FACTORS AFFECTING THE AVAILABILITY OF CERTIFIED BEAN SEED IN RWANDA

THE CASE STUDY OF NYAGATARE DISTRICT, EASTERN PROVINCE

A Research project Submitted to Larenstein University of Applied Sciences in Partial Fulfilment of the Requirements for the Degree of Master of Development, specialization Rural Development and Food Security

By

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DEDICATION

I’m dedicating my thesis to my lovely son Mugisha Trésor Divin whom I deprived of motherly care at his tender age by staying away from him during my study period.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

BCDA	Belgium Co-operation and Development Agency
CBB	Common Mosaic Virus
CIAT	International Center for Tropical Agriculture
CIP	Crop Intensification Programme
CODAR	Cooperative de Dévelopement Agricole de Rugali
DRD	Democratic Republic of Congo
FAO	Food and Agriculture Organisation of the United Nations
FGD	Focus Group Discussion
FRW	Francs Rwandais
GDP	Gross Domestic Product
GMO	Genetically Modified Organisms
IFAD	International Fund for Agricultural Development
ISAR	Rwanda Agricultural Research Institute
ISTA	International Seed Testing Association
KEPHIS	Kenya Plants Health Inspectorate services
MINAGRI	Ministry of Agriculture and Animal Resources
MT	Metric Tones
NARS	National Agricultural Research System
NGO	Non- Government Organisation
NISR	National Institute of Statistics of Rwanda
PRA	Participatory Rural Appraisal
RAB	Rwanda Agricultural Board
RDO	Rwanda Development Organisation
SLA	Sustainable Livelihood Approach
SSS	Services des Semences Sélectionnées
UNDP	United Nation Development Programme
USA	United States of America
USD	US Dollar

EQUIVALENTS

1 Hectare (ha)	= 2.5 Acre
1 Acre	= 0.405ha
1000Kg	= 1 tonne

Symbols

N: Nitrogen
P: Phosphorus

ABSTRACT

Beans are the primary source of dietary proteins in Rwanda as they supply 65 per cent of national dietary proteins. Even if improved bean seeds are principle vehicles to high agricultural productivity, key for improved income and also in fighting hunger in general, in Rwanda the current supply among farmers remains at only 3% which is inadequate to meet the demand for national beans production and the reasons as to why there is low production of certified bean seed among the seed producers are not yet known by Rwanda Agricultural Board (RAB).

The objective of this study was to contribute towards the availability of certified bean seed by investigating the main factors affecting its production in Rwanda. The insufficient quantity of certified bean seed was the rationale behind the study. For the feasibility of this study, Nyagatare district located in Eastern province was picked and farmers operating within the district have been selected as research units.
To attain the objective of the study, a case study strategy was adopted in order to get in-depth information from the field necessary for analysis. Different tools were used to carry out primary data collection. These included focus group discussion, Participatory Rural Appraisal and observation. Moreover, a desk study provided secondary information related to the topic of research. Processing and analysis of data collected were done with the help of Microsoft Excel software and Sustainable Livelihood Framework.

The results of the research revealed that private certified seed producers are not interested in growing certified bean seed because the benefits got is not attractive compared with growing maize seed. Indeed, producing certified bean seed require a big investment, as basic seed and pesticides needed are expensive. It has been also found that the application of pesticides is related to bean varieties available, which are susceptible to diseases, pests and drought; hence, yields obtained cannot compensate the prices of inputs used by farmers. Likewise, the study showed that land scarcity, inadequate post-harvest facilities, poor infrastructures (roads and poste-harvest facilities), inadequate tools and equipment, low income, expensive labour, limited access to credits and no supportive government policies constitute other constraints faced by private certified seed producers while growing bean seed.

The principal conclusion was that beans crop, though, is the primary source of dietary protein in the country, a short duration crop, and a key for helping to shorten the hunger periods and for providing quick cash; complete shift of farmers from beans production to maize production is likely to occur in the current context due to the advantage offered by maize crop in term of high yield which leads to high income, supportive policies, affordable investment and inputs, inexpensive labour and a variety of use presented by the maize crop. However, producing both maize and beans crops are recommended to guarantee both food security and income for farmers.
Nevertheless, this requires addressing the existing certified bean seed production and marketing constraints so as to make the activity more attractive for farmers.

CHAPTER 1: INTRODUCTION

1.1 Background

Rwanda is located in East Africa, bordered by Uganda in north, Burundi in south, Tanzania in east and Democratic Republic of Congo (DRC) in west. A narrow territory of 26,336 square kilometres, its population is estimated at 11 million people, the density is about 370 persons per square kilometre. Growth rate is 2.8% per annum and the population is expected to increase to about 12 million by 2015(NISR, 2009). With a GDP per capita of USD 520 and over 65% of the population living less than USD per day, Rwanda ranks among the poorest countries worldwide (UNDP, 2009).

According to Ministry of agriculture (2009), the Rwandan economy heavily relies on the agricultural sector, which provides 87% of jobs and accounts for 80% of all exports. Agriculture is indeed considered as the backbone of the Rwandan economy and make up 41% of GDP, while employing over 75% of the population engaged in mainly subsistence agriculture (MINAGRI, 2010). However, as argued by MINAGRI (2007), the sector is affected by climatic hazards that led to significant changes in season, thereby increasing the vulnerability of the population in some regions of the country.

Ministry of agriculture (2007) reported that particularly crop production sub-sector is characterized by a very strong dependence on climatic conditions and it faces a set of constraints including mainly the following ones:

- Predominance of subsistence farming and a weak connection to the market;
- Low level of productivity mainly due to the poor utilisation of intensification input (1.5% for improved seeds, 8Kg of fertilisers/ ha/ year compared to 150-180 Kg/ha in developed countries);
- Overexploitation of the soil without restitution of the nutrient and/or washed away by soil erosion;
- Poor performance of agricultural support services (provision of input, agricultural research, extension, funding)(MINAGRI, 2007).

The efficient seed development system is a key aspect to enhance agricultural productivity worldwide. However, as observed by Byakweli (2010), in Rwanda, the current and past trends of seed production reveal that seed production systems were more focused on quantities to be produced than on actual demand to be satisfied resulting in a gap between supply and demand. ISAR (2009) mentioned that, the formal seed sector accounts for approximately 1.5% of the total quantity of seeds used in the country. According to Ministry of agriculture (2007), the predominance of an informal seed system has led to a poorly organized marketing and distribution system in which the quality of products available on the market is not known due to storage, conditioning and transportation conditions which do not match required standards. MINAGRI (2010) explained that, this system is characterized by various exchanges among farmers themselves or through food traders and it however gets its strength from its sustainability and proximity service among producers.

At the level of formal seed system Rwanda Agricultural Board relies on certified seed produced by private seed producers at the end of every agricultural season to satisfy national seed needs. Within that formal seed system a number of food crops are focused on: maize, soybean, bean, cassava, potatoes and banana. However, seed producers are most of time interested in multiplying other food crops and neglect bean seeds. Hence, as reported by ISAR (2010), the on-farm bean productivity of about 0.3-1.0 tonnes per hectare is still low compared with 2 tonnes (for bush) and 5 tonnes per hectare (for climbers) that are achieved with optimal management conditions.

ISAR (2010) argued that, self-sufficiency in bean production in Rwanda is severely constrained by field and storage losses due to damage caused by prevalent diseases and pests (biotic factors) as well as soil and moisture related (abiotic) problems that are compounded by poor agronomic management practices.

According to Ministry of agriculture (2010), the socio-economic factors that affect productivity include lack of varieties that combine market and consumer preferred seed-types and high yields that leads to slow or poor adoption. ISAR (2009) reported that small land plots also don't allow good husbandry practices such as rotations and fallows. Likewise, as cited by Ministry of agriculture (2010), continuous cultivation exacerbates the cumulative effects and pressure of the diseases and pest on the bean crop and depletion of soil nutrients. The use of agro-input to replenish the nutrients or to control the pest is very low (the rate of fertilizer application is estimated at 1.3-3%)(Byakweli, 2010).

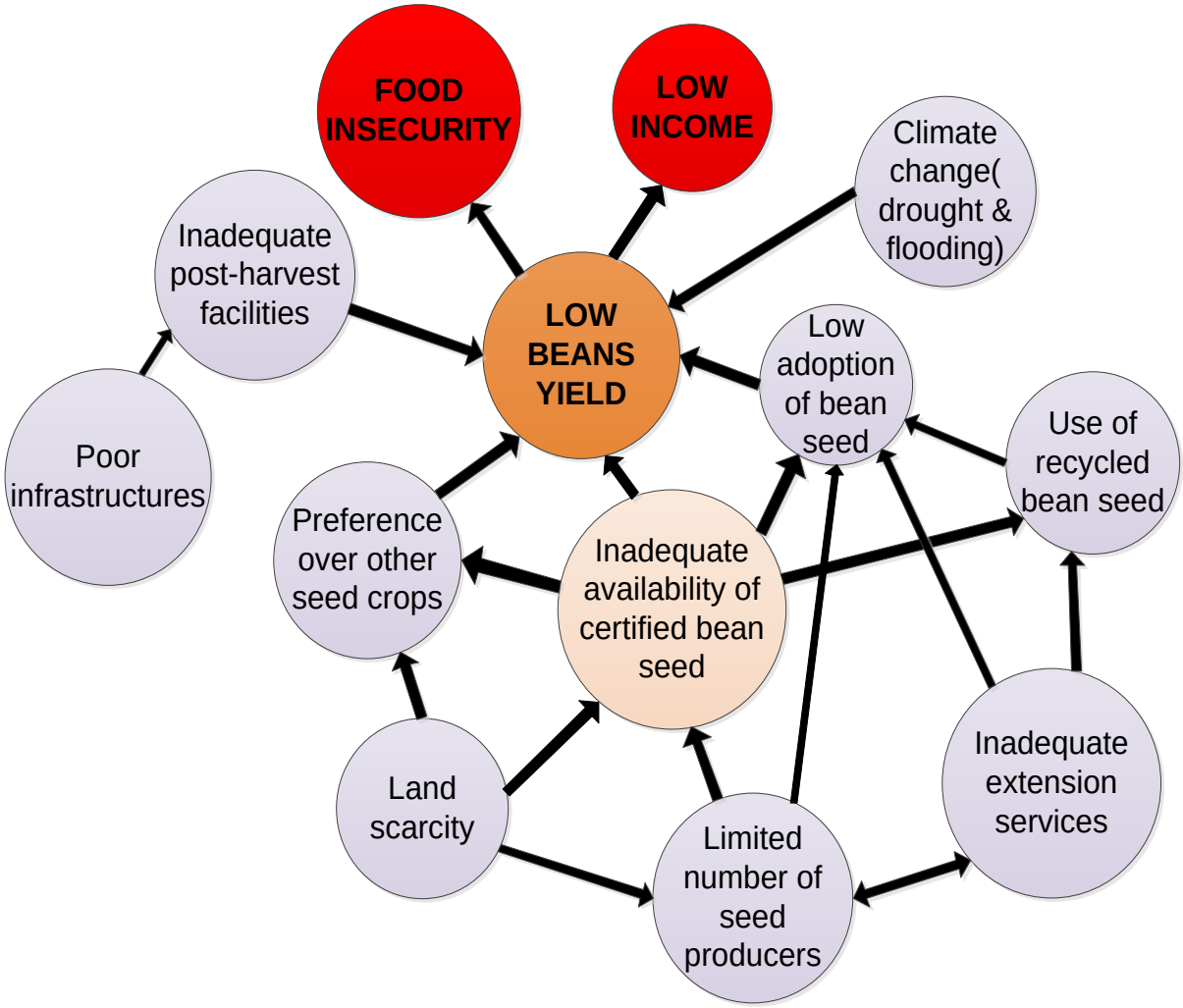
Ministry of agriculture (2009) cited that, the road/bridge network is so vulnerable that vast areas are inaccessible particularly during the rainy season. Furthermore, as quoted by CIAT (2008), markets are not adequately established; the quasi-government marketing organizations have better networks of markets but are poorly organized. They offer the farmers the lowest prices and generally do not have ready cash to offer the farmer when the crop is ready for sale (MINAGRI, 2009).

1.2 Problem statement

ISAR (2009) quoted that; beans are the primary source of dietary proteins in Rwanda as they supply 65 per cent of national dietary proteins. According to CIAT (2008), beans are a short duration crop (2.5-4months), and also key for helping to shorten the hunger periods and for providing quick cash. ISAR (2009) argued that, due to their diversified nutritional content and predominant protein supply in Rwandan diets, beans are regarded as a near-perfect food, and as the meat for the poor. However, as reported by ISAR (2009), the on-farm productivity of about 0.3 to 1.0 tonnes per hectare is still low, hence Rwanda is among importers of bean grains.
Ministry of agriculture (2009) stated that, even if improved bean seeds are principle vehicles to high agricultural productivity, key for improved income and also in fighting hunger in general, in Rwanda the low productivity of beans is linked with inadequate use of improved seed as the current supply among farmers is estimated at only 3 per cent (MINAGRI, 2009). Thus, farmers are obliged to plant saved seed of local varieties that are recycled over seasons. ISAR (2010) reported that, the yield loss associated with the use of poor seed quality progressively rises to about 86 per cent and 75 per cent for the climbing and bush beans respectively. Land scarcity, inadequate post-harvest facilities, poor infrastructures (markets, roads) and climate change especially drought are also challenging certified bean seeds production.

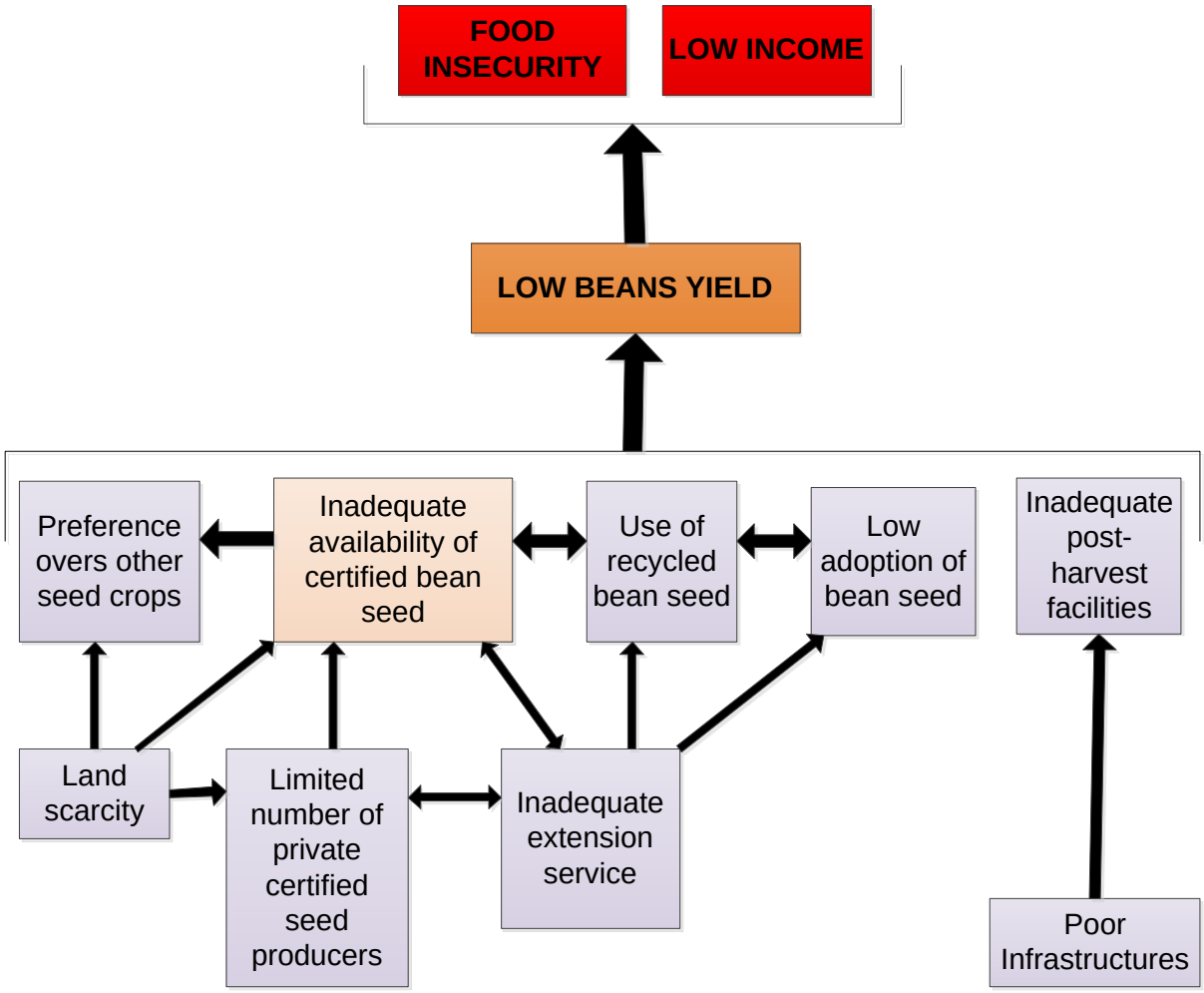
Currently in Rwanda, only few number of seed producers are getting higher yields of bean seed than expected. Participation of private sector in seed production is still very low (475 certified seed producers at national level) and most of certifeid seed producers prefer to grow more other crops than beans, thus the quantity of certified bean seed produced is insufficient at the beginning of every planting season. That's why Rwanda Agricultural Board in its Crop Intensification Program is always forced to buy local unselected bean seeds for distribution at the planting time.
There are only few studies being done regarding factors influencing the availability of certified bean seed, hence the reasons as to why there is low production of certified bean seed among the seed producers are not yet known by Rwanda Agricultural Board. There is therefore need to conduct an assessment of factors affecting the availability of certified bean seed in order to come up with mitigating recommendations to reverse the trends.

Figure 1 Causal effect problem visualisation



Source: Author

Figure 2 Problem tree



Source: Author

1.3 Justification of the study

Seed is a crucial input in any form of crop production and one of the most precious resources in farming. Louwaars (2007) argued that, the genetic makeup of the seed determines to a large extent the yield potential and yields stability of the crop. However, the use of certified seed is heavily depending on its availability and accessibility in a given area. In Rwanda, even though certified bean seed is key factor for beans crop productivity, the quantity and quality required to increase production is not available at most households' level. In the existing conditions, one of the main sources of this certified seed is private seed multiplication system.

This study along with the analysis of the situation of certified bean seed production should be useful for Rwanda Agricultural Board to make decision with regard to creating conducive environment for private certified seed producers and in general formulating policies and strategies for the development of the national seed sector. Besides, it would be a beneficial reference for researchers and other people interested in the area of study.

1.4 Research objective

To contribute towards the availability of certified bean seed by investigating the main factors affecting its production in Nyagatare District, eastern province, Rwanda.

1.5 Research question

1.5.1 Main question

What are the factors affecting the availability of certified bean seeds in Nyagatare District?

1.5.2 Sub questions

1. What preferences do seed producers have between multiplying beans over other seeds?
2. What benefits do seed producers get from certified seed production in general?
3. What benefit do seed producers get from certified bean seed production?
4. What are constraints encountered in certified bean seed production?
5.What are other main bottlenecks experienced by seed producers?
6. What inputs are seed producers using in seed production?
7. How do seed producers access improved seeds and other inputs?

1.6 Limitation of the study

The Rwandan government is actually providing an effort to increase agricultural production. However, cereals are promoted at the expense of legumes in particular bean. From this situation, research on bean crop is almost absent, so to find recent and diversified literature review has been a challenge for the current report. The other challenge was related to the restructuring of working organisation. Indeed, by the time of data collection Rwanda Agricultural Board was undergoing restructuring; hence the researcher could not easily access useful information available within organisation as many staff have been appointed to new positions whereas others were already retrenched. Hence, useful information expected to be collected from working institution in order to improve desk study were limited.

1.7 Definition of the concepts

Seed: For the purpose of this study seed will refer to any grain, plant or part of a plant used for plant propagation in general.

Certified seed: For the purpose of this study certified seeds originate from multiplication of basic seeds whose quality has been approved through official certification process. They are produced by private seed producers and are certified by seed inspectors.

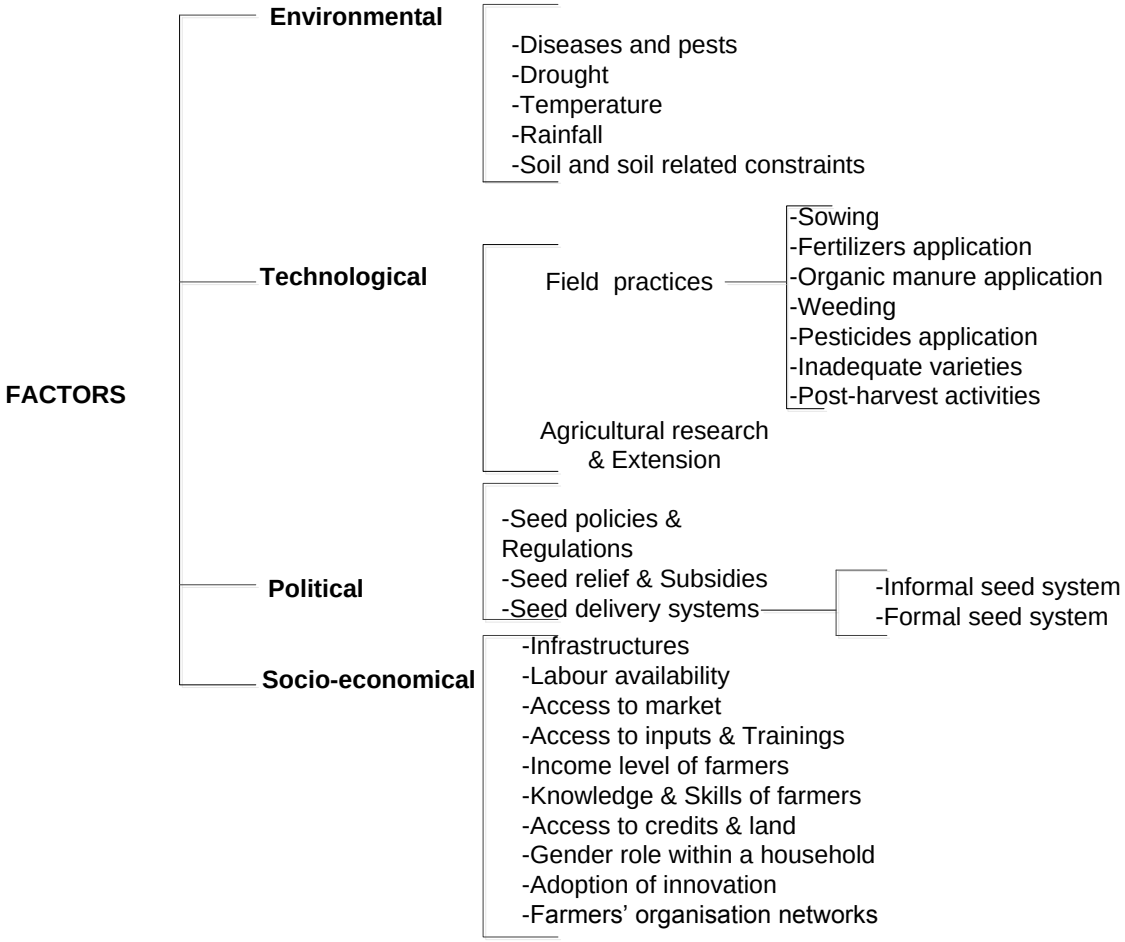
Seed availability: For the purpose of this study, seed availability is defined narrowly as whether or not seed of the target crops is present in the geographical area in question.

Seed producers: For the purpose of this study, seed producers will refer to any person or group of persons approved by the relevant authority, producing seeds according to the standards set forth by the Law.

Informal seed system: For the purpose of this research informal seed system will occur when famers or group of farmers produce seeds for their own use or for the use of neighbours outside the official seed production and control system.

Formal seed system: For the purpose of this study, formal seed sector will occur when seed production system is under the official control by the relevant State services.

Figure 3 Operationalization of the concepts



Source: Author

1.8 Organisation of the thesis

This report starts with chapter one which presents an introduction to the research background. The same section covers problem statement, justification of the study, research objective, and research question, limitation of the study and definition of the concepts. The second part looks at the literature review used to come up with relevant information that supported data collected from the field. Method of carrying out the research is covered in the third section whereas results of the research are presented, analysed and discussed respectively in fourth and fifth chapters. The report ends with section sixth where conclusion and recommendations on factors affecting the availability of certified bean seed are defined.

CHAPTER 2: LITERATURE REVIEW

In this chapter, the researcher aims to summarize the views of other authors in the area of research. Hence, this literature review focuses on the relationship between certified seed and food security, seed quality and seed certification, seed systems in East Africa, over view of seed sector in Rwanda and factors affecting certified bean seed production in the region.

2.1 Certified seed and food security

FAO (2001) demonstrated that certified seed is the single most important input in crop production; it carries the genetic potential of the variety and determines the ultimate productivity of other inputs. FAO (2004) argued that, the main role of other inputs in crop production is to exploit to a maximum the genetic potential of the seed. Therefore, as reported by Louwaars (2007) seed is and should always be the basic prerequisite of any food security scheme.

In this context, for every farmer to achieve food security, seed security is a key issue as far as seed is concerned. VAN DER BURG (1998) cited by Louaars (2007) define seed security as " the state in which all farmers in a region or farming system have ready access to sufficient quantities of seeds of adequate genetic and physical quality, at the right moment, year after year". The Seed and Plant Genetic Resources Services of the Food and agriculture Organisation of the United Nations (FAO, 2003) defined seed security as "the access by farming households (men and women) to adequate quantities of good-quality seeds and planting materials of adapted crop varieties at all time, good and bad". Seed security includes seed availability, accessibility and utilisation (quality).

-Seed availability and accessibility: Sperling and Cooper (2003) explained seed availability as whether or not seed of the target crops is present in the geographical area in question. Gregg and van Gastel (1997) cited in Louwaars (2007) argued that, it has to be there at the right time, in the right quantities with the right price so farmers can access the seed they need. The availability of seed in a given area is not enough to ensure seed security. But, resources to afford seeds influence seed security situation of farmers. FAO (2003) notified that:

> Seed access is specific to farmers or farmers' groups/communities and it is largely depends upon the assets of the farmers in question: whether or not the farmer has (financial capital) or social networks (social capital) to access seed. Land and physical assets may also be considered as determinants of access: if a farmer has sufficient land to guarantee self-sufficiency, and adequate storage, he/she is likely to have sufficient access under most conditions.

- Seed utilisation (quality): Remington, et al. (2002) as cited in Sperling and Cooper (2003) listed basic quality aspects, including physical, physiological and genetic or varietal characteristics: In the term of the issues of physical, physiological and sanitary seed quality, the following features are considered:(i) good germination and vigour, (ii) low moisture content, (iii) well filled grain, (iv) high physical purity, (v) absence of harmful weeds and low absence of other weeds, (vi) absence of visible fungi/disease and living insects (Remington et al.,2002 cited in Sperling and Cooper (2003)).

Concerning varietal or genetic parameters, FAO (2003) cited the following points to take into accounts:

> (i) Must be adapted varieties (ii) varietal characteristic should be described and meet farmers' requirements (iii) typically, they should be of good yield potential under farmers' conditions and ideally would be pest/disease-resistant/tolerant (iv) may be a pure variety, or a population or mixture, depending on farmers' needs (v) may be a

traditional or newly introduced variety, depending on farmers' needs and capacity to "experiment" (vi) presence of genetically modified organisms (GMOs) must be declared; GMOs should only be provided after a prior informed consent .

2.2 Seed quality and seed certification

Seeds are basic agricultural input as cited in previous paragraphs. Pelmer (2005) argued that more importantly quality seeds of any preferred varieties are basis of improved agricultural productivity since they respond to farmers needs for both their increasing productivity and crop use. Moreover, as mentioned by ISAR (2010) a sustainable increase in production and productivity of crops for farmers depends to a large extent on the development of high yielding varieties and on the establishment of efficient seed supply system-enabling farmers to easily have access to those quality seeds. Indeed, as quoted by Steven, et al. (2008) farmers require seeds that germinate uniform, under a broad set of environment conditions and are free from seed borne diseases.

FAO (1999) explained that:

> Seed quality goes hand in hand with seed quality control and certification in which the most important physiological, physical and sanitary seed qualities (viability, purity, health) are tested in a laboratory, commonly using procedures that are harmonized internationally by the International Seed Testing Association (ISTA).

Louwaars (2007) defended that, in developed countries, the results of seed quality tests can be communicated to the market either by printing the test results and the testing date on a label (used in USA) or banning the seed from the market that does not comply with certain minimum standards for any of the quality criteria (used in Europe). Conversely, as reported by FAO (2003) in developing countries, most farmers having small landholdings, being poorly educated and weakly financed, often characterize a developing agro-economy. Relatively few farmers are well to do, use quality inputs, and produce for the "market". Likewise, as argued by FAO (2004), most of these small farmers are uneducated; they do not understand the formal seed production technology or the value of certified seed. Thus, they are unable and/or unwilling to pay higher prices for seed. Much of their production is often for home consumption or barter.

As argued by Gastel, et al. (2002), this situation is further hindered by few incentives to produce for the market and thus affecting cash investments in seeds and other inputs. Almekinders, et al. (1994) reported that over 90% of agricultural production is derived from farmer-produced seed, hence, the market for certified seed is thus very small, and not many true "seed enterprises" operate successfully in the local seed supply used situation.

The seed quality cannot be guaranteed if there are non-skilled institutions that can certify seed quality control. According to FAO (2003), seed certification and quality control are intended to provide a service to farmers who purchase seed, since neither the identity of the variety nor most other quality parameters of the seed can be observed from visual inspection of the seed itself. FAO (2010) explained that, seed certification and quality control are performed by government agencies, by specialized independent organisation or by the seed companies themselves.

Furthermore, seed certification and quality control is costly and time consuming. According to Gastel, et al. (2002) the administration, field inspection, seed sampling and testing in a specialized laboratory add to the cost of seed production. The smaller the production units and the wider these are dispersed, the higher such cost will be. Tripp and Louwaars (2007) reported that, certification is provided in most countries for only few major food and industrial crops irrespective of what their seed laws prescribe.

2.3 Seeds systems

Seeds systems broadly fall into two categories; the informal and the formal systems**.**

2.3.1 Informal system

Cromwell (1996) describes informal systems as “traditional”, “informal” seed systems while Louwaars and van Marrewijk (1996) described it as “local”, since they operate mainly at farmer and community levels both in term of production and exchange mechanisms. According to research done by FAO (2004); throughout Latin America the term “informal” means illegality when related to seed systems. The reason for this is that “informal “is used to describe grain producers of some cash crops who sell part of their harvest as seed without being legally accredited as seed producers, this is a common practice in most countries (FAO, 2004).

CIAT (2004) explained that unlike Latin America, other regions of the world use the term “informal” to identify on-farm or traditional seed systems. This informal system is still used as a major source of planting material for subsistence crops. Louwaars (1994) reported that informal seed systems are very important for crop production in Africa and the systems vary among countries, regions and crops. CIAT (2010) argued that, this is the predominant system for food crops in subsistence agriculture as it is estimated that in developing countries, the informal seed system is responsible for more than 80 per cent of the total area planted with the subsistence crops. Turner (2008) considers informal seed system as a very resilient system, which is very active even without the support of the public or private institutions. Hence, on-farm seed systems are essential for improving food security for developing countries. FAO (2004) quoted that; they will likely continue to be the main source of seed for subsistence crops in the world. Since this system is not market-oriented, seeds are usually produced for consumption.

2.3.2 Formal system

Louwaars, N.P. & G.A.M. van Marrewijk(1996) said that:

> The formal seed production schemes use organized channels under the supervision and quality control system provided by public or private institutions, in accordance with special rules and regulations the system is able to meet the demands of modern agriculture and complies with the seed industry’s requirements.

This corresponds with the term “conventional seed sector’ (Camargo et al., 1993 cited in Louwaars, 2007) and the ‘ organized seed sector’ (Reusché and Chopra, 1993). Rubyogo, et al. (2007) mentioned that the main goal of the formal seed systems is profit, something very hard to attain with subsistence agriculture compared to the informal seed system which aims at self- supply of seed, considered an important alternative for improving food security. FAO (2004) reported that formal seed supply systems, then, are designed for commercial agriculture, and use improved varieties developed for market that responds to the application of the new technologies. Louwaars (1994) stated that the formal seed system is the easier to characterize, as it is a deliberately constructed system, which involves a chain of activities leading to clear products: certified seed of verified varieties.

2.3.3 Seed system in East Africa

Formal seed systems are different within countries in term of organisation, rules and regulations, type of crops focused on, quality and quantity of seed produced as well as equipment involved in the process. This section of report emphasizes formal seed system in East Africa and specifically Kenya where formal seed system is showing progress if you compare with formal seed system in Rwanda. This progress is confirmed by number of seed

companies operating there, type of crops involved and quantity produced. The following paragraphs are highlighting not only success of seed systems in Kenya but also challenges experienced by the country.

Ayieko .M. W. and D.L. Tschirley (2006) reviewed that seed industry in Kenya, like any other economy, is divided into the formal and informal system. The two systems vary in their magnitude and importance depending on the commodities they support. According to Kimani, et al. (2010) the formal system in Kenya mainly focuses on important food crops, such as maize, beans, wheat, rice, etc.; horticultural crops, such as vegetable as well as industrial crops such as coffee, tea, sugar and cotton. These crops have a huge local and export market. Ayieko M. W. and D.L. Tschirley (2006) reported that, currently, the formal seed sector comprise of five (5) public and fifty (50) registered private seed companies and seed produced through this system is distributed through officially recognized seed outlet, which must obtain registration and certification from KEPHIS.

Muyaga, et al. (2005) as cited in Ayieko .M. W. and D.L. Tschirley (2006) has written that the government of Kenya has been pursuing strategies aimed at increasing agricultural productivity as this has been seen to be central to accelerating economic growth and improving the wellbeing of both rural and urban people in Kenya. Hence, as reported by Kimani, et al. (2010) seed has been recognized as core to realizing this strategy. Compared to other agricultural inputs, seed has been shown to have the greatest potential to increase on-farm productivity and enhance food security.
Nyoro and Aringa (2004) state that:

> A well-functioning seed system is one that uses the appropriate combination of formal, informal, market and non-market channels to efficiently meet farmers' demands for quality seeds. While the seed industry in Kenya is better developed compared to other countries within the region, high cost of seed relative to other purchased inputs, coupled with the inability of the formal seed system to meet the demand have been cited as bottlenecks to the seed industry.

Kimani, P.M., R. Chirwa and R. Kirkby (2000) explained that the regulatory and legal framework of the national seed system limits the development of the informal seed system because the existing seeds and plant variety legislation are not supportive of the informal seed sector relative to on-farm seed production, exchange, maintenance, development and registration of landraces. Furthermore, as noticed by Rohrbach and Howard (2003) cited in Muthoni. J and D. O. Nyamongo (2008), the formal seed system in Kenya is also linked with other challenges like the state monopoly in seed inspection and certification which has sometimes hampered production of certified seeds and seed growers have lost their crops due to late inspection by an overstretched, under-resourced seed inspection service.

Muthoni.J and D. O. Nyamongo (2008) found that informal system embraces most of the ways in which farmers themselves produce, disseminate and procure seed: directly from their own harvest, through barter among friends, neighbours and relatives, and through grain markets or traders. Ayieko.W and D.L.Tschirly (2006) mentioned the major reasons perpetuating use of farm-retained seeds in Kenya: the high cost of certified seeds and marketing problems in the formal markets especially due to poor transport and communication infrastructure in some remote parts of the country and unavailability of clean seeds in the markets. MOA, 2007 cited in Muthoni. J and D. O. Nyamongo (2008) argued that informal system does not meet the full requirement of certified seed in term of physical purity, freedom from disease, pests and noxious weeds as well as viability. This situation may lead to yield losses and accompanying food insecurity prevalent in some of the smallholder communities.

2.3.4 Overview of seed sector in Rwanda

The Rwanda seed commodity chain is characterized by the coexistence of formal and informal seed systems.

Formal system: According to Ministry of agriculture (2007) the formal system is rather recent and has been developed in response to an increase in agricultural productivity. It is based on services provided by the public sector stakeholders such as ISAR for the production of foundation seed and RAB for the production of basic seed. ISAR (2010) reported that participation of the private sector in seed production and conditioning is still very low. It is only limited to certain associations, cooperatives and enterprises, which produce and market seeds under control of RAB.

Informal system: Byakweli (2010) quoted that the informal seed system, which far is the most important, consists of all actors who produce and market seeds without interacting with government institutions, which regulate seed production, control and marketing activities. FAO (2003) argued that it is mainly based on traditional practices of farmers who select and keep a portion of their production as seeds for the next seasons. It is also characterized by multiple transactions and exchanges between farmers themselves, or through traders from whom farmers can also purchase food commodities some of which, are sorted to be used as seeds as mentioned by ISAR (2009). The major deficiency of this sector lies in poor quality of products and the risk of disease propagation (Byakweli, 2010).

2.3.4.1 Seed production and challenges

According to ministry of agriculture (2007), the current and past trends of seed production reveal that seed production systems were more focused on quantities to be produced than on actual demand to be satisfied resulting in difference between supply and demand. In fact, the formal seed sector accounts for approximately 1.5% of the total quantity of seeds used in the country (ISAR, 2010). The current demand for certified seed is not well known but it is far higher than what is available (MINAGRI, 2010). The following table provides some figures about seeds needed and seed distributed in 2009.

Table 1: Seeds needed and seeds distributed in 2009

Crops	**Certified Seeds needed (MT)**	**Certified Seeds distributed (MT)**	**Satisfaction rate**
Wheat	421	326	77%
Maize	1175	891	76%
Beans	1278	32	3%

Source: *MINAGRI, 2010*

Rwandan seed sector continues to experience a number of challenges constraining it from producing adequate seeds for the farmers. As noted by Ministry of agriculture (2007) those challenges include:

- Land scarcity due to high population increase;
- Inadequate funds to execute activities;
- Climate change especially drought;
- Inadequate technical supports from the institutions managing seeds (extension and human resource skills);

- Inadequate facilities for seed quality control and post-harvest handling services;
- Inadequate access to microcredits by the private seed producers and high dependency on rain.
- On the other hand, farmers lack awareness of the usefulness of improved seed (ISAR, 2010).

Ministry of agriculture through a National Agricultural Survey of 2008 revealed that only 10% of farmers reported using improved seeds. The main reason is that the majority of them cannot distinguish the traditional seed from certified one and they believe that nothing can replace informal seeds. In addition, as reported by Byakweli (2010), bureaucratic challenge in the seed accessibility is caused by a centralized system by RAB in which seed certificates are issued at the Headquarters in Kigali, thus restricting seed accessibility due to heavy administrative procedures and to scarce distribution network. Moreover, MINAGRI (2008) mentioned that there is not an efficient marketing strategy and the system is still characterized by a structural inefficiency in meeting the demand. Finally, it has been noted that there is no seed security stock; thereby the risk of vulnerability in case of a bad-cropping season is high (MINAGRI, 2008).

2.3.4.2 Importance of beans in Rwanda

ISAR (2009) argued that beans are the primary source of dietary proteins in the country as they supply 65% of national dietary proteins compared to 4% from animal resources. Beans also contribute generous amount of energy (32%); and micronutrient: iron, zinc and vitamin A and B that promote normal body cognitive growth and development. ISAR (2009) explained that, due to their diversified nutritional content and predominant protein supply in Rwandan diets, beans are regarded as near-perfect food, and as the meat of the poor. According to CIAT (2008) beans are a short duration crop (2.5-4months), and also key for helping to shorten the hunger periods and for providing quick cash. Different sources estimate that beans cover 22-30% of cultivated land, being first or second to banana. However, as reported by ISAR (2009), the on-farm productivity of about 0.3-1.0 tonnes per hectare is still low compared with 2 tonnes (for bush) and 5 tonnes per hectare (for climbers) that are achieved with optimal management conditions. This low productivity, coupled with the high per capita consumption for beans of 60 kg, means the demand for beans outweighs production (ISAR, 2009).

FAO (2004) stated that, despite this insufficient production, the proliferation in population, especially in urban area has recently created an exponential rise in opportunity for marketing and earning income from beans by farmers. ISAR (2010) argued that, to exploit this, the farmers will be better linked and be reactive to the specific market and consumers demands and preference of grain types, such as the yellow, red, red mottled and white seeded beans that fetch premiums prices instead of the current predominant non attractive mixed varieties (ISAR, 2010).

Both the bush and climbing bean types are cultivated in Rwanda. ISAR (2009) explained that where they are adapted like in the mid to high altitude zone above 1700m, the climbing beans types are most suitable for intensified production in Rwanda because of the prevailing small land holding averaging 0.7 hectare per household. This is due to the higher yields of about 3.5-5.0 tonnes per hectare that triples that of the bush types under similar ideal production conditions as reported by CIAT (2008). However, ISAR (2009) declared that, their longer maturity duration doesn't permit production in the drier and warmer lower altitude zones and the bush types are more predominant in such zone such as in eastern Province.

2.3.4.3 Private certified bean seed producers

Currently, there are 475 private seed producers approved by RAB to produce seeds including beans. They are expected to meet a number of criteria to qualify as a seed producer. As a starting point, they have to apply to Rwanda Agricultural Board in order to be visited by seed inspectors who confirm that they fulfil the conditions required by RAB. These conditions include: (i) availing a minimum of 5ha of land; (ii) the land must be fertile and isolated from other lands not allocated to seed production; (iii) no exposure to erosion; (iv) easy accessibility by seed inspectors for field inspection; (v) availing a storage facility that allows proper handling of seed at harvest and post-harvest time; (vi) have basic agricultural implements (hoes, machetes, rakes, wheelbarrow, bags, etc.); (vii) recruit a technician agronomist to do the monitoring of seed production and(viii) agree to sign a contract with RAB where a number of seeds production rules are cited including a condition of growing only basic seed produced by RAB, allowing seed inspectors to do field inspection, seed sampling and laboratory analysis in order to provide seed certificate; (ix)Seed producer should be willing to sell the certified seed to RAB (own experience).

2.4 Factors affecting bean seed production

As reported by CIAT (2008), Beans are faced with several problems that reduce the productivity and commercialization of the crop, contributing to food insecurity, unavailability of low cost protein, and low incomes for both rural and urban population in Africa. These problems can be grouped into six categories: Those associated with (i) production, (ii) seed delivery system, (iii) marketing, (iv) agricultural research extension (v), problems of seeds producers and (vi) problems of land scarcity

2.4.1 Production problems

Problems in bean production processes have contributed to low yields, which result in regular food shortage and lack of surplus for cash. The yields are varying across the region from 200 kg/ha in less favourable environment to 700 kg/ha in more favourable environment when grown in pure stands, and about half of this when intercropped (CIAT, 2008). Several biotic and abiotic factors contribute to low bean yield. Kimani(2000) listed biotic constraints including diseases and pests, varieties with low yield potential, and susceptibility to diseases and pests. He also reported the main bean diseases and pests in East Africa, in descending order of importance starting by angular leaf spot (*Phaeiosariopsis griseola*), anthracnose (*Colletotrichum lindemuthianum*), bean stem maggot (BSM) (*Ophiomyia* spp.), bruchids (*Zabrotes subfasciatus* and *Acanthoscelides obtectus*), root rot, common bacterial blight (CBB), aphids, rust, and bean common mosaic virus (Kimani, 2000). Wortmann, et al. (1998) declared that the severity of these diseases varies with season and locations, but the top five listed above are widespread and cause serious yield losses. The management of these diseases is constrained by pathogenic variation for most of them.

Buruchara, et al. (1996) explained that, the important diseases of beans specifically in Rwanda are angular leaf spot (*Phaeoisariopsis griseola*), and root rot caused by complex of soil pathogens, particularly Pythium, Fusarium and Rhizoctonia species, bean common mosaic virus (BCMV), and anthracnose (*Colletotricum lindemuthiunum*)(Ascochyta blight (*Ascochyta phaseolorum*) and halo blight (*Pseudomonas syringae pv. Phaseoli*) are important in higher and cooler altitude (over 1700 m above sea level), while common bacterial blight and bean rust feature in the warmer lower altitude zones (1000-1400m) (Buruchara et al., 1996). ISAR (2009) reported that, the fungal diseases (angular leaf spot, root rots, anthracnose, common blight and rust) alone cause grain yield loss of 219, 575 tonnes per year, equivalent to 89 million USD in Rwanda. CIAT (1998) cited in CIAT, (2008) mentioned that Bruchids cause heavy post-harvest losses and, consequently, heavy losses of profit because farmers are obliged to sell their beans immediately after harvest when price

are low. Wortmann, et al. (1998) listed the most important abiotic constraints including soil, soil related constraints and rainfall. Phosphorus (P) is the most frequently deficient nutrient and supply is low in 65% and 80% of the bean-production areas of Eastern and Southern Africa. Kimani (2000) revealed that the availability of soil Nitrogen (N) in Eastern Africa is low on 50% of the production areas. Rwanda Agricultural Research Institute (ISAR, 2010) reported poor soil fertility (low N, P) and acidity among the most important abiotic constraints. Drought has been listed as a main constraint in eastern region of Rwanda where the annual rainfall ranges from 800-1000 mm. Even though those precipitations are rather adequate, but their inconsistent nature cause frequent drought that limits bean yields (ISAR, 2010).

According to CIAT (2010), farmers generally recognize the need to improve their yields by carrying out cultural practices such as timely planting, fertilizers and manure application, weeding, crop protection in the field and after harvesting, and timely harvesting and storage, they are limited by socio economic constraints including inadequate labour (women who normally occupy beans production are overloaded), inability to hire labour, and lack of cash to buy fertilizers, chemicals, and spray equipment or to construct proper storage structures. In other situations, farmers lack know-how on appropriate production and post-harvest management practices. Moreover, the same author explained that, many farmers still grow their traditional bean varieties, which are susceptible to diseases and pests and have low yield potential. These varieties also lack tolerance to soils deficient in different elements; hence beans production is affected negatively (CIAT, 2010).

2.4.2 Seed delivery constraints

Sperling, et al. (2004) declared that improved bean cultivars are likely to have minimal impact if an efficient and reliable seed delivery system is not in place. Likewise, many farmers in the region do not have access to quality bean seed, especially of the improved varieties, and have to rely on their saved seeds. Kimani, et al. (2010) said that, this is attributed to inadequate seed distribution networkers, where they exist. Due to the poor infrastructure, seeds reach the farmers late in the season or do not reach them at all. In order case, the quantity are inadequate and of poor quality. In area where seeds are readily available in local shops and markets, farmers may not have adequate resources to purchase them. All these factors contribute to the low productivity of beans in farmers' fields (Kimani et al., 2010).

2.4.3 Marketing constraints

Farmers grow beans not only for their own domestic consumption, but also as a source of income. Many farmers value beans as fast growing crop, which can be converted easily and regularly to cash, especially during times of need. According to Nekesa, et al. (1998) farmers' attempts to commercialize the crop face numerous problems such as:

- Low prices;
- Production located far from main market;
- Poor infrastructure in rural areas resulting in expensive and often unreliable transport;
- Insufficient production unable to offset marketing costs;
- Limited access to market information, resulting in reliance on exploitative middlemen;
- Inappropriate storage facilities and inability to control post-harvest diseases and pests (especially weevils) and
- Lack of alternative source of income where farmers are unable to hold their produce until prices improve (Nekesa et al., 1998).

2.4.4 Problems facing national agricultural research systems

According to Kimani, et al. (2010) breeders, in collaboration with other scientists, are expected to provide solutions to farmers' problems. This basically involves developing well-adapted bean cultivars with high yield potential, desirable seed characteristics, tolerance to

the major biotic and abiotic constraints, and acceptability to consumers. However, Kimani, et al. (2010) continued by mentioning that, in carrying out their responsibilities, bean breeders in the National Agricultural Research Systems (NARS) in the region are faced with several problems that slow down the realisation of their goals. As cited by CIAT (2004) these problems and their associated constraints (which include local varieties that lack adequate resistance to low soil fertility, pests and diseases) are attributed to the following:

- Lack of reliable sources of genetic resistance for some problems, such as angular leaf spot, anthracnose, and low soil N and P;
- Lack of knowledge about the epidemiology of major diseases;
- Inadequate financial resources to develop effective breeding programmes;
- The information exchange system between and within countries is poor;
- Inappropriate research and extension methods are often used.

2.4.5 Problems of seeds producers

According to Kimani, et al. (2001) many public and private commercial companies have included the bean in their seed production enterprises in the last two decades. However, seed producers in the neighbouring Kenya (Kenya Seed Company) have reduced their scale of operation because they have found the bean seed business unattractive due to unstable demand, small and localized markets with a wide range of buyer profiles, and the high cost of producing good-quality seed (Kimani et al. 2001). In Rwanda, the foundation seed project Appui au Secteur Semencier du Rwanda was sold bean seed at lower price to farmers and NGOs than the production costs. Thus, seed production was only possible because of price support by the Rwandan government and the Belgian Co-operation and Development Agency (BCDA). After 2000, the support was withdrawn; hence growing certified bean seed become less attractive (Kimani et al., 2000). FAO (2004) reported that, seed producers are poorly linked with research and the commercial seed sector, and they do not have access to basic seed of new varieties. In addition, they lack the resources and knowledge for producing, cleaning, packaging, labelling, and marketing quality seed. Because of limited resources of land and capital, farmer seed producers can only produce limited quantities (FAO, 2004).

2.4.6 Land scarcity

According to Ministry of agriculture (2010), land is a major resource for bean-growing families, but because of rapid population growth, the availability of productive land has declined. This has resulted in intensification of cropping and a subsequent decline in soil fertility in previously high-potential bean-producing regions. Wortmann, et al. (1998) noted that:

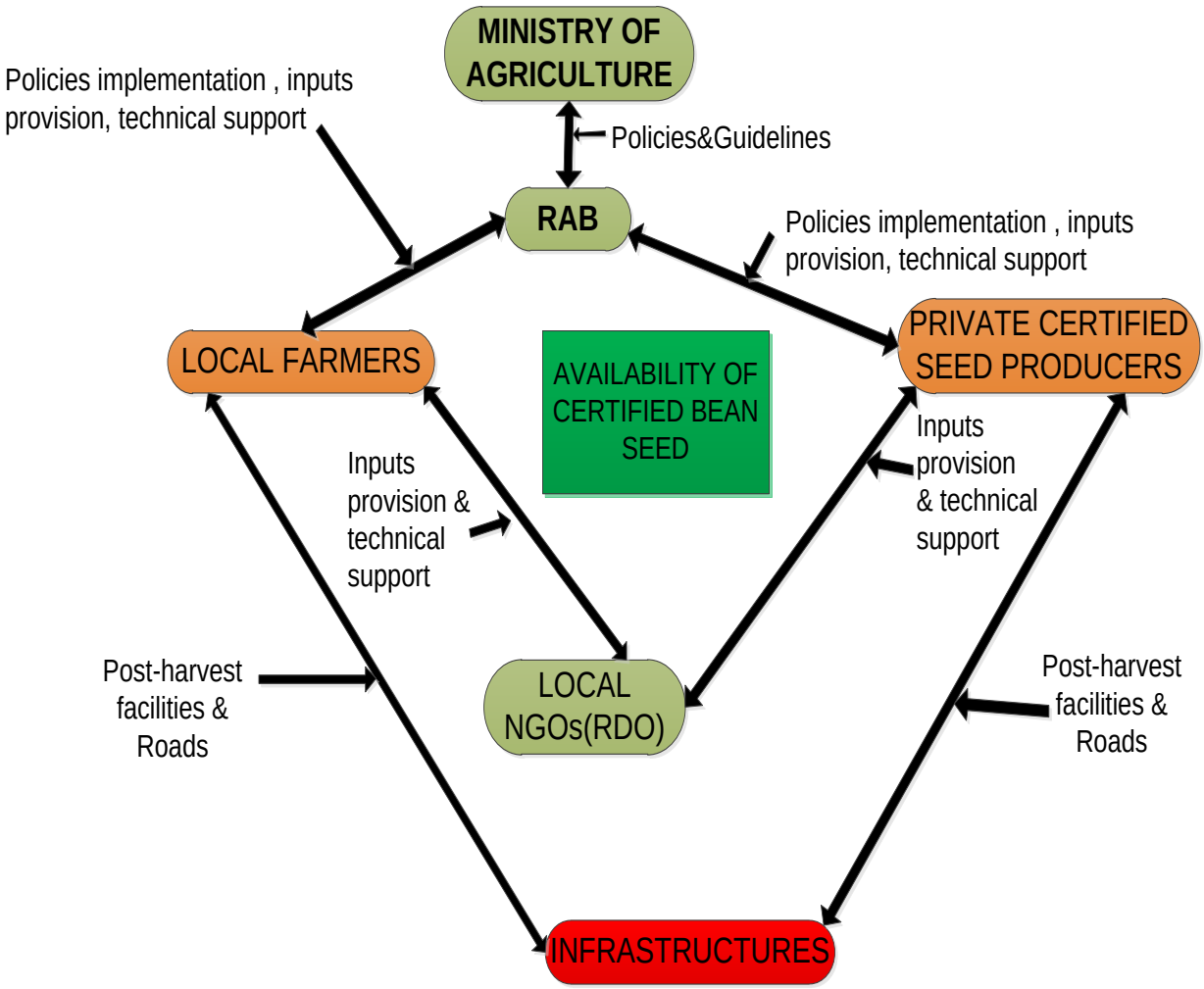
> There is a strong correlation between population density and intensity of bean production. Major constraints to increasing productivity by land-scarced families include: local varieties are not well adapted to low soil fertility, drought, and associated soil-borne diseases such as root rot and charcoal rot; land-scarce families either cannot afford to buy fertilizers or these are not profitable to apply when moisture is a limiting factor; continuous cropping results in the build-up of soil pathogens and diseases; because of population pressure, fragmentation of parcels, and concomitant decline in land sizes, there are limited opportunities for crop rotation leading to reduced soil fertility and high incidence of diseases; management strategies to control soil fertility, diseases, and pests are inadequate; rainfall is irregular or inadequate and lack of low-cost, labour-saving technologies.

CHAPTER 3: RESEACH METHODOLOGY

This chapter emphasizes the research approach to be used in the study and the different instruments to be applied for collection, processing and analysis of data that generate answers to the research questions. This section presents hence the research design, selection of the study area, description of the study area, selection of respondents, sampling procedures, methods of data collection, data processing and analysis.

To come up with field data, a number of stakeholders involved in seed system and socio-economic factors mainly infrastructures available have been used as sources of information as presented in figure 4 below. The figure provides the relationship between the main key factors affecting the availability of certified bean seeds. It brings the theoretical thinking of the connection between Ministry of agriculture, Government institutions (RAB) and local NGOs operating in agriculture sector, private certified seed producers and local farmers. It also illustrates how certified bean seeds availability is affected by socio-economic factors mainly existing infrastructures.

Figure 4 Stakeholders and available infrastructures



Source: Author

3.1 Research design

In order to give answer to the research questions listed in chapter one, research is designed into two steps: the first step involves desk study and the second steps was collection of data on the field. The desk study part collected theoretical information, which is useful to understand concepts related to this study. Hence, secondary information has been gathered by reading different literatures and documents related to the topic of research. Information based on desk study was collected through electronic search using library books of digital library of Wageningen, as well as reliable Internet source related to the research topic. In addition, reports and unpublished document from working place have been consulted to provide secondary information.

The second step involves gathering of primary information where a case study has been employed to get them from the field. Checklists with semi-structured questions have been used to investigate information from private certified seed producers; local farmers who are using certified seed but without participating in certified seed production and a key informant (staff of local NGO supporting seed producers). For the same purpose Participatory Rural Appraisal (PRA) tool particularly crops preference raking provided information about crop preferred by seed producers. Furthermore during this step, researcher used observation as mean to get information. Use of those different tools in data collection guaranteed triangulation of information.

3.2 Selection of the study area

The district of Nyagatare is one of the seven districts making the Eastern Province. It is divided into 14 sectors made of 106 cells and 630 villages. This district was selected as the study area due to the fact that it is the first district holding a big number (27%) of seed producers in the country with favourable potentials of growing bush beans. Moreover, many organisations with different support are attempting to improve agricultural sector in the area through farmers' cooperatives as well as individual farmers. So the aim of this study is to find out the constraining factors affecting the availability of certified bean seed among private seed producers operating in Nyagatare district, so the data gained from this area can be used to present a generalized case to the whole country. The final criterion for selecting this study was working experience of researcher in the study area, so it was easy to reach the area as well as respondents as long as researcher is familiar with local situation.

3.3 Description of the research area

Spreading an area of 1.741 square kilometres, the district borders with Uganda at the North, Tanzania at its East, Gatsibo district at the South and by Gicumbi district of the Northern Province on the Western border. Nyagatare is the largest district in Rwanda. It lies in an area of grassy plains, and low hills of 1513, 5m with excellent views in all directions, including the mountains of southern Uganda and, on a very clear day, the Virunga volcano range. The land is not farmed as extensively as other area of the country, and there is a large amount of cattle. The main crops grown are maize, beans, cassava, soybean, groundnut and banana. The area has a higher average daytime temperature (23,3°C-27, 7°C) than the Rwandan average, and lower precipitation (827mm/year), which come sometimes lead to droughts.
The soil of this area is characterized by the tightness of the humifere layer of the soil brought about by the grassy savanna and by the vertisoils that are rich in nutrients mineral elements but lacking organic substances. The total population is 291.452 inhabitant whose 51% are women (Nyagatare district, 2007).

3.4 Selection of respondents

This research is designed to investigate the research problem from four kinds of respondents: private certified seed producers who are still growing certified bean seeds, seed producers who stopped to grow beans for the last two seasons, local farmers who are using certified seed but without participating in certified seed production and staff of Rwanda Development Organisation (RDO), NGO supporting farmers within Nyagatare district. Accordingly, the respondents for the case study are as follows; in Rwimiyaga sector seven (7) respondents from cooperative ABIBUMBYE have been selected while in Mimuri sector seven (7) respondents from cooperative CODAR have been selected to represent certified seed producers who are still growing bean seed. To back up the information from previous cooperatives, eight (8) individual certified seed producers growing beans in Rukomo sector have also been selected. In Karangazi sector, five (5) respondents represented individual certified seed producers who stopped growing bean seed for the last two seasons whereas five (5) respondents represented individual local farmers using certified seed in Nyagatare sector. One (1) staff RDO has been selected as a key informant. To ensure triangulation of information, respondents were from different locations and gender; some of them belong to cooperatives whereas others are working individually.

Table 2 Repartition of respondents according to location and status

Sector	**Status of respondents**						
Gender	Certified seed producers growing beans		Certified seed producers who stopped growing beans		Local farmers using certified seeds		RDO's staff (Key informant)
	Male	Female	Male	Female	Male	Female	Male
Rwimiyaga	1	6					
Mimuri	3	4					
Rukomo	4	4					
Karangazi			3	2			
Nyagatare					3	2	
NGO (RDO)							1
Total	8	14	3	2	3	2	1
	33						

Source: Own fieldwork, 2011

3.5 Sampling procedure

During sampling procedure, out of 14 sectors of Nyagatare district, research targeted only five (5) sectors where seeds producers are concentrated and on the basis of the existing information about each farmers. This research involves three categories of samples including private certified seed producers, local farmers using certified seed and local NGOs operating in Nyagatare district. Hence a purposive random sampling technique has been employed to explore information from respondents. With this strategic sample, selection of research units has been guided by the information intended to be extracted from the research units. Such information is provided by the use of the set of research questions that research has to deal with (Piet and Hans, 2010).

Two cooperatives (ABIBUMBYE and CODAR) involved in seed production have been purposely selected respectively in Rwimiyaga and Mimuri sector and have acted as focus groups representing private seed producers who still growing bean seed. This group of respondents holds a big number of research units because not only the study expects to extract information using discussion but also representatives of each cooperative through

semi-structured interview have answered a questionnaire. Furthermore, during focus group discussion, all respondents participated in PRA by making a list of seed crops preferred. Similarly, eight (8) individual seed producers who grow bean seed in Rukomo sector provided individual information through questionnaires while five (5) seed producers working individually within Karangazi sector represented seed producers who stopped to grow bean seed for the last two seasons. Karangazi sector has been selected because it holds a big number of seed producers who abandoned bean seed production according to information available in seed quality control and certification service. Information from those respondents has been extracted using discussion in focus group and questionnaires. A list of approved private seed producers operating within district has been used to identify research units.

In Nyagatare sector, five (5) respondents using certified seed without participating in seed production have been selected as respondents. Those farmers have been selected using a list of seed distribution available at sector level and only farmers cultivating one hectare were considered. Respondents have been grouped to make focus group for discussion. Many NGOs are operating in Nyagatare district, however RDO has provided information related to research topic because it supports seed producers particularly for maize seed production. A semi-structured interview has been carried out with one staff of RDO to provide information related to research questions.

3.6 Method of data collection

This research has qualitative and quantitative approach and is centered on primary and secondary data which are provided by both field and desk study. Desk study was carried out from the beginning of July 2011 while field study has been conducted from 3rd week of July to 1st week of August 2011. Data analysis and write up has been done till 7th September 2011.

3.6.1 Primary data

Primary information has been collected through a case study. This approach is chosen for data collection because it provides an in depth information on the factors affecting certified bean seed availability in the area under research. The methods used under the case study were interview, focus group discussion, PRA particularly preference ranking of seed crops and observation. Hence, primary data has been collected with semi-structured interview from certified seed producers who are still growing bean seed, certified seed producers who stopped to grow certified bean seed for two last seasons and key informant from RDO. The semi-structured interview has been conducted in collaborative way after getting the consent of the respondents by the researcher at their homestead so as to get relevant information as much as possible.

Focus group discussion has been used for all respondents except key informant and individual certified bean seed producers operating in Rukomo sector for identifying and prioritizing research decisions. Furthermore, seed producers in focus group, using preference ranking crops list have done classification of seed crops by preference. This PRA tool has provided information related to seed crops that seed producers focus on in comparison with bean.
Field data collection and interview have been conducted for a total of sixteen (16) days. Each respondent has been interviewed for a maximum of 45 minutes per session on a face-to-face interview using questionnaires for 8 days. Four (4) focus group discussions were carried out for eight (8) days where two (2) hours per session per day were allocated to every focus group. In addition to interview, the researcher has had time to do observation in the area. Through observation researcher was able to get and triangulate information like size of field, post-harvest activities, existing infrastructures and available livelihood assets. Information from observation has been used to back up data collected using checklist and questionnaire.

3.6.2 Secondary data

To come up with general background and literature review, the study used scientific books, PhD thesis, reports, unpublished documents from working place during field data collection and materials from Internet. The literature review has been used to link the findings with existing information providing answer to research questions.

3.7 Data processing and analysis

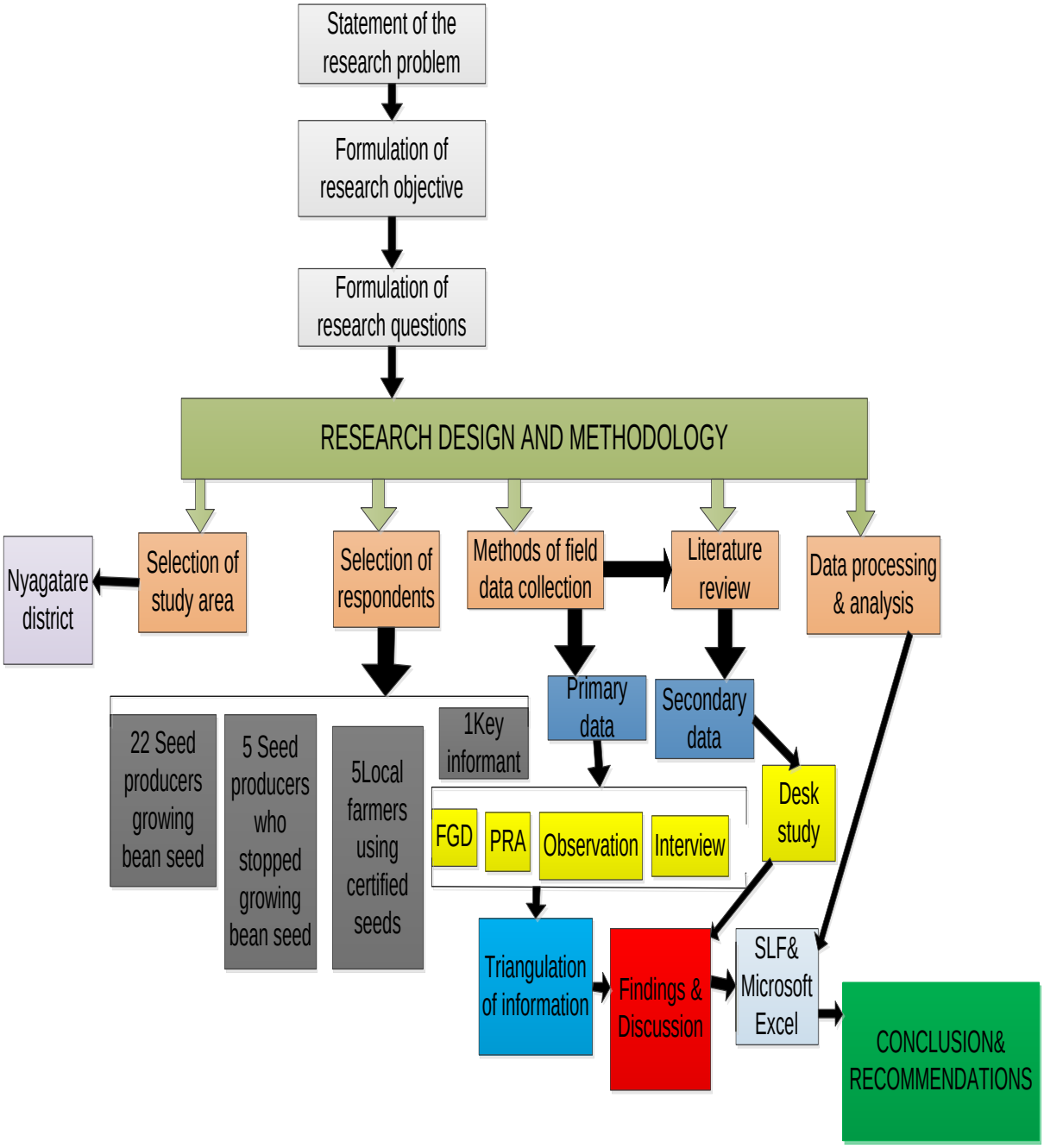
The data collected from the field has been read and re-read for a better understanding and for getting the data into a format that is easy to work with. Data collected in Kinyarwanda have been then translated in English for easy analysis. The edited, translated and tabulated data were analysed using simple statistical calculation by applying Microsoft Excel.

Qualitative information have been grouped and ranked according to the similar responses from the interviews. Hence, notes from checklist, questionnaires and PRA had to be categorized and typed up. The different categories or types of responses found has been noted down, and then separated into groups that share similar characteristics such as satisfaction and non-satisfaction with the entire seed production process. Data from focus group discussions and observation supported the interpretation of data from the individual interviewees.

Sustainable Livelihood Approach (SLA) has been used to analyze the situation. It is a tool often used by development agency for planning and assessing development interventions. It helps facilitators and planners, as well as people in communities, to better understand the different factors that affect the livelihoods of different people. It focuses on how people strategically use the resources available to them to forge livelihoods, and how development interventions affect the available resources and the way people interact with them (Ellis, 2000). The SLA (annex 3) provides a picture of key element in describing or understanding the issues affecting livelihoods in a household, community, region or country. This includes the concepts of people's capitals; people's vulnerability or susceptibilities to stress and shock; the policies, institutions, processes and organisation, which affect people; the outcomes that people are looking for and the livelihood strategies people adopt to achieve these (Chamber, 1995).

While SLA is compatible with participatory research approaches, in this case study, there is a need to adapt the framework to the specific research context and purpose so as to understand and describe the issues affecting the livelihood of private certified seed producers. Therefore, the information gathered from interview, participation, observation and document reviewed have been combined and formed the basis for the sustainable livelihoods analysis. The main components to be analysed include vulnerability context, livelihood assets, and the influence of policies, institutions and processes on farmers. Livelihood coping strategies adapted by seed producers has been also analysed. However, livelihood outcomes could not be analysed in one month of research. The literature reviews related to factors affecting the availability of certified beans seeds were also used to supplement the analysis. Concisely, to achieve the research objective, a number of steps have been taken as summarized in figure 5.

Figure 5 Conceptual research framework



Source: Author

CHAPTER 4: FINDINGS

The results are expressed as answers to research questions, which aim to find out the factors affecting the availability of certified bean seed in Nyagatare district. Findings include kinds of seed crops grown by seed producers and the reasons of preference, benefits of being a private certified seed producer, certified bean seed production constraints and solutions proposed by seed producers, how seed producers get inputs and their role in seed production, main constraints experienced during certified seed production and strategies adopted by seed producers when there is inadequacy of some assets.

4.1 Kind of seed crops grown by seed producers.

The study has shown that seed producers interviewed grow mainly two kinds of seed crops: maize and bean. However a big size of land is allocated to maize seed as shown by Table 3.

Table 3 Certified seed crops grown per size of land

Categories of seed producers	Seed crops grown	Size of land (ha)	Percentage (%)
Seed producers who are growing beans seeds (N= 10)	Maize	55	73
	Beans	20.5	27
Seed producers who stopped growing beans seed (N=5)	Maize	25	93

Source: Own fieldwork, 2011

The figures within table 3 reveal to what extent seed producers have high preference of maize seed over bean seed. Among seed producers who are still growing bean, maize seed occupied 73% of their land whereas bean seed occupied only 27%. The same case has been observed among seed producers who stopped growing beans; 93% of land is allocated to maize seed and the remaining land is occupied by bean crop that are used for domestic consumption. This information is supported by the views obtained during focus group discussion with both seed producers who grow bean seed and those who stopped growing bean seed.

4.1.1 Preference ranking of seed crops by seed producers

The results from study showed how seed producers have made preference among seed crops that they are supposed to grow. Table 4 indicates the preference ranking of seed crops made by seed producers during focus group discussion. Seed producers have made preference ranking after a consensus about a seed crop to be chosen.

Table 4 Preference ranking of seed crops by certified seed producers

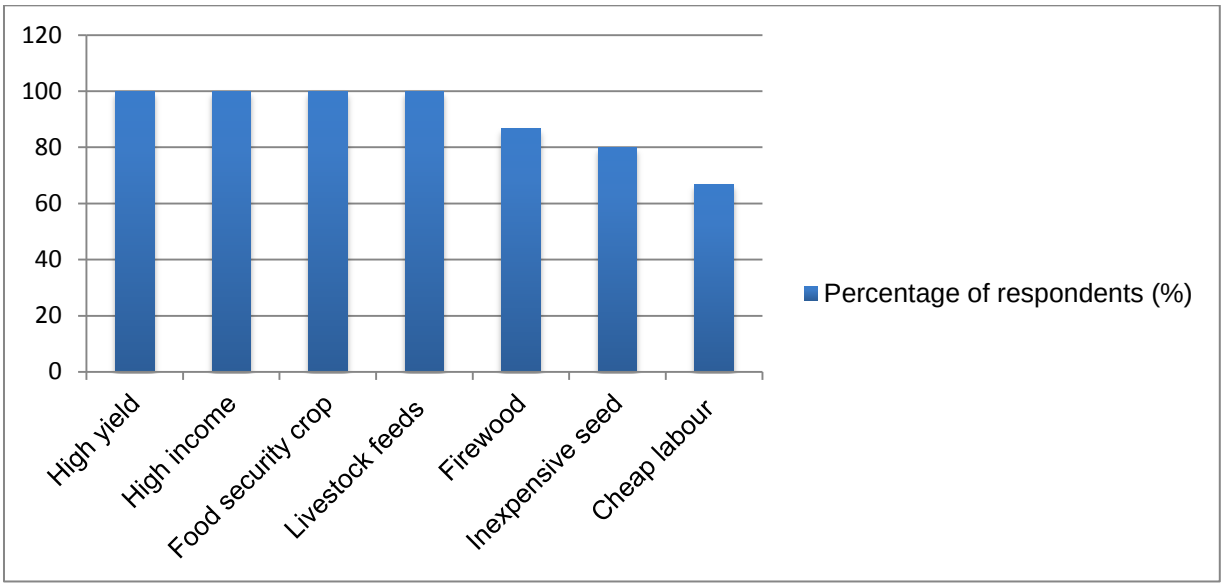
	Maize	Soybean	Bean	Sorghum	Cassava	Total score	Rank
Maize		Maize	Maize	Maize	Maize	4	1
Soybean			Soybean	Soybean	Soybean	3	2
Bean				Bean	Bean	2	3
Sorghum					Sorghum	1	4
Cassava						0	5

Source: Own fieldwork, 2011

The previous table (4) is indicating the position held by every seed crop in seed production according to seed producer's preference. As shown by the analysis of data, bean seed

occupy the third position after maize and soybean while cassava is the last crop after sorghum. The reasons of growing more maize than other crops especially bean seeds have been enumerated by seed producers interviewed as presented by figure 6.

Figure 6 Reasons of growing more maize seeds than beans seeds



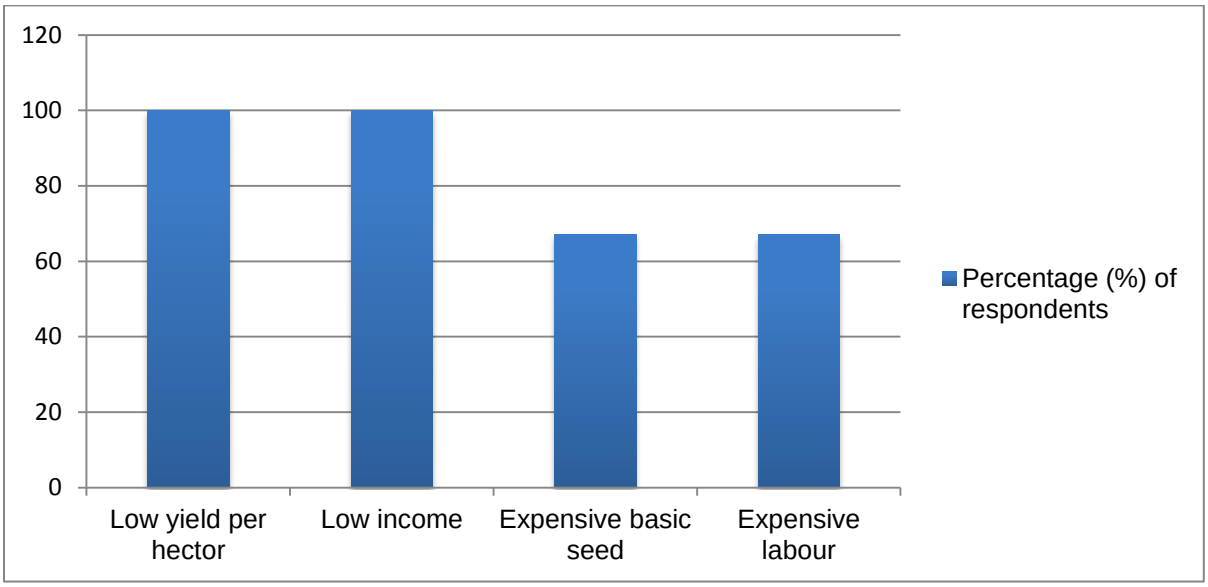
Source: Own fieldwork, 2011

It has been found that, the totality of seed producers (100%) prefer to grow more maize than bean because this crop has high yield which leads to high income, it ensures household's food security and it provides residues (maize straw), which are used as livestock feeds. The majority of respondents have respectively cited the additional reasons of growing maize crop; those criteria include use of residues as firewood (86.6%), availability of inexpensive basic seed (80%), and cheap labour at sowing and grading activities (66.6%). This information compares well with the results of the focus group discussion. Furthermore, during focus group discussion, seed producers appreciated the tolerance to diseases and pests revealed by maize crop along its growing cycle.

In addition, according to information provided by a representative of local NGO (RDO), maize seed growers are receiving more supports than bean seed growers as maize is considered as multipurpose crop. He explained that RDO intervene by providing technical support, some post-harvest facilities like threshing machines and advocacy in different actions. RDO deals only with maize value chain from production to consumption, hence not only seed producers are supported but also many actors are involved in the chain. The criteria to select beneficiaries include belonging to a cooperative, participating in land use consolidation and be a part of opinion leaders.

During data collection, not only reasons of growing more maize than beans have been declared by seed producers, but they also enumerated the main reasons of not increasing the size of bean field as indicated in figure 7.

Figure 7 Reasons of not increasing size of bean field



Source: Own fieldwork, 2011

As presented in figure 7, all private certified seed producers interviewed (100%) have stated that bean crop generate low yield per hectare, hence the profit is low when you compare with inputs invested. Expensive basic seed and expensive labour during sowing and grading bean seeds are other challenges mentioned by 67% of respondents. Respondents of focus group discussion including seed producers who stopped growing bean concurred with this information but they expressed high susceptibility of bean crop to diseases, pests and climate change particularly drought. Moreover, flooding has also been mentioned during focus group discussion as a factor that prevents seed producers from growing bean seed crops.

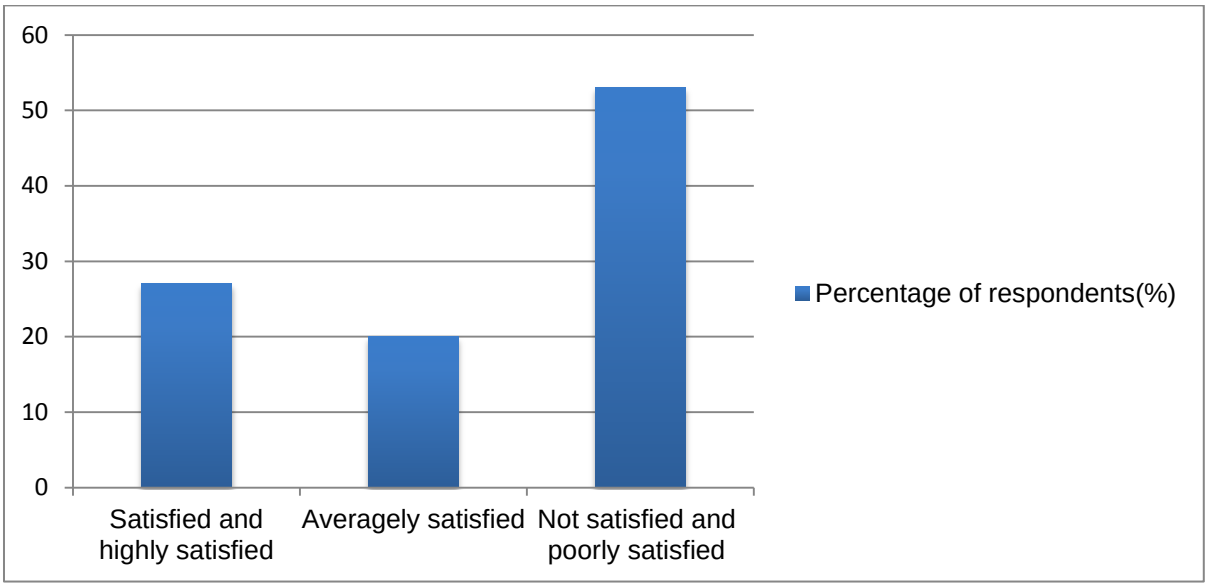
4.2 Benefits of being a certified seed producer

It has been found that there is a benefit of growing certified seed in general. This statement has been approved by opinions given by certified seed producers during focus group discussion. Benefits listed include access to market with a high and stable price, access to trainings related to technical practices needed in seed production and post-harvest activities, easy access to improved seed of diverse crops with high yield and tolerant to diseases and pests. However, information provided during interview showed that benefits got by seed producers are different according to seed crops grown as shown by the following results with bean seed as a case.

4.2.1 Benefits from beans seed production

The study has shown to what extent private certified seed producers are satisfied with benefits got from bean seed production as presented in figure 8.

Figure 8 Level of satisfaction of farmers with seed production



Source: Own fieldwork, 2011

More than a half of seed producers interviewed (53%) are not satisfied with benefits got from growing bean seed. This statement is supported by different views received during focus group discussion, which enumerated various constraints (general to certified seed production and specific to bean seeds production) as presented in the next section

4.3 Certified seed production constraints (general)

It has been found that seed producers face a number of constraints during seed production. Among bottlenecks listed during focus group discussion comprise inadequate quality and quantity of basic seed supplied by RAB, late payments of seed producers, insufficient investments, expensive transport of seed and difficulty to access credits. A representative of RDO agrees with this information and has stressed the inadequate post-harvest facilities owned by seed producers. Furthermore, observation made by researcher approve inappropriate conditions in which post-harvest activities for both maize and bean seeds are executed as it could be seen respectively on figures 9 and 10

Figure 9 Abibumbye cooperative members drying maize cobs on ground with high risk of seed contamination

Figure 10 CODAR cooperative members sitting and walking on bean seed during grading activity with a high risk of mixing seed with foreign matter

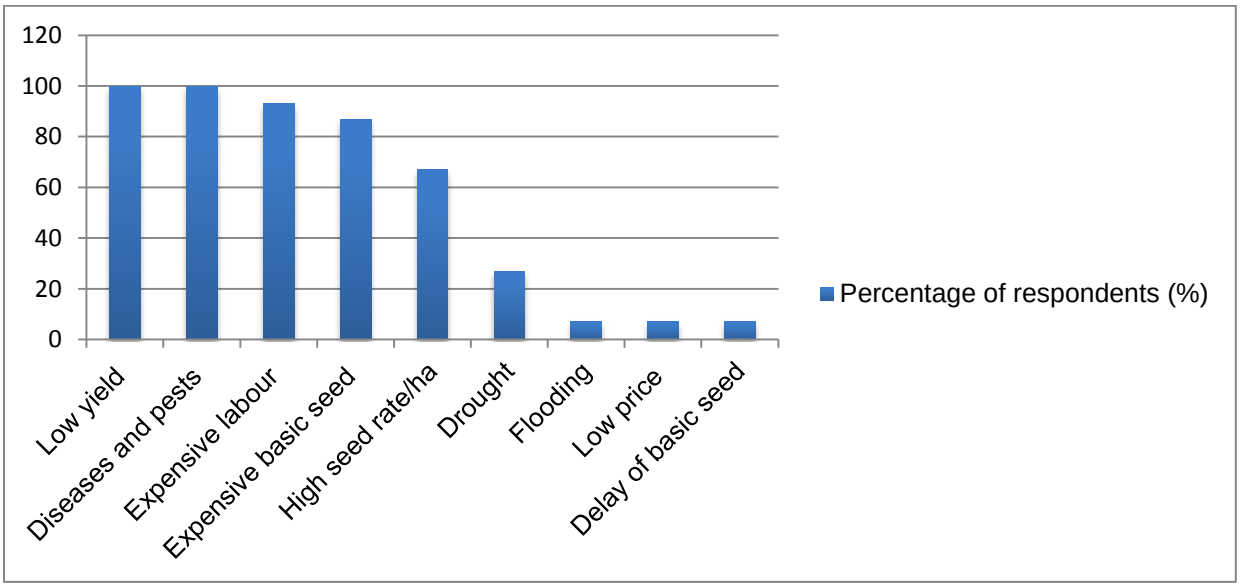
As it could be seen, both Cooperative Abibumbye and CODAR execute post-harvest activities under inadequate conditions. By dry maize cops on ground instead of using mats, sheeting or other alternatives affects negatively the quality and the quantity of seeds, as soil is a source of many impurities. It also increases the labour at grading time, as seed producers have to provide certified seeds without any damage or impurity. Likewise, sitting and walking on bean seeds increase the risk of seed contamination by mixing seeds with foreign matters.

It was also found that private certified seed producers during focus group discussion have appreciated standards required in certified seed production as the key factors to produce seeds of high quality. However, seed producers criticized seed quality control and certification service. They listed delay and sometimes lack of field inspection, delay for seed sampling, delay in seed certificate delivery, lack of consistency in laboratory results and insufficient permanent technical support. Finally, information provided through focus group discussion by local farmers who are not participating in seed production highlighted limitations, which prevent farmers from contributing in certified seed production. The main restrictions include a high investment that is not affordable by every famer and rigid requirements set to be a seed producers like size of land that exclude a big number of local farmers to participate in certified seed production activity.

4.3.1 Specific constraints in certified bean seed production

Private certified seed producers mentioned major constraints during bean seed production as presented in figure below.

Figure 11 Constraints of certified bean seed production



Source: Own fieldwork, 2011

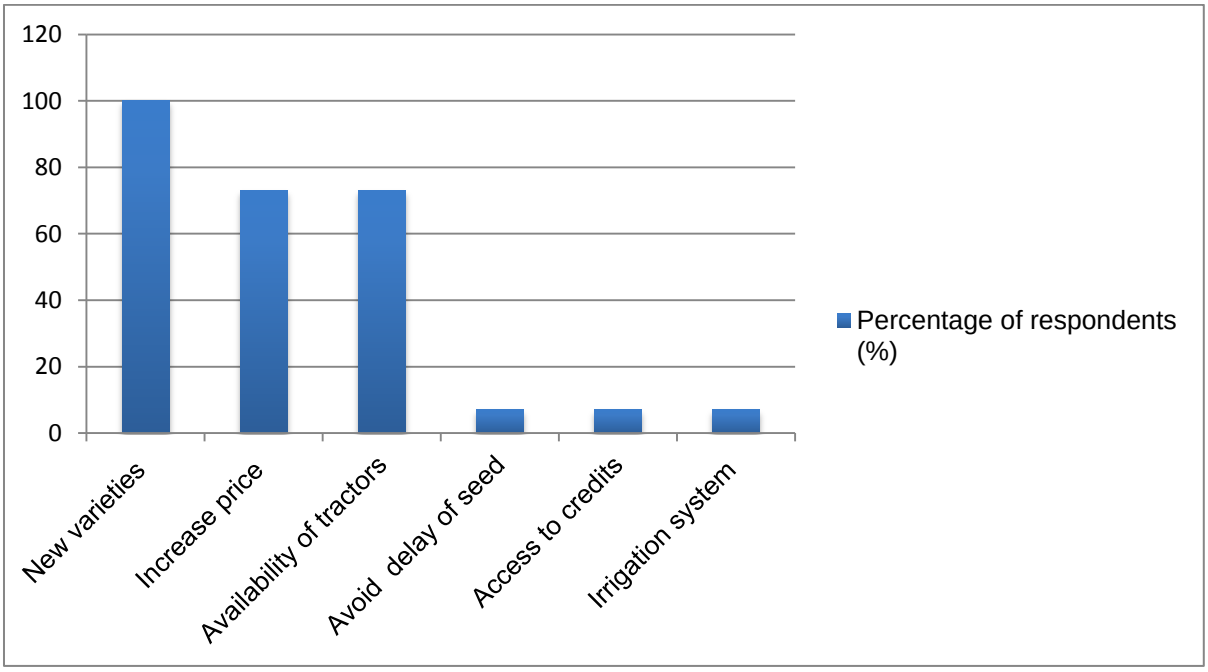
The results of the study have shown the yield of certified bean seed produced per hectare is not profitable. Varieties susceptible to diseases and pests are the main constraints experienced by seed producers as cited by 100% of respondents. Expensive labour needed for sowing and grading bean seed constitute other bottlenecks for bean seed production as quoted by 97% of seed producers interviewed. Expensive basic seed and high seed rate per hectare observed at sowing time are others problems as mentioned respectably by 87% and 67% of respondents. Few seed producers (27%) listed climate change especially drought as a constraints encountered during bean seed production. Flooding, low price paid to seed producers for certified bean seed and delay to avail basic seed by RAB have been mentioned by low percentage of respondents (7%). The previous information agrees with the opinions provided by private certified seed producers during focus group discussion, however flooding has been stressed as a major bottleneck experienced during bean seed production. Furthermore, the opinions collected during focus group discussion with seed producers who stopped growing beans support views provided in earlier paragraph and emphasized the high cost of basic bean seed and non-attractive price given to seed growers.

This study has gathered data about solutions proposed by seed producers themselves to overcome certified bean seed production constraints as highlighted in the next paragraph (4.4.).

4.4 Solutions to constraints as proposed by seed producers.

Private certified seed producers have proposed a number of solutions to solve problems related to bean seed production (Fig.12).

Figure 12 Solutions proposed by private seed producers



Source: Own fieldwork, 2011

As it could be seen, the totality of respondents (100%) mentioned introduction of new varieties with high yield and tolerant to diseases and pests as the first solution to increase certified bean seed production. The majority of respondents (73%) suggested to increase price of certified bean seed and to provide tractors near seed producers. Few farmers (7%) have listed respectively other solutions to improve certified beans seed production.

Those solutions include avoiding the delay observed for availing basic bean seed, facilitating seed producers to access credits and planning for irrigation system to respond to critical drought. Views collected during focus group discussion agree with the previous arguments, however, facilitating private certified seed producers to access credits has been stressed by certified seed producers as the core solution that can solve the main problems of certified bean seed production. A key informant who represents local NGOs has supported the same opinion and has furthermore underlined the creation of cooperative bank that may include all certified seed producers within the district.

4.5 Access to inputs by farmers

The information provided by farmers interviewed has shown that the main inputs used include fertilizers, pesticides, seeds and agricultural implements. Fertilizers are used for both maize and bean crops whereas pesticides are mostly used to combat bean diseases and pests. Observation has shown that the important agricultural implements available comprise hoes, sheeting, sprayers, sacs, machetes, wheelbarrow and threshing machine. Among

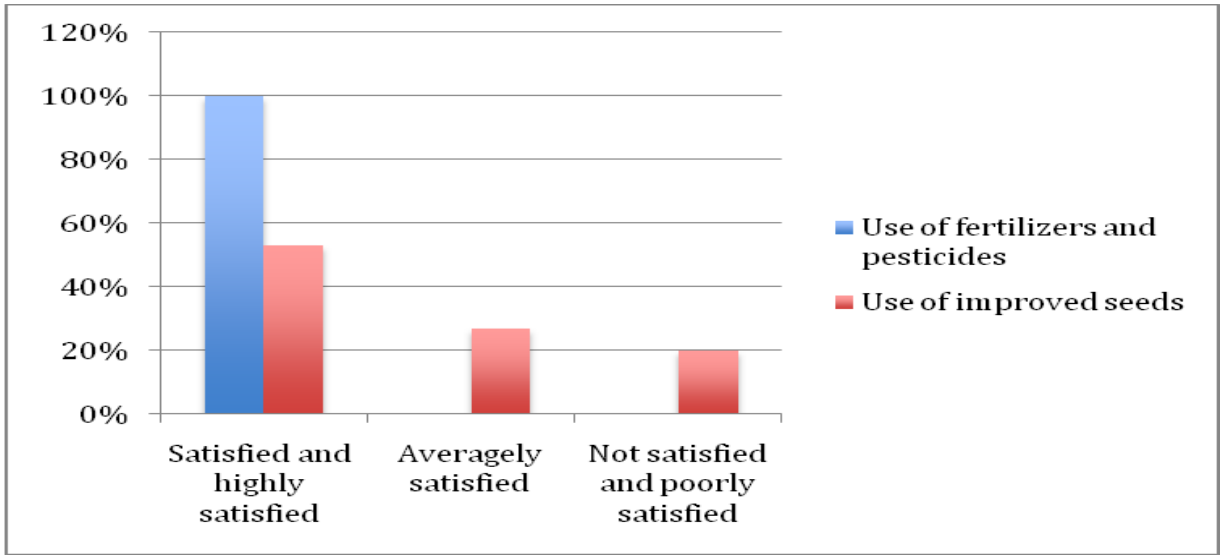
those implements listed, local supporters provide only threshing machine to some farmers; others are procured and owned by farmers themselves as cited by seed producers during interview.

The results of the study have revealed the sources of improved seeds, fertilizers and pesticides. Indeed, regarding the source of improved seeds, fertilizers and pesticides, both private certified seed producers and local farmers get fertilizers and improved seeds from ministry of agriculture. Private certified seed producers acquire basic seed by paying the total cost of seeds to Rwanda Agricultural Board through its seed production unit. Likewise, seed producers themselves at private markets purchase pesticides. Local farmers who are using certified seeds get seed from ministry of agriculture through Crop Intensification Program (CIP) and they only payback the quantity of seed received at sowing time. The seed is then collected at village level to constitute strategic stock during bad seasons.

4.5.1 Application of inputs and farmers' satisfaction in seed production.

The study has found that seed producers appreciate the roles played by different inputs (fertilizers, pesticides and improved seeds) used in seed production as highlighted in figure 13.

Figure 13 Satisfaction of seed producers with role played by fertilizers, pesticides and improved seed



Source: Own fieldwork, 2011

The results presented in the figure above, demonstrate that the totality of respondents (100%) are satisfied with the contribution of fertilizers and pesticides to increase seed production. This information agrees with views provided by focus group discussion. Considering the use of improved seeds, only 53% of respondents are satisfied with the role played by improved seed to increase crops yield, 27% are averagely satisfied while 20% are not satisfied. The focus group discussion approved the opinions of 53% respondents where seed producers were highly satisfied with the contribution of improved seed to increase agricultural production. However, they were not totally satisfied with the quality and quantity of seed provided by RAB as well as the existing seed delivery system.

4.6 Strategies adopted by private certified seed producers

The findings revealed that seed producers have a number of strategies mainly when there is insufficient land and inadequate inputs especially fertilizers, pesticides and basic seed. Table 5 is indicating strategies adopted by certified seed producers interviewed.

Table 5 Strategies adopted by certified seed producers

When	**Strategies**	**Percentage (%) N= 15**
When there is scarce land	Hiring land	**67**
	Skip growing some food crops	**33**
When there are insufficient fertilizers	Apply more organic manure	**73**
	Stop application of fertilizers	**27**
When there are inadequate pesticides	Stop application of pesticides	**73**
	Remove diseased plants from the field	**27**
When there are inadequate basic seeds	Use of certified seed approved by RAB	**73**
	Grow more food crops	**20**
	Apply fallow	**7**

Source: Own fieldwork, 2011

Data in table 5 revealed that the majority of respondents (67%) hire land while 33% skip growing some food crops to cope with land scarcity. Over 70% of private certified seed producers interviewed apply more organic manure when there is an insufficient fertilizer while 27% of respondents stop application of fertilizers. When there are scarce pesticides, the majority of respondents (73%) stop application of pesticides whereas 27% remove diseased plants from the field. Use of certified seeds approved by RAB is a coping strategy adopted by 73% of respondent when there is lack of basic seed, 20% of seed producers interviewed grow more food crops while 7% apply fallow over field allocated to seed production. Previous results agree with ideas given by seed producers during focus group discussion where land use consolidation has been another solution mentioned as a remedy for land shortage.

CHAPTER 5: DISCUSSION

This chapter presents the interpretation of the findings from field research in relation to the research questions administered. These guided the researcher to come up with investigated factors that affect certified bean seed availability within Nyagatare district. The analysis focuses on the kinds of seed crops grown by seed producers and the reasons of preference, benefits of being a private certified seed producer, main constraints experienced during certified seed production in general and certified bean seed in particular, how seed producers get inputs and their role in seed production and strategies adopted by seed producers when there is inadequacy of some assets. To analyse the situation, the investigator uses Sustainable Livelihood Approach as a tool. Hence, the analysis emphasize vulnerability context, assets owned by seed producers, influence of policies, institutions and process on farmers and coping livelihood strategies adapted. The discussions are backed up by literatures review related to the findings.

5.1 Kind of seed crops grown by seed producers.

The findings revealed that private certified seed producers choose to grow more maize seed than other seed crops because it has potentials like high yield, high income, it ensures household food security as it has different forms of domestic consumption. Additionally, it is used as livestock feeds and firewood. Certainly, preference of other seed crops was depending on the interests that farmers find in each crop. Even though soybeans crop was not grown by seed producers at the time of data collection, it has been listed as an interesting crop compared to bean crop as it shows resistance to diseases, pests and drought. Seed producers explained the reasons of ranking sorghum and cassava at the last position; sorghum crop is not among priority of crop intensification program of ministry of agriculture, hence there is no market for certified sorghum seed. However, this statement does not prevent local farmers from growing sorghum for domestic uses as it has multiple traditional consumptions. Most of sorghum seeds used by farmers belong to traditional seeds system that comprises local markets and seed exchanges among neighbours. Cassava crop has been recorded as a crop of little interests for seed growers. According to them, to harvest cuttings that are used as seed take several months, hence the money invested in seed production does not bring back a quick profit, which is targeted by seed producers.

The majority of bean seed producers are not ready to increase the size of land allocated to bean seed whereas others seed growers stopped growing bean seed. Indeed, certified bean seed production is exposed to a number of constraints in indicated in figure 9, which affect negatively the production and discourage private certified seed producers. These findings agree with CIAT (2008), which observed that a number of problems such as diseases and pests and variety with low yield potential among others are encountered in bean production processes in Africa, which leads to low yields. The implication is that famers are not interested in growing the crop. The above findings are further supported by field results (table 3), which indicated that certified bean seed occupied a small proportion of land distributed to certified seed production compared to maize.

5.1.1 Vulnerability Context

In addition to the above constraints, farmers' decisions as to what kinds of crops they grow are closely linked to their vulnerability in the environment in which they operate. The vulnerability context frames the external environment in which people's livelihood and the wider availability of assets are fundamentally affected, both positively and negatively by trends, shocks and seasonality over which farmers have limited or no control (Nguyen, 2006).

Trends: Certified bean seed production is affected by trend in government policies. For instance, Ministry of Agriculture during prioritization of crops, promoted cereals (maize, wheat and rice) at the expense of bean. Thus, more basic maize seed is produced by government institution (RAB) in order to fulfil the seeds needs of private certified seed growers. Thereafter, private certified seed producers produce maize seed abundantly to satisfy the seed needs of national farmers through Crop Intensification Program. From this situation, only new varieties of maize with high genetic potentials are released by research while existing improved bean seed varieties are degenerating in rural area. Furthermore, the national seed system is not supportive of the existing bean seed and varieties. Hence, both formal and informal seed systems provide bean seed of poor quality, which lead to low yield. The same case has been experienced in Kenya where the regulatory and legal framework of the national seed system limits the development of the informal seed system because the existing seeds and plant variety legislation are not supportive of the informal seed sector relative to on-farm seed production, exchange, maintenance, development and registration of landraces (Rohrbach and Howard, 2003 cited in Muthoni. J and D. O. Nyamongo, 2008).

According to ISAR (2010), a sustainable increase in production and productivity of crops for farmers depends to a large extent on the development of high yielding varieties and on the establishment of efficient seed supply system-enabling farmers to easily have access to those quality seeds. Rubyogo, et al. (2007) mentioned that the main goal of the formal seed systems is profit, something very hard to attain with subsistence agriculture. Formal seed supply systems, then, are designed for commercial agriculture, and use improved varieties developed for market that responds to the application of the new technologies. However, inadequate technology observed in Rwandan Agricultural Research Institutions constitutes a trend that affects negatively certified bean seed availability. As shown by results of the study, a high proportion of private certified seed producers listed low yield among principal reasons of not increasing the size of land allocated to bean seed. Subsistence of bean varieties susceptible to diseases, pests and drought is attributed to inadequate technology that is not ready to release new varieties with high genetic potentials.

Shocks: It was found that natural shocks specifically drought and flooding coincide with the season of growing bean. Few farmers have mentioned flooding as a constraint during data collection. Indeed, some farmers grow beans in valley, hence when rains are abundant fields are submerged. However, drought has been reported by ISAR (2010) as a main constraint in eastern region of Rwanda where the annual rainfall ranges from 800-1000 mm. Those precipitations are rather adequate, but their inconsistent nature cause frequent drought that limits bean yields. From field results, beans pests and diseases have also been mentioned among natural shocks that contribute to low beans yield within Nyagatare district. This argument is supported by Kimani (2000) whose study revealed that; bean yield is affected by biotic constraints that include diseases and pests, varieties with low yield potential, and susceptibility to diseases and pests. These shocks eventually discourage farmers from undertaking bean production affecting certified bean seed availability in the country.

Seasonality: Seed has to be available for every crop production cycle. It has to be there at the right time, in the right quantities with the right price so farmers can access the seed they need (Gregg and van Gastel, 1997 cited in Louaars, 2007). Although, results of the study have shown that some kinds of seasonality are observed during certified bean seed production particularly seasonality of prices and seasonality of low production and prevent farmers from accessing adequate seeds. For instance, high costs of labour occur at planting and grading times compared with other periods of the year. Hence seed producers are constrained either to pay a lot of money or to stop growing bean mainly when income is insufficient. Another seasonality of prices is perceived when seed producers purchase inputs

needed to grow bean. Costs of those inputs are unstable and change according to growing seasons which cannot be easily afforded by farmers most of the times.

Still, private seed producers purchase basic bean seed at high price and they sell certified seed at low and inflexible price fixed by RAB. For example, price of basic bean seed is set by RAB at 600FRw (1USD) per kilo, so seed producers have always to pay this amount in order to get basic bean seed. Although, 500FRw per kilo are paid to seed producers when they supply certified bean seed to RAB. Those figures have been fixed without taking into account the changes in cost of inputs that can occur during bean production cycle. There is also fluctuation of prices paid by seed producers to seed transporters from villages to RAB stores. Actually, it is long time that RAB set transport prices according to quantity transported per lorry. However, freight fees paid by private certified seed producers to seed transporters increase with the prices of fuel along the year and the distance to travel. Hence, freights fees paid by RAB to seed producers cannot compensate the costs encountered by private seed producers; consequently, this contributes to seed producers leaving out bean crop among their priorities. This is in line with what Ayieko.W and D.L.Tschirly(2006) found out that major reasons perpetuating use of farm-retained seeds in Kenya include; the high cost of certified seeds and marketing problems in the formal markets especially due to poor transport and communication infrastructure in some remote parts of the country.

Seasonality of low seed production is another constraint for seed producers because bean seed yield varies over the year and according to crop species. For instance, maize crop provides a yield between 1500-3000 Kg per hectare whereas bean crop provides a yield between 200-1000 Kg (own experience). Field results indicated that drought is one of the main constraints faced by bean seeds producers. These constraints (both abiotic and biotic factors) are never consistent during all agricultural seasons and they do not affect all crops at the same time. For example, when beans crop is affected by those factors, bean seed production is of poor quality and quantity unable to counterbalance marketing costs. This situation prevents the majority of seed producers from growing bean seed as the process involves the high cost of producing good quality seed. This argument is supported by Kimani, et al. (2000) who reported that until year 2000, in Rwanda, the basic seed was sold at lower price to farmers and NGOs than the production costs. Consequently, bean seed production was only possible because of price support by the Rwandan government and the Belgian Co-operation. After 2000, the support has been withdrawn; hence growing bean seed became less attractive. The same case has been experienced in Kenya where many public and private commercial companies have included bean in their seed production enterprises in the last two decades. However, seed producers in Kenya (Kenya Seed Company) have reduced their scale of operation because they have found the bean seed business unattractive due to unstable demand, small and localized markets with a wide range of buyer profiles, and the high cost of producing good-quality seed (Kimani et al., 2001).

5.1.2 Farmers' livelihood assets

The availability of seed in a given area is not enough to ensure seed security. But, resources to afford seeds influence seed security situation of farmers. FAO (2003) notified that seed access is specific to farmers or farmers' groups/communities. It is largely depends upon the assets of the farmers in question: whether or not the farmer has (financial capital) or social networks (social capital) to access seed. Land and physical assets may also be considered as determinants of access: if a farmer has sufficient land to guarantee self-sufficiency, and adequate storage, he/she is likely to have sufficient access under most conditions (FAO, 2003).

By investigating the main constraints affecting certified bean seed production, it's necessary to analyse the livelihood assets owned by private certified seed growers. These include; natural, financial, physical, human and social capitals are objects of discussion. Different combinations of assets are required for participating in seed production as an income

generating activity in the households. Seed producers need to get profit from the investments of their assets. However, the results of the study have shown that over 50% of seed producers interviewed are not satisfied with benefits got from growing bean seed. Low yield, which leads to low income, has been mentioned by 100% of respondents. Although, during focus group discussion, it was found that access to market with a high and stable price is among benefits got by seed producers. Not only financial capital influences seed production activity by income earned or spent by seed producers, but also human and physical capitals of seed producers are improved by trainings related to technical practices needed in growing certified seeds and access to improved seed of high genetic potential compared with traditional ones.

Natural capital: Land is a major resource for bean-growing families, but because of rapid population growth, the availability of productive land has declined. This has resulted in intensification of cropping and a subsequent decline in soil fertility in previously high-potential bean-producing regions (MINAGRI, 2010). The results of the study have shown similar situation where land scarcity has been listed among limitations for certified seed production. For instance, lack of sufficient land observed within the district has been enumerated as a criterion, which excludes a big number of local farmers to become private certified seed producers. Actually, inadequate land obliges seed producers to hire land for seed production. Also, seed producers prefer to skip growing some food crops so as to produce more seed crops for cash. When it is decided to sacrifice a seed crop, certified bean seed is the first to be left out by seed producers because of being unattractive crop; hence availability of certified bean seed is affected negatively. On the other hand, when seed crops are grown at the expense of food crops, food insecurity is likely to occur as long as more attention is paid for cash crops. Another issue linked with hiring land concern agricultural practices involved in seed production such as crop rotation and isolation. Certainly, no respect of crop rotation resulting into seed contamination is probable as long as seed producers have limited control and ownership over the hired land. Thereafter, problems of soil infertility, pests and soil-born diseases are likely to appear contributing to low quantity and quality of bean seeds.

The above findings are supported by a study from Wortmann, et al. (1998a). In their findings, major constraints to increasing productivity by land-scarced families include: local varieties are not well adapted to low soil fertility, drought, and associated soil-borne diseases such as root rot and charcoal rot; land-scarce families either cannot afford to buy fertilizers or these are not profitable to apply when moisture is a limiting factor; continuous cropping results in the build-up of soil pathogens and diseases; because of population pressure, fragmentation of parcels, and concomitant decline in land sizes, there are limited opportunities for crop rotation leading to reduced soil fertility and high incidences of diseases; management strategies to control soil fertility, diseases, and pests are inadequate; rainfall is irregular or inadequate and lack of low-cost, labour-saving technologies.

Financial capital: Financial capital is a key asset for the successful utilization of other assets. It has been found that seed production activity requires big investments, as it constitutes the core source of household's income. However, it is difficulty for private certified seed producers to accomplish their tasks with low income they own. This is confirmed by the fact that when RAB delays to pay seed producers, the majority of farmers are not able to continue seed production activity for next season. Likewise, poor quality of agricultural implements observed at household level, insufficient post-harvest facilities and inadequate application of pesticides and fertilizers described the level of income owned by seed producers. Additionally, limited access to credits has been mentioned as a main constraint that prevents local farmers from investing in certified seed production particularly bean seed because of expensive basic seed and high quantity of seed rate per hectare needed. For example, seed producers require 70kg of basic bean seed to sow one hectare whereas they only need 25kg of basic maize seed to sow an equivalent area. Information from RAB concerning prices shows that a kg of basic bean seed is more expensive than a kg of basic

maize seed (section.5.1). From this situation, taking into account income owned by farmers, maize crop is preferred over bean crop. This study is in agreement with findings reported by Byakweli (2010) who said that inadequate funds to execute activities, inadequate facilities for seed quality control and post-harvest handling services, inadequate access to microcredits by the private certified seed producers constitutes the main bottlenecks to certified bean seed production.

Physical capital: The results of the research have indicated the main physical assets involved in certified seed production. Tool and equipment for production, seeds, fertilizers and pesticides are the main items found in tool and technology component. It has been found that, the totality (100%) of respondents is satisfied and highly satisfied with the role played by fertilizers and pesticides in seed production rather than improved seeds. Indeed only 53% of respondents were satisfied with use of improved seeds (Fig.11). The inadequate quality and quantity of existing improved seed is the main reason that reduces the satisfaction level of seed producers. However, FAO (2001) found that the main role of other inputs in crop production is to exploit to a maximum the genetic potential of the seed.

The study revealed how inadequacy and lack of physical assets particularly roads affect the availability of certified seed in general. Due to poor roads, freight fees paid by seed producers increase, hence expected profit is altered. Likewise, seeds supplied by local government reach the farmers late in the season or do not reach them at all. A study by Nekesa (1998) reported that farmers' attempts to commercialize the crop face numerous problems such as; low prices, production located far from main market, poor infrastructure in rural areas resulting in expensive and often unreliable transport, insufficient production unable to offset marketing costs, limited access to market information, inappropriate storage facilities and inability to control post-harvest diseases and pests. Moreover, the results of study realized that the implements available are insufficient and of poor quality. This situation affects most of the planting and post-harvest activities. For instance, lack of adequate equipment at planting time like tractor and sowing machine, postharvest facilities like sheeting, pallets, grading machine and adequate storage influence negatively the quantity and quality of seed particularly purity, moist content, which in turn affects germination faculty of seeds. CIAT (2010) supported this argument by reporting that farmers generally recognize the need to improve their yields by carrying out cultural practices such as timely planting, fertilizers and manure application, weeding, crop protection in the field and after harvesting, and timely harvesting and storage, they are limited by socio economic constraints including lack of cash to buy fertilizers, chemicals, and spray equipment or to construct proper storage structures. To overcome constraints related to insufficient physical assets, seed producers have mentioned a number of facilities to be provided: irrigation system, sowing machine, grading machine, tractors and diversified market for main inputs (improved seeds, fertilizers and pesticides).

Human capital: Concerning human capital, only the skills of the labour force are a subject of discussion. Even though CIAT (2010) reported that, farmers lack know-how on appropriate production and post-harvest management practices. Moreover, many farmers still grow their traditional bean varieties, which are susceptible to diseases and pests and have low yield potential. Field results however found that, private certified seed producers are skilled and appreciate the standards required for certified seed production as a guarantee to produce seeds of high quality. They understand the contribution of improved seed, fertilizers and pesticides. However, limited income to buy those inputs and to hire labour for appropriate application constitutes the major blockages.

Social capital: Social capital means the social resources upon which people draw in pursuit of their livelihood objectives. It has been observed that, seed producers are connected by membership when they are grouped in cooperatives. Some of these members have been in groups that existed over a long time and have recently registered as seed producers. This relationship of trust encourages them to tackle even difficulty tasks like seed grading as it has been witnessed during focus group discussion with CODAR and ABIBUMBYE (solidarity) cooperatives. Land use consolidation is another kind of social network proposed by seed producers as a solution to land scarcity. The strong social connections provide a forum for all seed producers to discuss their problems and develop solutions together with different actors involved in the sector for support and advice. This eventually facilitates seed production as it helps to meet the criteria approved by RDO. For instance, to be a member of a cooperative is the one criterion to benefit from RDO's support.

5.1.3 Policies, institutions and processes

The ways in which private certified seed producers use assets in their livelihoods is influenced by existing policies, institutions and processes. As it was found that seed producers prefer growing more maize seed than bean seed, the practice is probably connected with government policies, which promote maize crop as well as local NGOs like RDO that supports only farmers who grow maize. For instance, the difference between quantities of certified seed needed and quantities of certified seed distributed in 2009 (table 1) is showing how policies influence the decisions of private sector including certified seed producers as well as local farmers. Certainly, the figures in the table displayed that at national level; certified bean seed was needed at a high rate compared with other crops. However, the same table shows the satisfaction rate of bean seed of 3% whereas maize and wheat are satisfied over 70%. From this situation, local farmers in general and seed producers in particular will be attracted by growing cereals that are supported by governments policies. Hence, bean crop will be neglected as long as there are inadequate political and technical supports mainly from local government.

Agricultural Research Institutions and how they release new genetic material influence in the way they use modern or traditional technology. For example, when new varieties of bean are not available, farmers are constrained to grow deteriorated ones; the same situation is observed when extension institutions do not release properly new technology. Farmers will continue to practice traditional technology as long as existing extension system is inadequate or concentrating only on special programs.
According to CIAT (2004), local bean varieties that lack adequate resistance to low soil fertility, pests and diseases are attributed to:

- Lack of reliable sources of genetic resistance for some problems, such as angular leaf spot, anthracnose, and low soil N and P;
- Lack of knowledge about the epidemiology of major diseases;
- Inadequate financial resources to develop effective breeding programmes;
- The information exchange system between and within countries is poor;
- Inappropriate research and extension methods are often used.

Regarding certified seed production, most of activities undertaken by private seed producers are influenced by seed rules and regulations provided by RAB and specially the ways seed quality control and certification service are operating. Delay observed in field inspection, seed sampling, seed certificate delivery and payment constitute the main limitations of certified seed production. Other limitation include bureaucratic challenge in the seed accessibility by a centralized system by RAB in which seed certificate are issued at the Headquarters in Kigali, thus rest
ricting seed accessibility due to heavy administrative procedures and to scarce distribution network. Moreover, there is not an efficient marketing strategy and the system is still characterized a structural inefficiency in meeting the demand (MINAGRI, 2008). The same

case has been observed in Kenya where the formal seed system is also linked with other challenges like the state monopoly in seed inspection and certification which has sometimes hampered production of certified seeds and seed growers have lost their crops due to late inspection by an overstretched, under-resourced seed inspection service as noted by Rohrbach and Howard, (2003) cited in Muthoni. J and D. O. Nyamongo(2008). Furthermore, an efficient and reliable seed national seed policy, which is not in place influence the unavailability of, certified seed in general and certified bean seed in particular. This argument is in line with the study of Sperling, et al. (2004) who quoted that improved bean cultivars are likely to have minimal impact if an efficient and reliable national seed delivery system is not in place.

5.1.4 Livelihoods strategies

According to Nguyen, et al. (2006), livelihoods strategies indicate the range and combination of activities and choices that people make in order to achieve their livelihood goals. It has been found that, certified seed producers make some choices to solve some problem related to inadequacy of land, fertilizers, pesticides and basic seeds. The majority of respondents (67%) hire land whereas 33% grow more seed crops at the expense of food crops. This kind of strategy can lead to decrease of food crops in the region; hence food insecurity is likely to occur. However, land use consolidation has been another solution mentioned as a remedy for land shortage. A big number of seed producers (73%), apply organic manure when fertilizers are not sufficient. This practice is explained by the fact that, a big number of cattle are observed within Nyagatare District compared with the remaining parts of the country. Not only is this strategy adequate to save money, but also it is beneficial to sustain environment. The fact given that the majority of seed producers (73%) stop application of pesticides when they cannot afford them, pests and diseases can destroy completely seed crops when their attack is severe. Likewise, use of certified seeds approved by RAB as coping strategy adopted by 73% of respondents, is not a safe strategy as long as RAB is the only source of improved seed. When improved seed are not available in RAB, farmers are obliged to stop their business and it can affect their livelihood including food security status.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

Conclusion and recommendations of this report are drawn from case study results where interviews, focus group discussions, participatory rural appraisal have been the main tools to collect primary information. Likewise, the observations made by the researcher have also been used.

6.1 Conclusion

Bean crop constitutes the primary source of protein in Rwanda as they supply 65% of national dietary compared to 4% from animal resources. Due to their diversified nutritional content and predominant protein supply in Rwandan diets, bean are regarded as near perfect food and as the meat of the poor (ISAR, 2010). However, the on-farm productivity is decreasing whereas per capita consumption is increasing. Though certified seed is the single most important input in crop production and the basic precondition of any food security system, the low productivity of bean is linked with inadequate availability of improved beans seed as the current supply among farmers still low.

The objective of the study was to contribute towards the availability of certified bean seed by investigating the main factors affecting its production, with a case study of Nyagatare district, eastern province, in Rwanda. The findings of the research have contributed to the achievements of the research objective.

The research concluded that there is a number of factors affecting the availability of certified bean seed in Nyagatare District. The study showed that, being a certified seed producer is in general attractive as farmers have access to high and stable prices compared with growing food crops. Trainings related to practices involved in seed production constitute another benefit got by seed producers. However, the benefits got depend on the kind of crops grown and inputs required. The study concluded that certified bean seeds production is not attractive as it is constrained by a number of factors, which oblige private certified seed producers to grow more maize seed than bean seed and sometimes to abandon definitively bean seed production.

Many factors contribute to low availability of certified bean seed in Rwanda. These include existence of varieties susceptible to disease, pests and drought, expensive labour, expensive basic seed, high seed rate per hectare, non-supportive government policies, land scarcity, inadequate investments owned by private seed producers, limited access to credits, poor infrastructures (roads) that lead to high price of transport, insufficient post-harvest facilities, poor quality of agricultural implement available and lack of some critical equipment like tractors and sowing machines causing to low yields.

Although Rwandan government through RAB is providing the inputs such as fertilizers at subsidised costs, the farmers themselves pay for pesticides and basic seeds. However, the low level of incomes in farmers households hinder their accessibility levels which makes the majority of farmers to avoid participating in certified seed production, skip crops which require expensive inputs e.g. beans, use inadequate or no inputs at all. This affects the availability of certified seeds in the country.

Farmers are aware and appreciate the criteria needed in the certified seed production as key factor for quality seed production. However, farmers noted inappropriate services provided by seed quality control and certification team. Indeed, lack of consistent laboratory results, delays in field inspection and certificate delivery obstruct certified bean seed production.

The study is not complete without information about exact quantity of beans seed produced per hectare, exact cost of inputs used so as to calculate income earned by a seed producer.

This information could be useful to conclude to what extent beans seed production is not attractive so as to provide helpful advices and recommendations to the actors involved. Livelihood outcomes assessment could not be described and understood during a research of one month. Although, this information is necessary in order to realise the better changes in livelihood of private certified seed producers according to livelihoods strategies adopted. Likewise, the study did not manage to find out the estimated quantity of bean seed that a household needs to be bean seed secure. The availability of this information should provide database relevant to certified bean seed needs for national seed suppliers as national seed demand still unknown. Thereafter bean seed production should be enhanced accordingly. Consequently, the limitations of the study listed previously should be areas for further research.

6.2 Recommendations

Reaching Rwandan food security cannot be successful with promoting only cereals crops, as their nutritional value cannot provide sufficient proteins like bean. Promoting bean crop is a key condition to avoid malnutrition among population, the fact given that proteins provided by this crop are in high quantity and cheaper compared with those provided by animals and other crops grown. Promoting bean crop should improve national bean production and this will only be feasible with the resolution of current problems faced by both informal and formal bean seed systems in Rwanda. The following are recommended to certified bean seed sector stakeholders.

1. Private certified seed producers: Operating in structured and well managed certified seed producer cooperatives is important to negotiate seed prices for their members and to seek how transport cost should be reduced by collecting their yield together rather than to work individually. Land use consolidation where farmers put their land together should be promoted as an alternative to address Land scarcity in the region.
NGOs, donors and microfinance institutions are attracted by well-structured and managed cooperatives. Consequently, private certified seed producers should organize themselves in cooperative to get support from government, Developments Agency and NGOs for accessing credits and other expensive equipment like tractors, sowing and threshing machines. Cooperatives will be a forum where their opinions could be collected before report them to the high institutions for advices and advocacy.

2. Rwanda Agricultural Board (RAB): To increase bean seed production, the following points should be emphasized by RAB:

- ✓ Providing policies that support both formal and informal bean seed systems. Moreover, it should be better to set policies which support not only cereals but also legumes specifically bean, as they are the main source of proteins. Hence, RAB should reconsider incorporating the main staple food crops in their priorities taking into account farmers' own cultivars and preferences;
- ✓ Carrying out a base line study on the certified seed demands so as to address the gap that exists between demand and supply of seeds through existing formal and informal seed systems;
- ✓ Reinforcing seed quality control and certification team by recruiting more staff and training them in order to provide adequate services;
- ✓ Supporting both technically and financially the agricultural research services so as to provide adequate genetic materials with high yield, tolerant to diseases, pests and drought;
- ✓ Starting a seed production extension program in order to sensitize farmers the necessity of improved seed as the current use and supply still low;
- ✓ Privatising basic seed production to private sector to create private seed companies independent to government assistance;
- ✓ Allowing private certified seed producers to be represented at the times of setting

prices of certified seed and transport prices;

- ✓ Creating seed collecting points in every province so as to solve the problem of transport faced by seed producers when they transit certified seed to RAB headquarter (Kigali).
- ✓ Providing subvention for certified beans production (basic seed, tractors, irrigation system, sowing and grading machine), as high investments are required;
- ✓ Collaborating with banks and if possible provide guarantee fund for farmers willing to participate in certified beans production, as the activity needs more investments.

3. Ministry of infrastructures in collaboration with local government: Due to poor roads, which result into high freight costs and less profit for the farmers, Ministry of infrastructures should intervene to create new roads and bridges within remote areas. Furthermore, in collaboration with local government, local population should maintain existing roads during community work.

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ANNEXES

ANNEX1. CHECKLIST

A. CERTIFIED SEED PRODUCERS GROWING BEANS

1. The benefits of being seed producers
   a) Whether they received trainings and other agricultural implements
   b) The prices and marketing systems
   c) Advantages/disadvantages of seed production over other crops

2. The seed quality control and certification process:
   - Seed producers views on criteria considered in the selection of seed producers
   - Seed producers views on requirements considered in seed production.

3. Other main constraints experienced by seed producers in producing certified beans seed

B. CERTIFIED SEED PRODUCERS WHO STOPPED GROWING BEANS

1.The main reasons of stopping producing certified beans seed
   - Constraints encountered in previous bean seeds production

C. LOCAL FARMERS USING CERTIFIED SEED

1. The main reasons of not participating in certified seed production
   a) Source and types of certified seed used
   b) Awareness about the seed production systems in place
   c) Awareness of the benefits of seed production/in relation to other seeds

D. KEY INFORMANT

1.The roles of Rwanda Development Organisation (RDO) to certified seed production
   a) Criteria involved to supporting seed producers
   b) Kind and the reasons for the supports given
   c) Challenges and future plans in seed production
   d) Suggest recommendations about existing problems

ANNEX2. QUESTIONNAIRE

General information
Name of respondent.....
Sex of respondent: M ☐ F ☐

Sector (location):.....
Date:.....
1.KINDS AND FIELD SIZE OF CROPS GROWN

A. How many hectares do you have per seed crop produced?
1.Maize .....ha
2.Bean.....ha
3. Sorghum.....ha
4.Soybean .....ha
5.Cassava .....ha
6.others (specify)……

B. Why do you prefer those crops?
1. High yield
2. High income
3. Low labour
4.Low inputs (fertilizers and pesticides)
5.Inexpensive basic seeds
6. Others (specify)……

C. Do you plan to grow more bean seeds?
Yes or No
If no why? ……...

2. ACCESS TO INPUTS

A. What kind of inputs do you use in seed production?
1.Pesticides
2.Fertilizers
3.Agricultural Implements
4. Others (specify)……...

B. How do you get those inputs?

1. Purchased
2. Subsidies
3. Donation
4. Others (specify)……...

C. To what extent are you satisfied with the role of inputs in increasing seed production?

1.Not satisfied at all
2.Poorly satisfied
3.Averagely satisfied
4.Satisfied
5.Highly satisfied

3. ACCESS TO IMPROVED SEEDS

A. How do you get your seeds?

1.Purchased via RAB
2.NGOs donation
3.Own seeds (saved seeds)
4. Other (specify)…….

B**. To what extent are you satisfied with the use of certified bean seeds to increase production?**
1.Not satisfied at all
2.Poorly satisfied
3.Averagely satisfied
4.Satisfied
5.Highly satisfied

4. BENEFITS FROM SEED PRODUCTION.

Are you satisfied with the income got from bean production?

1. Not satisfied at all
2. Poorly satisfied
3. Averagely satisfied
4. Satisfied
5. Highly satisfied

5. What strategies do you adopt when you have inadequate:
1. Land
…….
…….
2. Inputs (Pesticides & Fertilisers)
…….
…….
3. Basic seed
…….
…….

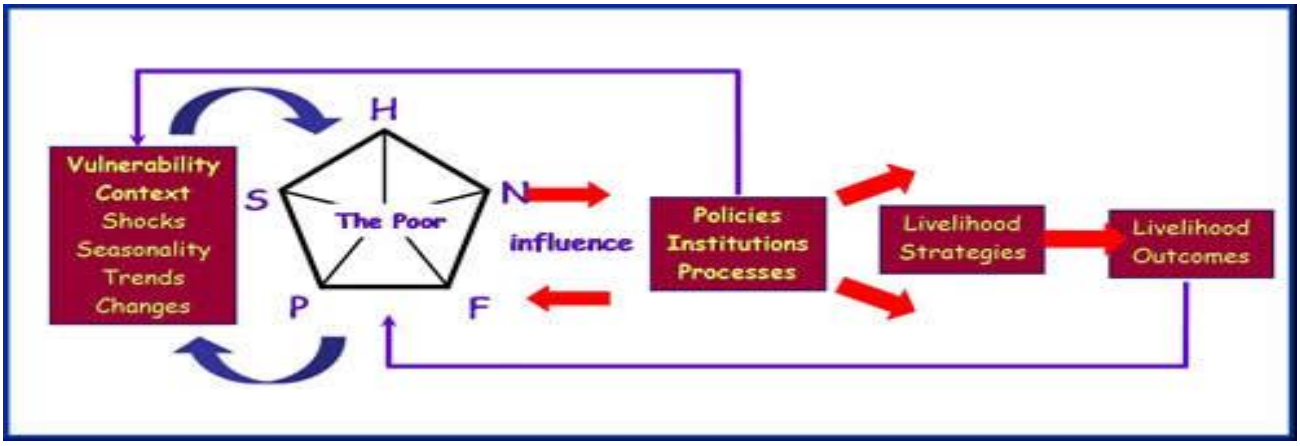
6. BOTTLENECKS

A) List five major bottlenecks in order of priority faced in bean seed production

1. ……
2. ……
3. ……
4. ……
5. …….

B) What do you think can be done to overcome these bottlenecks?
…….....
.....……

ANNEX3. SUSTAINABLE LIVELIHOOD FRAMEWORK (SLF)



Source: IFAD, 2011