactions.

❖ **Proposed Red bulb onion value chain in Rubavu district**

Figure 33: Proposed red bulb onion chain map



Reference

1. Barbara, 2013. Curing Onion for Storage. [Online] available at: <https://www.growveg.com/guides/curing-onions-for-storage/ > [Accessed on June 1, 2018].
2. Bayat, F., S. Rezvani, and A.E. Nosrati. 2010. Effect of harvesting time and curing temperature on some properties of Iranian white garlic. Acta Hort. (ISHS) 877:869-875.
3. BNR, 2015. Raw data: Informal Agricultural imports & Exports data. Kigali: National Bank of Rwanda.
4. Brewster J. L., 2008. Onions and Other Vegetable Alliums. Production Science in Horticulture Vol. 15. CABI.
5. Bucagu, C.; Uwayezu, E. and Nyamurinda B., 2015. Profiling and Mapping Suitable Land for Horticulture Investment in Rwanda. Kigali: MINAGRI.
6. CICA, 2018. Agricultural Information and Communication Centre (CICA). Kigali: MINAGRI.
7. Clay, D. and Turatsinze J., 2014. Baseline report on the Rwanda Horticulture organization Survey (RHOS). AGRER Consortium.
8. Deloitte, 2013. Transaction Advisory Services for Implementation of the Rwanda Logistics and Distribution Services Strategy: Agro-Logistics Component. Kigali: TradeMark East Africa.
9. FAOSTAT, 2018. Crop data. [Online] available at: <http://www.fao.org/faostat//en/#data> [accessed on May 20th, 2018].
10. Harmony Henry C., 2014. National Horticulture Strategy. Kigali: NAEB.
11. Hunt A. G., 2016. Optimizing Onion bulb quality for counter-seasonal export markets.
12. ILO, 2007. Local Value Chain Development. Colombo: International Labor Organization.
13. ITC, 2018. Onion trade indicators for Rwanda. [Online] available at: <https://www.trademap.org/Country_SelProductCountry.aspx?nvpm=1|646|||0703|||4|1|2|1|1||2|1|> [accessed on May 30, 2018].
14. Kaplinsky, R. and Morris, M., 2001. A Handbook for Value Chain Research, paper prepared for the IDRC, [pdf] available at:<http://www.ids.ac.uk/ids/global/pdfs/VchNov01.pdf>[accessed on May 30, 2018].
15. Kilimo Trust, 2017. Characteristics of market for Onions in EAC. Regional East African Community Trade in Staples (REACTS).
16. KIT, Faida MaLi and IIRR. 2006. Chain Empowerment: Supporting African farmers to develop markets.
17. KIT and IIR, 2008. Trading up. Building cooperation between farmers and traders in Africa, Royal Tropical Institute, Amsterdam; and International Institute of Rural Reconstruction, Nairobi.
18. Kitinoja, L. and Kader A.A., 2002. Small Scale Postharvest Handling Practices: A Manual for Horticultural Crops (4th edition). Postharvest Horticulture Series No. 8: 43-56
19. Kitinoja, L. and Kader, A.A. 2003. Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (4th Edition). Postharvest Horticulture Series No. 8E. University of California, Davis. Postharvest Technology Research and Information Center.
20. Maw, B.W., C.L. Butts, A.C. Purvis, K. Seebold, and B.G Mullinix. 2004. High-temperature continuous-flow curing of sweet onions. Appl. Eng. in Agr.20:657-663
21. MINECOFIN, 2013. Strategic Plan for the Transformation of Agriculture in Rwanda Phase III. Kigali.
22. Mukundente J.B., 2017. Onion Aggregated farms in Karongi. [Online] available at: <http://rwandadailynews.com/amakuru/mu-rwanda/article/karongi-bategetswe-guhuza-ubutaka-bagahinga-ibitunguru-none-babiburiye-isoko>. [Accessed on May 30, 2018]

23. NAEB, 2018. About National Agrcultural Export Development Board. [Online] available at: <http://www.naeb.gov.rw/index.php?id=27>[accessed on May 20, 2018].
24. NISR, (2016). National Institute of Statistics of Rwanda (NISR), Statistical Yearbook, 2016 edition (SYB2016). Kigali: NISR.
25. Opara L. U., 2003. Onion: Post-Harvest Operation. Rome: FAO.
26. Opara, L.U., M. Geyer. 1999. Onion storage. CIGR Handbook of Agricultural Engineering Volume IV Agro Processing. pp. 125-156. The American Society of Agricultural Engineers, St. Joseph, MI.
27. andfeasibility study in essential oils on behalf of price project. Kigali: SPIU- MINAGRI.
28. Rwanda Private Sector Driven Agricultural Growth (PSDAG), 2015. Horticulture Value Chain Analysis. Alexandria: IRG.
29. Thuong, T. T. and Pabuayon, I. M., 2016. Factors Affecting the Storage Decision of Onion Farmers in Kinh Mon District, Hai Duong Province, Vietnam. Economics, Management & Agricultural Development 1(1) pp. 15-27.
30. USAID, 2018. Rwanda Agriculture and Food Security. [Online] available at: <https://www.usaid.gov/rwanda/agriculture-and-food-security> [accessed on May 25, 2018].

Appendices

Appendix 1: Reflective Journal

INEZA Herve
Master Student
APCM- Horticulture Chain
September, 2018

Research Project- Reflective journal

Real time arrived in my master course program when students were informed that they have to start thinking about the ideas for their research project. That was early in February, and I thought maybe I still have time however after critically analyzing the trajectory provided to us; I realized that I had not much to do with my research. The decision came; I started contacting different stakeholders in Rwanda horticulture sector to look for my commissioner. Since then, research project process is in progress, I have played different role in Problem definition, research designing, field research and reporting my results as well as draw the conclusion and suggest recommendations. Some challenges were recorded during the whole research process and I learned number of thinks that will help me in my future carrier. The overall objective of my research is to investigate the possibilities of red bulb onion curing practices at farm level in order to provide useful advice to stakeholders on strategies for development of the value chain that contributing to the onion farmers' income.The below table matrix gives an overview of how my research project was progressing.

Steps of the research	**Activities and my role**	**The relevance of the activity**	**Challenges**	**outcome on my personal development**
Problem definition	**Select a research idea.** I played a role of contacting relevant stakeholders in order to find out current challenges in horticulture.	I liked how stakeholders were enthusiastic to share with me their view on the sector. It helps me to get an idea	- Often challenges in horticulture are not specific to one crop; having things in general I was hard to decide on which crop I have to work on.	- I experienced how I should take initiative to solve the problem. - communication skills with stakeholders
	Pitch the research idea to Supervisors I was supposed to present my Idea and convincing the audience	The activity prepared me to familiarize with presentation and answering question about the topic to remove doubts to audiences.	- I challenged by feedback which said that my topic was broad compare to the time limit	- I learned how time is not a problem; I have to have a plan that fits to the time limit. - Be focus
	Background of research	It helps to get	- Insufficient specific	- the challenge

Steps of the research	Activities and my role	The relevance of the activity	Challenges	outcome on my personal development
	My task was to describe the onion value chain in such a way it gives a current situation to the reader	general information on the topic and what other researchers were done about your concerns	information on the onion in Rwanda; many reports are generalizing horticulture; I remember I was about to drop the topic.	build with me the ability to confront the risk of work on new topic
	Research problem The role is to come up with a research problem that respond my Commissioner needs and fulfillment the academic requirements	I was good experience to manage collaboration between different parties (commissioner and university) and keeping good communication with both parties.	- I think myself I was confused on what I have to put in the statement, several attempts were tried but it was not satisfying. 'Your problem statement is not a problem is a solution' stated by one of my assessor	- To do a deeper reflection on the topic and analyzing situation to get root cause of problem are what I remained with me. - Accept the feedback to help me to change was also a big reason I learned
	Research Objective Task was to formulate the objective that contribute to the answers of problem	A very good exercise actually! In one sentence It shows how research is 'SMART'	- Convincing the measurability and achievability within limited time was a bit challenging me. I think I changes two or three times.	- having SMART targets is something I have to consider in my future work. - be responsible - And having ability to accept feedback in a positive way.
	Formulation of research questions & Conceptual framework Getting main questions and sub questions that responding to your objective. Conceptualize my research to guide the remaining activities	I enjoyed that I should generalize and focus on specific issues and try to find out whether my results /findings are answering my objective	- The big challenge I faced was feedback from the assessment. It was agreed between me and supervisor to use one main question however it was not enough to convince assessor. This created the situation	- I experience how I should manage to work under pressure. - keep calmness and to look right way to solve the problem - time management

Steps of the research	Activities and my role	The relevance of the activity	Challenges	outcome on my personal development
			whereby I end up changing a lot to my initial proposal within a single week. Really it was a challenge	
Literature review	**Literature review Summarize different concepts which will**	I appreciated how I get familiarized with different concepts in order to select ones fit to my research	- I had no idea about different on literature between research project and normal report we used to produce.	- This has induced my innovative skills and problem solving abilities.
	Presentation of research proposal I was supposed to present my research proposal and convincing the audience the relevance of the project.	The activity prepared me to familiarize with presentation and answering question about the topic to remove doubts to audiences.	- Challenges were to hear negative feedback some had mentioned earlier about research questions and conceptual framework. - but also my poor time management in presentation	- it was a reminder that I have to improve the way of presenting - time management - accept and self reflecting on the feedback
Results and discussions	**Research design** my role was to plan the progress flow of my research, indicating area, told and methods which will help in gathering data	- I enjoyed the exercise; I get familiarized with coordination of the activities, being organizer and facilitator at the same time.	-Source of information was not easy to decide on it. Sometime you think people will be enthusiastic will your project but when you start process of contacting them get different results.	- Organization skills - leadership - improving communication skills - ownership - And decision making.
	Conducting interviews The task was to conduct a survey with farmers and interviews to different key informants. * Preparation of questionnaires and checklist which will collect data answering of	I enjoyed most this part because it is the principal part of the success of the research. It requires such a good plan. It showed what kind	- challenges of missing some respondents at last minutes - some questions which are not relevant to some of my respondents - lacking answers to	- time management - planning skills - improving communication skills - behave as good facilitator - problem solving

Steps of the research	Activities and my role	The relevance of the activity	Challenges	outcome on my personal development
	research questions * plan the field work and get appointment of interviews	of challenges a researcher can face during conducting the interview and also how you can overcome those challenges.	some of my planned questions (like productivity of the onion farmers farms)	ability - creativeness - taking the initiatives - networking
	Analysis of finding & Discussions Activities concerns with processing, data entry, organizing results of interviews, analyzing and discussing findings in the report	- I was very happy to see my findings are responding most of my questions - Very enthusiastic in production of graph and tables for my results. - And sharing with supervisor the progress of my analysis.	- I had small challenge to SPSS in data analysis; some graphic tables were not really good visualizing the results and of course there are some combinations that SPSS cannot perform. - Missing primary data to respond my questions	- It builds in me some skills of creativities. - reflective skills - Managing time - decision making - communication with my superiors
Conclusions & Recommendations	**Conclusions & Recommendations** My role is to draw overall conclusions that responding to the research main questions as well as propose recommendation that will help to solve the problem.	I am very confident that findings from data collection are reflecting to the actual situation of my work done. It is invaluable role to find that my work can contribute to the development of the country.	- The real challenges yet to come!! (I mean the assessment) - But honestly I was challenges on how I should write my conclusions and recommendations. Concerting my colleagues, I realized that everyone has its own style depend upon maybe his/her supervisor so it was my time to take decision.	- having critical and reflective thinking on the results - be decisive - Be SMART and - think about the Theory of Change.

In summary, Curing as one postharvest practices at farm level is possible however the impact of curing practices on the red bulb onion value chain will need couple of strategies to be implement by different stakeholders;

Improving communication to upgrade value chain coordination: NAEB should lead the consultative meetings of stakeholders which will set the long terms goals of value chain. Dissemination of right information about red bulb onion value chain should be reinforced by RAB, NAEB, CICA and district. And a good coordination of supporters at district level must be done.

Facilitate the farmers' integration in value chain should be done through the enhancement of the capacity of farmers' organization. This can be done by providing postharvest infrastructures to farmers' organization that can facilitate collection, curing and storage at the same time. Make financial support available to farmers' organizations to help as working capital.

Build a sustainable value chain will need a strong relation within chain actors. Farmers, wholesalers and Chercheurs should create strong organizations or strengthen the existing organizations among themselves. And regular meetings to share experiences should be hosted by district.

##

Appendix 2: Test of Difference in age between male and female

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Farmer age	Equal variances assumed	.055	.816	-2.116	38	.041	-8.292	3.919	-16.226	-.358
	Equal variances not assumed			-2.135	33.314	.040	-8.292	3.883	-16.189	-.394

Appendix 3: Average size and Ubudehe

ANOVA

Average size of farm (Are)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	308.683	2	154.341	.763	.474
Within Groups	7485.692	37	202.316		
Total	7794.375	39			

Appendix 4: Average size and responsible for onion harvesting

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Average size of farm (Are)	Equal variances assumed	2.156	.150	1.098	38	.279	7.40000	6.74110	-6.24664	21.04664
	Equal variances not assumed			.857	4.617	.434	7.40000	8.63382	-15.35915	30.15915

Appendix 5: Farm size and harvesting equipments

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Average size of farm (Are)	Equal variances assumed	2.156	.150	1.098	38	.279	7.40000	6.74110	-6.24664	21.04664
	Equal variances not assumed			.857	4.617	.434	7.40000	8.63382	-15.35915	30.15915

Appendix 6: Questionnaire for Survey

QUESTIONNAIRE (FARMERS SURVEY)

I. Identification

1. Sex
2. Age
3. Ubudehe (livelihood level)
4. Sector
5. Do you belong to the cooperative? Yes No

6. Which season do you grow onions?
   1. Season A
   2. Season B
   3. Season C

7. Who is responsible for onion seasonal planning?
   1. Farmer
   2. Cooperative
   3. Local government
   4. Central government

8. What average size of land (in hectare) do you allocate to onion production per season?
   (.....)Ha

9. Please rank the following factors which influence decision making of the onion production size. (Rank from 1 to 5, 1 = least important and 5 = very important)
   - Current market price 1 2 3 4 5
   - Crop intensification program 1 2 3 4 5
   - Availability of the customers 1 2 3 4 5
   - Cost of production 1 2 3 4 5
   - Shelf life of onion produce 1 2 3 4 5

10. What average quantity of onion production do you harvest per season?
(.....) Kg.

11. Do you practice intercropping in onion production?
    Yes No
12. What is the main crop intercropped with onions?
    1. Irish potato
    2. Maize
    3. Beans
    4. Other vegetable

13. Does the rotation practice happen in your onion production site?

    Yes No

14. What is the main crop rotated with onions?
    1. Irish potato
    2. Maize
    3. Beans
    4. Other vegetable

15. How do the following factors influence the harvesting time?
    (Rank from 1 to 5, 1 = least important and 5 = very important)
    - Government agriculture planning 1 2 3 4 5
    - Customers 1 2 3 4 5
    - Next planting season 1 2 3 4 5
    - Maturity of onion 1 2 3 4 5
    - Weather 1 2 3 4 5

16. Who does the onion harvesting?
    1. Farmer
    2. Cooperative
    3. Customer

17. Do you practice the following activities after harvest?
    - Sorting Yes No
    - Size Grading Yes No
    - Curing Yes No
    - If curing exists, the practice is done:
        1. Under the sun
        2. By using other technology

    - Packaging Yes No
    - Storing Yes No

18. If no curing what is causing the challenge to the farmers?
    (Rank from 1 to 5, 1 = least important and 5 = very important)
    - Lack of knowledge 1 2 3 4 5
    - Inadequate infrastructure 1 2 3 4 5
    - High cost of production 1 2 3 4 5
    - Lack of market 1 2 3 4 5

19. In your opinion, how are the following main stakeholders involved in supporting sustainable onion value chain? (score from 1 to 5, 1 = least significant and 5 = very significant)
    - Cooperative 1 2 3 4 5
    - Government 1 2 3 4 5
    - Local NGOs 1 2 3 4 5
    - International NGOs 1 2 3 4 5
    - Research institutions 1 2 3 4 5
    - Universities 1 2 3 4 5
    - Financial institutions 1 2 3 4 5

20. In your opinion, to what extent the following supporting activities are concerned with onion postharvest in your district? (Rate from 1 to 5, with 1= least important and 5 = very important):
    - Research activities 1 2 3 4 5
    - Extension services 1 2 3 4 5
    - Farmer Field School 1 2 3 4 5
    - Financial support 1 2 3 4 5
    - Effective information sharing 1 2 3 4 5

21. Does the existing policy and regulation talk about onion curing practices in your district?
    Yes No

22. If yes, how satisfactory are the policy and regulations for improving sustainable onion value chain?
    1. Very bad
    2. Bad
    3. Neutral
    4. Good
    5. Excellent

23. Is there any agreement related to onion production management between farmer and the following?
    - Cooperative Yes No
    - Government Yes No
    - Local NGOs Yes No
    - International NGOs Yes No
    - Research institutions Yes No
    - Universities Yes No
    - Financial institutions Yes No

24. Who is your main direct customer?
    1. Cooperative
    2. Middlemen
    3. Local wholesalers
    4. Kigali wholesalers
    5. Gisenyi wholesalers
    6. Retailers
    7. Final Consumers
    8. Exporters

25. What is the equipment used in produce measurements?
    1. Bunches
    2. Bags
    3. Scales/ balance
    4. Non harvested Field

26. What is the average price (RwF/ Kg) of fresh onion at farm level in:
    - Off season (..... RwF/ Kg)
    - Pick season (..... RwF/ Kg)

27. What is the average price of cured onion at farm level?
    - Off season (..... RwF/ Kg)
    - Pick season (..... RwF/ Kg)

28. From your experience, rank the following farming enterprises according to the level of profitability (score from 1 to 6, 1 = least profitable and 6 = most profitable)
    - Onion
    - Irish potato
    - Maize
    - Beans
    - Carrots
    - Cabbage

29. What current handling equipments do you use?
    1. Plastic crates
    2. Traditional baskets
    3. Plastic bags

30. Does the farmer have access to adequate infrastructure to facilitate collection and curing practices?
    1. At individual farmer house
    2. At cooperative
    3. Public infrastructure
    4. No adequate infrastructure

31. If there exists infrastructure, does the house have access to the electricity?
    Yes No
32. If there exists infrastructure, does the house have access to the potable water?
    Yes No

33. Is the farmer aware of curing practices?
    Yes No

34. Does the farmer gain the knowledge by:
    1. Farming experience
    2. Training organized by supporter
    3. Experience from other farmers

35. Does the farmer have Mobile phone?
    Yes No

36. Does the farmer have access to internet?
    Yes No

37. Is the farmer willing to go for curing?
    Yes No

38. If the onion curing practices are done by the third party, in your opinion the payment transactions should be done?
    1. In cash after handing fresh onions?
    2. Bank transfer after handing fresh onions?
    3. Cash/ bank transfer after selling cured onion?

39. In your opinion who do you think can take a lead to perform onion curing practices?
    1. Farmer
    2. Cooperative
    3. Wholesaler
    4. Government
    5. NGOs

40. What is the distance from farm location the feeder road
    (.....)km

41. What is the distance from farm to collection site?
    (.....)km

42. How are the existing feeder roads?
    1. Very bad
    2. Bad
    3. Good
    4. Very good
43. Do the cooperative own the onion production after harvest?

    Yes No
44. Do the farmers look for market collectively?

    Yes No
45. How are the currency transactions done currently?
    1. Cash between farmer and customer
    2. Cash between farmer and cooperative before selling production
    3. Bank transfer between farmer and cooperative after selling production

46. What are the organization statuses of customer?

    .
    1. individual
    2. registered organization
    3. non registered organization

47. What kind of agreements exists between farmers and customers?
    1. no agreement
    2. unwritten agreement
    3. written agreement

48. What costs do you incur per season? Rwf.....

49. From your opinion, what the average farmgate price per kilogram can attract you to sign a long term contract.

Appendix 7: Checklist for interviews

Checklist for interviews

1. Brief description of your project/ organization
2. How your activities are related to onion value chain?
3. Discuss the current situation in red bulb onion value chain in relation to seasons, postharvest, farmers.
4. Give us an idea on market channels of onion production (quantity, quality, transactions of production and money)
5. Talk about stakeholders involved in supporting sustainable onion value chain? What about their supporting activities?
6. Do you have an idea on strategies, regulations and policies that guide the value chain
7. Talk about relationships between chain stakeholders
8. Discuss onion in the economic perspective
9. Tell us about postharvest infrastructures in value chain (warehouses, equipments, water, electricity,..)
10. Do the farmer practice /aware of curing practices?
11. What are the organization statuses of main chain actors? (farmers organizations and agreements among the stakeholder)
12. What do you think on curing practice at farm level
13. How curing practices can be implemented (technology, logistics, economical and organizational).

Talk about future impact of onion curing in RBO value chain