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Research Article

THE CONTRIBUTION OF FUNCTIONAL FOOD TO THE FARMERS' SOCIO-ECONOMIC WELLBEING IN RWANDA: A STUDY OF CARROTS FARMERS IN NYABIHU DISTRICT

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ABSTRACT

Functional food farming and vegetable production in particular offer an economic opportunity as they generate income for the farmers and people in areas where these kinds of products are cultivated. This study assesses the contribution of functional food to the farmers' socioeconomic well-being in Rwanda with a focus on carrot farmers in the Nyabihu district, Rwanda. The study is descriptive with a mixed approach of both quantitative and qualitative methods with a target population of 170 carrot farmers from whom a sample size of 119 respondents was selected. Data were collected using a questionnaire and interview and analysed using descriptive statistics. The findings reveal that carrot farming generates income and employment opportunities for rural farmers and people in the area, which in turn permits them to meet their various daily expenses and improves their health conditions. Functional food farmers also face some challenges which include shortage of farming land, pests and diseases, soil erosion and landslides and unstable prices of input amongst others. However, land consolidation, spraying crops against diseases, and provision of loans are among the measures to address such challenges. Different stakeholders including the government, the private sector and NGOs should work in synergy to create a favorable and enabling environment that supports people in rural areas to fully participate in functional food farming.

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1. INTRODUCTION

The concept of functional food was first promoted in 1984 by Japanese scientists who studied the relationships between nutrition, sensory satisfaction, fortification and modulation of physiological systems. In 1991, the Ministry of Health introduced rules for approval of a specific health-related food category called FOSHU (Food for Specified Health Uses) which included the establishment of specific health claims for this type of food (Burdock, Carabin, & Griffiths, 2006; Kwak & Jukes, 2001a; Menrad, 2003; and Roberfroid, 2000). Functional foods have the potential to cure some diseases, lower the risk of contracting others, and even improve general health conditions in the body (e.g., pre- and probiotics). Functional foods entered the global markets with force in the past decade and rapidly gained market share conservatively estimated to exceed that for organic food, the global functional food market size is projected to reach USD 275.77 billion by 2025 (Mishra et al., 2022). Moreover, demand for functional foods within the developing countries is growing, presenting a lucrative opportunity to develop domestic markets. The economic returns from functional foods can offer improved opportunities for all members in the supply chain: from raw material producers and processors to retailers.

In developing countries, similar demographic and public health trends are evolving among higher socio-economic groups, and functional foods have entered these markets. Growing domestic markets and the possibility of exports to the dominant markets of the United States, Europe and Japan provide economic opportunities in this sector. This potential source and the increased economic value from functional foods can offer new or improved opportunities for all in the supply chain, starting from primary producers and many developing countries could potentially benefit from investing in the production and development of functional foods (Kotilainen et al., 2006). Similar to other Sub-Saharan African nations, Rwanda's social economic growth and poverty reduction depend heavily on agriculture. 90% of the nation's food demands are met by the agriculture sector, which also accounts for 80% of employment, 63% of foreign exchange, and 39% of GDP (World Bank, 2013).

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Rwanda was introduced new vision and a new strategic plan (NST1) to implement it since vision 2020 ended in 2020. The new vision was Vision 2050 which introduced some mid-term targets for 2035 to keep track of progress where by poverty will be eliminated 2030 from 38.2% as of 2014, GDP per capita of USD 4,036 from 820 USD in 2019 by 2035 and GDP per capita of USD 12,476 from 820 USD in 2019 by 20250. This new vision identified five pillars that would contribute to the desired ultimate goal laid out in the national strategy. Transformed agriculture sector will be market driven, linked to urbanization & trade and nearly 15 times more productive than to day was three of the five pillars (Umulisa, 2022). As an instrumental part of the strategy moving forward, the Government of Rwanda is very active in different sectors looking to stimulate market growth, agribusiness development and increased productivity. In the context of Rwanda Development Board (RDB), agriculture sector is a large contributor to the national economy. A significant share of this contribution is from the horticulture farming (MINICOM, 2011). This sector is where most functional foods (vegetables and fruits) are found and the market of these products have increased especially in urban centers of the country.

Increasing demand for horticultural products due to an increasing population provides opportunities for local production but also enables the development of added value products and services in areas (Joosten et al., 2015). Rwandan functional foods farming is crucial to improving the standard of living for people because of available market. Shifting production from current subsistence towards market-oriented agriculture can significantly increase the income and welfare of small farmers (smallholders) as well as contribute to economic growth and poverty alleviation on rural people (Cheber 2018). That is why horticulture production has been targeted in agricultural sector due to the market growth and export promotion of horticultural crops (vegetables, flowers and fruits). Carrots are one of the vegetables grown that have potential market in the whole country and carrots farming contributes to socio-economic wellbeing of farmers in the area in a number of ways such as generating income to the growers and other people get job opportunities concerning about carrot farming like planting, packing carrots and applying pesticides and insecticides on crops and it also contributes to fighting against malnutrition by enabling farmers to afford variety of food type, eating carrots in daily meal and carrots or functional food in general provides anti-oxidant that prevent our body from diseases.

Despite the contribution of carrots production to the socio-economic wellbeing of farmers and consumers, many people however do not understand and gain these benefits because they do not consider carrot farming an activity that can generate income. Consequently, this leads them to poor living conditions. In rural areas of the country for instance, some people are suffering from the problems of low income and mal nutrition. This affects their socio-economic conditions leading to rural poverty due to bad attitude towards agriculture where most educated people and especially the youth consider agriculture as a dirty job meant for illiterate. For them, agriculture is not a career or a business. They prefer the white-collar jobs available in urban areas at the advantage of agriculture.

Moreover, the farming of this kind of functional food in the country in general and in Nyabihu district in particular where there is favorable climate conditions is still insufficient compared the demand across the country. The increasing trends of consumption of these products are expected to sustain throughout the forecast period.

Against this background, this paper aims to make a comprehensive analysis of the contribution of functional food to the farmers' socio-economic wellbeing, using a case study of carrots farmers grouped in KOGIMUIN (Koperative Girisuku Muhinzi w'imboga n'imbuto Nyabihu) cooperative, a farmers' cooperative in Horticulture cultivation and marketing of carrots, cabbage, cauliflower, broccoli, green pepper, onions (red and white), in Nyabihu district. More specifically, this paper focuses on the analysis of carrots production and how it generates income to the farmers, reduces unemployment and improves nutrition, health, education and housing conditions. The paper also discusses the challenges faced by rural functional food farmers and proposes possible strategies to address existing challenges.

The rest of this paper is organised in 4 sections namely, literature review, methodology, presentation and discussion of the findings and conclusion and recommendations.

2. LITERATURE REVIEW

This section deals with review of existing literature on the variables of the study focusing on the functional foods and social and economic wellbeing concepts and on the impact of functional foods.

2.1 Functional Foods Concept

The International Life Sciences Institute [ILSI] (1999) defines functional foods as foods that, by virtue of the presence of physiologically-active components, provide a health benefit beyond basic nutrition. Functional foods have also been defined by International Food Information Council [IFIC] (2009) as foods (or beverages) that provide health benefits beyond basic nutrition, like improving the diets or reducing the risk of specific diseases. As cited by Küster-Boluda (2017), the functional foods are those foods that include a variety of relevant components to improve health status or reduce the risk (non-prevention) of the disease. Those foods also must bring benefits beyond those of basic nutrition. For example, foods that are low in fats and sugars or incorporated fiber, among others, are functional foods.

In Indonesia, Badan Pengawas Obat dan Makanan (National Agency of Drug and Food Control or BPOM) defined functional foods as "processed foods with one or more food components, which based on scientific research have a certain physiological function beyond their basic function, do not pose harmful effects and contain health benefits" (Bakti, et al, 2019). However, BPOM retracted that definition.

Roberfroid (2011) defined functional foods as "food that encompasses potentially helpful products, including any modified food or food ingredient that may provide a health benefit beyond that of the traditional nutrient it contains". Another researcher, Lajolo (2002) defined functional food as "a food and not a drug, that is part of a normal diet, and that can produce benefits beyond basic nutrition". On the other hand, according to DeFelice (2007), functional food is defined as "any substance that is a food or part of a food that provides medical and/or health benefits, including the prevention and treatment of disease". Some functional foods are also high in omega-3 fatty acids, a healthy type of fat shown to reduce inflammation, boost brain function, and promote heart health (Sohaimy, 2012).

Enjoying a wide range of nutrient-rich functional foods as part of a healthy diet can help ensure that nutritional needs are met. In addition, it can be beneficial to include foods that are fortified with specific nutrients that are important for growth

and development. For example, cereals, grains, and flours are often fortified with B vitamins like folic acid, which is essential for fetal health (Greenberg, et al, 2011). Other nutrients commonly found in functional foods also play key roles in growth and development, including omega-3 fatty acids, iron, zinc, calcium, and vitamin B12 (Morrison & Regnault, 2016).

2.2 Social and Economic Wellbeing Concepts

It is important to distinguish between the extremely specific concept of well-being and other ideas. In their opinion, it is important to distinguish this notion from others that are similar, such as happiness, satisfaction, pleasure, usefulness, and quality of life. This is the stance held by Forsé and Langlois (2014). However, there is some disagreement along the boundaries between these ideas. (Forsé and Langlois, 2014). According to the economist Layard (2006), well-being pertains to "feeling well—to enjoy life and want this feeling to be maintained". According to the Finnish sociologist Allardt (1993), well-being is related to "the satisfaction of a need" and he differentiates it from happiness and the standard of living, or from the quality of life.

McCallum and Price (2016) argue that wellbeing has emerged as "something everyone seemingly aims for, and arguably has a right to". While wellbeing is not a new concept, it has become an important concept within contemporary school community contexts.

However, identifying an agreed definition of wellbeing, in addition to establishing a consensus on how quality wellbeing can be achieved and sustained, is far more problematic with the term wellbeing often poorly defined and under-theorised (Camfield, Sterile and Woodhead, 2009). To compound the issue of definition inconsistency, wellbeing is often used interchangeably with other terms such as 'happiness', 'flourishing', 'enjoying a good life' and 'life satisfaction', all which have very different interpretations and underlying meanings. Bradburn (1969) (as cited in Dodge, Daly, Huyton and Saunders, 2012) defined wellbeing as being present when an individual is high in psychological wellbeing, where an excess of positivity (positive affect) predominates over negative affect. In contrast, Shah and Marks (2004) argued that wellbeing is more than just positive affect (happiness, feeling satisfied), with feeling fulfilled and developing as a person an equally important aspect in defining wellbeing. Diener et al. (1999) extend the definition of wellbeing even further by defining wellbeing as subjective (thus the term subjective wellbeing, {SWB}) more specifically as consisting of three essential interrelated components: life satisfaction, pleasant affect, and unpleasant affect.

Concerning social wellbeing, various conceptualizations by various scholars have been provided throughout the literature. Keyes (1998) defined social wellbeing as people's perceptions and experiences in social circumstances as well as the degree of successful responses to social challenges. Keyes (1998) and Key-Roberts (2009) proposed that social wellbeing has five dimensions, namely social integration, acceptance, contribution, actulisation and coherence.

Social integration concerns with individual's evaluation of the quality of relationships to the society and self; social acceptance deals with individual's interpretation and acceptance of other people based on their character as well as the feelings of confidence and comfort in interacting with them; social contribution regards individual's evaluation of his/her own social value as well as belief in having something valuable to share with the society; social actualization concerns individual's belief in the evolution of society and the possibility of progress and actualization through it whereas social coherence is about individual's perception of the quality, organization, and the soundness of the living world (Keyes, 1998 and Key-Roberts, 2009).

Based on these five dimensions, it is evident that social wellbeing is individuals' description of their perceptions and experiences of their well-being in the society as well as satisfaction with their own social structure and function (Key-Roberts, 2009; Law, Steinwender, and Leclair, 1998).

Social well-being can be defined as people's appraisal of their social relationships, conditions, and functioning in social community. It is individuals' perceived quality of their relationships with other people in their social networks, neighborhoods, and communities (Keyes and Shapiro, 2004). As cited by Kansky (2017), social well-being is an essential dimension of health along with physical and mental aspects. It can impact positively on the quality of life, social interactions, and social performance.

In terms of economic wellbeing, existing literature provides that the key concepts relating to economic wellbeing of people, families or households are the economic resources they have available to support their material living conditions, and their control over these resources and conditions. People's wellbeing is affected by individual circumstances and their lifestyle choices (Australian Bureau of Statistics, 2013).

There are three key interrelated components of economic wellbeing, namely income, consumption and wealth. To study these components separately only reveals part of the picture of economic wellbeing. (Llena-Nozal et al., 2019) argued that the economy of well-being can therefore be defined as an economy that: expands the opportunities available to people for upward social mobility and for improving their lives along the dimensions that matter most to them; ensures these opportunities translate into well-being outcomes for all segments of society, including those at the bottom of the distribution; and reduces inequalities.

Income can be used to support current consumption, such as food, clothing, education, housing or leisure activities. Income can also be saved and invested to increase wealth which can be used to support consumption in the future. Some people with low incomes have considerable wealth, allowing them to maintain consumption levels above their current income by converting some of their wealth into income (Australian Bureau of Statistics, 2013).

Other people may have high incomes and relatively low levels of consumption if they are paying off debts or saving and investing. People with low reserves of wealth may face financial difficulty in times of need, such as during a period of reduced income or substantial unexpected expenses (Australian Social Statistics, 2013).

OECD (2011) argues that income and wealth are essential components of individual well-being. Income refers to the flow of economic resources that an individual or household receives over time. It includes wages and salaries and money earned through self-employment as well as resources received from other sources such as property, pensions and social transfers. These concepts and components of household income are further elaborated in the Canberra Group Handbook on Household Income Statistics (United Nations Economic Commission for Europe [UNECE], 2011). In contrast, wealth is a "stock" concept: it refers to the value of accumulated assets at a given point in time. It includes the value of property, pensions and financial assets, along with physical assets such as vehicles and household goods. In calculating a measure of net wealth,

debt and other liabilities are subtracted from the value of assets. Income allows people to satisfy their needs and pursue many other goals that they deem important to their lives, while wealth makes it possible to sustain these choices over (OECD, 2013)

2.3 Functional Foods and Socio-Economic Wellbeing

Different empirical studies show that functional food resulted much importance to the people such as health benefits by preventing some diseases, improving food security and nutrition, and economic opportunities. Figueroa and Sánchez (2004) in their study on functional foods in the Spanish market found that health is one of the main variables in the study of consumer behavior towards functional foods. They concluded that health and safety are the most relevant aspects for the consumer when choosing functional foods.

Vukasović (2017) in Developing New Functional Food and Nutraceutical Products *argues that* Functional foods is a relatively new term used to describe food products which have been enriched with natural substances/components with a specific physiological preventive and/or health-promoting effect. Factors such as raised consciousness about human health, development of the food industry, and medicine and branches of natural science studying the relation between nutrition and health have led to the popularization of foods with proven health effects. Such foods are called functional foods.

The development of the fruit and vegetable sector in developing countries has a positive impact on the FNS of the people engaged in the sector and for urban and rural consumers. This explorative study focused on the different FNS pillars for assessing the potential of horticultural sector. Availability of fruit and vegetable (F&V) production has increased over the past 10-15 years, also in food-insecure countries such as Ethiopia, Rwanda, Ghana, Uganda, Kenya, Indonesia and Vietnam. Different donor-funded projects have been implemented to increase production of fruit and vegetables. Some of these projects show positive impact in terms of increased production. However, Food utilization overall consumption levels of fresh fruit and vegetable are still below the daily intake levels recommended by FAO and WHO (Joosten et al., 2015).

At country level, early studies by Mittal (2007) and Bhat (2019) have pointed out that with adequate research and development, horticulture in India can be considered as a commercial opportunity. India's horticulture production has shown manifold increase in the past two decades, ranking India second in the world only next to China (Bhat, 2019). Study in India has focused mainly on domestic consumption demand, export and import (Chand et al., 2008). Product specific scientific research on tomato (Javanmardi et al., 2013), mango (Jana et al., 1994), strawberry (Wani et al., 2013), kiwi (Pramanik et al., 2005) has revealed that horticulture can be a profitable business in Indian climate. Recently, Kulshrestha and Agrawal (2019) using Johnson cointegration test showed Indian agriculture as a whole has been contributing positively towards economic growth of India.

As the Permanent Secretary, Ministry of Commerce and Industry told the KT Press in 2019, vegetable exports could be Rwanda's next big thing by 2015. Since 2011, vegetables have boosted the country's exports value by $20M with an average of 7% growth every year. In 2011, Rwanda earned $4M, increasing to $5M and $6M in 2012 and 2013 respectively, then dropping to $5M in 2014 due to reduced productivity. He added there is a huge demand for Rwandan vegetables, fruits and flowers, around the world due to their quality. Some of the major vegetables and fruits grown in Rwanda include onions, cabbage, tomatoes, baby peas, avocados, carrots, passion fruits, pineapples and fresh maize. Most of them are exported to the DRC, but there are other bigger markets such as UK, Belgium, Netherlands and France. Other export destinations include; Burundi and Uganda. During vegetables and fruits exports peak in 2013, Rwanda was experiencing both informal and formal cross border trade within regional markets.

The concept of functional food gathering is not old in Rwanda; however, vegetables and fruits farming (horticulture) are considered by this study as category of functional food grown in Rwanda specifically carrots farming in Nyabihu district and its socioeconomic potential for rural farmers. The intention of this study is mainly to show the contribution of functional food farming especially carrots to the socioeconomic wellbeing of farmers based on high demand of consumers of that kind of food for health benefits. The study focusses on how the extension of market of carrots at domestic and regional levels can affect accumulation and generation of income for farmers as well as the provision of employment in the area.

3. METHODOLOGY

Under this section, the methodology adopted in conducting this study is discussed.

3.1 Research Design, Population, Sample Size and Sampling Procedure

This study adopted descriptive research design with a mixed approach of both quantitative and qualitative methods. Descriptive design was adopted to provide a picture of the situation and explain current farming practices and finally make judgment on how functional food farming as practiced by the farmers improve their socio-economic welfare. The target population for this study is 170 members of the cooperative of carrots farmers in Nyabihu district. From the population, a sample size of 119 was determined using Slovin formula as follows:

$$n = \frac{N}{1+N(e)2}$$

Wherby, n: is the minimum sample size, N: is the total population, e: is the margin error

$$n = \frac{170}{1+170(0.05)2}$$

$$n = \frac{170}{1.425}$$

n=119.298. Thus, sample size is 119.

Purposive sampling technique was used to select participants who are more knowledgeable about the subject matter and those who can read and write so that they can fill questionnaire easily.

3.2 Data Collection, Reliability and Validity and Analysis Methods

A survey questionnaire made of five-point Likert Scale items was administered to the participants and interviews with key informants were conducted to complement data gathered by questionnaire. The questionnaire was structured into 5 sections. Section 1 dealt with demographic information of respondents; section 2 collected information on the farmers' perceptions on the extent to which functional food gathering generates income to the farmers; section 3 collected data on the extent to which carrots farming provides employment opportunities; and section 4 gather data on the extent to which carrots farming improve nutrition, health, education and housing conditions of the farmers, and section 5 collects data on the challenges faced by carrots farmers and the strategies to address those challenges.

To ensure the validity, the research questions were well formulated and linked to the research objectives. Researcher asked questions related to objectives in the questionnaire items that can help to collect necessary data to achieve the objectives of the study. In addition, the questionnaire and interview guide were discussed with experts in the field including the supervisor before starting the fieldwork. On the other side, to ensure reliability, the wording of questions was checked in order to avoid ambiguous questions; inspiring mood was created to attract the respondent's positive attitude; and mutual trust and respectful interaction was guaranteed. In addition, research instruments were pre-tested with a reasonable number of respondents. For data analysis, descriptive statistics such as frequencies and percentages were used and the analysis was done using the Statistical Package for Social Sciences (SPSS).

4. PRESENTATION AND DISCUSSION OF THE FINDINGS

This section presents and discusses the findings of this study. However, it begins with a general identification of the respondents to provide a comprehensive overview of the farmers involved in the research.

4.1 General identification of the respondents

The identification of respondents consists of the characteristics of the people involved expressed in terms of gender, age, marital status, educational level and market availability and accessibility. Table 1 presents age and gender characteristics of the respondents.

Table 1: Gender and Age of Respondents

	Gender			Age				
	Male	**Female**	**Total**	**18-30**	**31-40**	**41-50**	**Above 50**	**Total**
Number of Respondents	94	25	**119**	16	78	20	5	**119**
Percent	79	21	**100.0**	13.4	65.5	16.8	4.2	**100.0**

Source: Field data, 2022

According to Table 1, both males and females participated in the study, whereby the majority of respondents (79%) were males, against 21% of females. In terms of age, respondents were grouped into different age groups including youth and adults. However, the majority of respondents is in the early adulthood with the age ranging bwtween 31-40 and 41-50 with 65.5% and 16.8% respectively. On the other hand, 13.4% of the respondents constitute youth aging 18-30. This implies that most of the farmers who participated in this study were in early adulthood and active age. In addition, this gives an impression these are people who have more responsibilities (children) in their communities and who should do something to generate income to satisfy their needs and secure their families. The respondents were also described in terms of marital status and education level as presented in Table 2.

Table 2. Marital Status and Education Level of Respondents

Marital Status	***Number of Respondents***	***Percent***
Single	19	16
Married	85	71.4
Divorced	3	2.5
Widow/widower	12	10.1
Total	**119**	**100.0**
Education Level	***Number of Respondents***	***Percent***
No level	1	0.8
Primary Level	68	57.1
Ordinary Level	26	21.8
Technical Skills	15	12.6
Advanced Level	7	5.9
University Level	2	1.7
Total	**119**	**100.0**

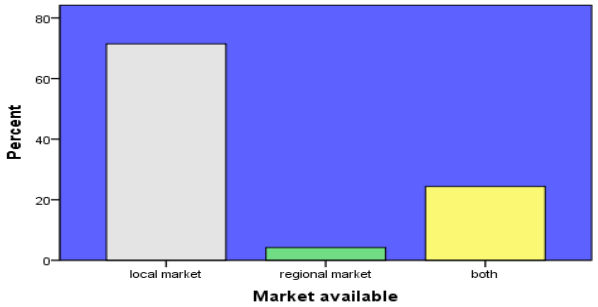
Source: Field data, 2022

Refer to Table 2, 16% of the respondents are single, 71.4% are married and 2.5% of the respondents are divorced, while 10.1% of the respondents are widow/widower. The majority of the respondents are married. The majority of the respondents are marrie;, this implies that farming in this area is likely to be successful when married couples work together and complement each other. The coordination of the activities might become easier for married couples than for divorced.

In terms of education level, Table 2 indicates that the majority of the respondents (57.1%) have primary level of education. This is followed by 21.8% having ordinary level of education. Only 12.6% have technical skills, 5.9% have advanced level of education, and 1.7% have the university level. On the other hand, only 0.8% has no recognised level of education. Generally, the results in Table 2 imply that almost all respodents are able to read, count and write. Considering that knowledge increases with education level, this is something that cannot be understated. Importantly, educated individuals are easier to mobilize than uneducated people when it comes to embracing innovations, and resistance to change is probably higher among the uneducated group than educated on.

In terms of market availability and accessibility to the respondents, Figure 1 indicates that the majority of respondents, equivalent to 71.43%, access local markets, 4.20% access regional markets, 24.37% access both local and regional markets. This implies that the great portion of the production of functional food in Nyabihu district has local demand. This leads farmers to selling their production locally than regionally.

Figure 1: Market availability and accessibility



4.2 Carrots Production and Income it generates to the Farmers

This was assessed by focusing on the quantity of carrots produced, income generated to farmers and daily wages paid for different jobs performed in carrots farming. The quantity of carrots produced is expressed in terms of sacks whereby each sack is estimated to have on average 50 kilograms. Table 3

summarises the quantity of carrots produced by the farmers in Nyabihu district and Figure 2 presents income generated from carrots production. Besides to generating income to farmers, carrots production generates income in form of daily wages to the people outside the cooperative who perform different jobs related to carrots production. Table 4 therefore provides a summary of daily wages earned by various people outside the cooperative of carrots farmers for different jobs performed.

Table3: Carrots Production in Nyabihu district

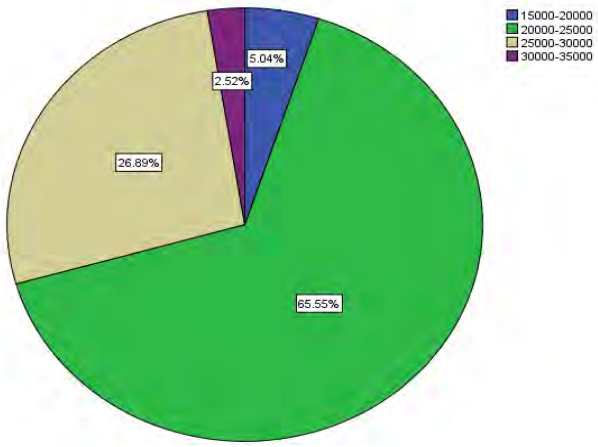
Quantity (sacks) produced	Number of respondents	Percent
1-3	3	2.5
3-5	44	37.0
5-7	62	52.1
Over 7	10	8.4
Total	**119**	**100.0**

Source: Field data, 2022

Regarding Table 3, the farmers equivalent to 52.1% of all respondents produce 5-7 sacks of carrots every season. Those producing over 7 sacks are 8.4% while those producing 3-5 sacks are 37% and those producing 1-3 sacks are 2.5% of all respondents. This provides a picture of the quantity of carrots production Nyabihu district. Existing literature indicates that the increase in demand of carrots on the market has been found to lead farmers to producing more quantity of carrots and this create economic opportunities for smallholder farmers (Williams, Pehu and Ragasa, 2006). The production of carrots is one of the sources of income for the farmers in Nyabihu district to improve their standard of living.

In terms of income generated from carrots production, it is imperative to mention that the income depends on the prevailing price at the market. According to Figure 2, it is evident that 65.5% of the respondents show that they generate an income between 20,000-25,000 Rwandan franc per sack of carrots. This indicates that a farmer who can produce, for instance, 5-7 sacks of carrots can generate a minimum income between 100,000 and 125,000 Rwandan Franc per season.

Figure 2: Income generation from Carrots Production



Source: Field data, 2022

However, due to price flactuations, the price per sack of carrots is unpredictable. As such, the farmers cannot predict with certainty an income generation from carrots paroduction.. In response to this, Musabanganji et al. (2019) shows that market-oriented agriculture through the export promotion has been promoted just to facilitate Rwandan farmers especially in rural areas to get income by accessing and competingon regional trade.

It is also important to mention that carrots farming generates income to the people outside the cooperative in form of daily wages paid for different jobs performed. According to Table 4, the majority of the respondents stated that the income earned from daily wages paid for the jobs related to carrots farming range 1000-1500; 1500-2000; and 2000-2500 Rwandan franc.

Table 4: Daily wages in Rwandan Franc (RWF) paid for different jobs in carrots farming

Daily wages paid to workers	1000-1500 RWF		1500-2000 RWF		2000-2500 RWF		2500-3000 RWF		Over 3000 RWF	
	n	%	n	%	n	%	n	%	n	%
Carrots cultivativation	98	82.4	21	17.6	-	-	-	-	-	-
Carrot's planting	25	21	93	78.2	1	0.8	-	-	-	-
Pesticides and insecticides application	39	32.8	80	67.2	-	-	-	-	-	-
Carrots harvesting	72	60.5	-	-	47	39.5	-	-	-	-
Carrots washing and packing in sacks	1	0.8	5	4.2	66	55.5	40	33.6	7	5.9
Carrying carrots from the farm to the collection center	11	9.2	81	68.1	26	21.8	-	-	1	0.8

Source: Field data, 2022 **n= Number of respondents**

The majority of the respondents equivalent to 82.4% of all respondents revealed that they are paid a daily wage of 1000-1500Rwf for carrots cultivation; 78.2% are paid a daily wage of 1500-2000Rwf for carrots planting and 67.2% are paid a daily wage of 1500-2000Rwf for applying pesticides and insecticides in carroats plantation; 60.5% are paid a daily wage of 1000-1500Rwf for carrots harvesting; 55.5% are paid a daily wage of 2000-2500Rwf for carrots washing and packing in sacks; and 68.1% are paid a daily wage of 1500-2000Rwf for carrying carrots from the farm to the clloection centre.

The findings in Table 4 are complemented by the results from interview, whereby one the interviewees said "*wages for harvesting carrots are not always the same, it depends on working hours.* Another interviewee said: "*the wages paid for packing carrots in sacks vary depending on the quantity of carrots harvested or production, but I cannot earn under 2500Rwf per day*".

These findings indicate that functional food farming especially carrots does not only generate income to the farmers but also to the people in the community through the provision of various jobs. Accorndingly, Williams, Pehu and Ragasa (2006) stated that farming for the functional foods industry can benefit primary producers and rural communities in other ways. Poorer communities can benefit from growing functional food markets through domestication of wild plant species; enhanced links to the private sector, for example, through contract farming; employment or business opportunities from processing functional foods; and employment on plantations.

4.3 The extent to which carrot farming provides employment

This section provides a detailed information from the respondents regarding the extent to which carrots farming provides employment to the people in Nyabihu district**.** Using the Likert scale, Table 5 shows the views of the respondents on how carrots farming provides variety of jobs to the people in the area.

Table 5: The extent to which carrot farming provides employment

Employment	Very Large		Large		Moderate		Low	
	n	%	n	%	n	%	n	%
Cultivation and planting activities	80	67.2	39	32.8	-	-	-	-
Applying pesticides and insecticides in carrots plantation	13	10.9	79	66.4	27	22.7	-	-
Harvesting duties	65	54.6	42	35.3	12	10.1	-	-
Washing and packing carrots in sacks	99	83.2	19	16.0	-	-	1	0.8
Carrying carrots from the farm to the collection center	18	15.1	67	56.3	33	27.7	1	0.8
Repairing farming tools	1	0.8	1	0.8	30	25.2	71	59.7
Selling carrot seeds	1	-	1		35	29.4	64	53.8
Safeguarding carrots plantation	2	1.7	1	0.8	72	60.5	43	36.1

Source: Field data, 2022 **n= Number of respondents**

According to Table 5, it is shown that the majority of the respondents rated very large and large respectively the extent to which carrots farming provides employment to the people outside the cooperative. More specifically, the extent to which carrots farming provides the people outside the cooperative of carrots farmers with cultivation and planting employment was rated very large and large by 67.2% and 32.8% respectively; applying pesticides and insecticides employment was rated very large, large and moderate by 10.9%, 66.4% and 22.7% respectively. Harvesting employment was rated very large, large and moderate by 54.6%, 35.3% and 10.1% respectively. Washing and packing carrots employment was rated very large, large and low by 83.2%, 16.0% and 0.8% respectively. Carrying carrots from the farm to the collection center was rated very large, large and moderate by 15.1%, 56.3% and 27.7% respectively.

On the other hand, the extent to which carrots farming provides the people outside the cooperative of carrots farmers with repairing farming tools, selling carrots seeds and safeguarding employment were rated by the majority of respondents low (59.7%), low (53.8%) and moderate (60.5%) respectively. The implication of these findings is that repairing farming tools, selling carrots seeds and safeguarding activities are not accessible to many people outside the cooperative. These are jobs performed by few people with dedicated skills.

In relation to these findings, Kaur & Singh (2017) argued that vegetables and fruits farming generated employment in India and reliable source of livelihood to local farmers, who otherwise had to face difficulty. According to Data for Cambodia, Niger, and Vietnam show that profits per hectare are 3–14 times higher in vegetable production than in rice production while profits per labor-day are double (Joosten et al., 2015). Vegetables provide more employment per hectare than cereals. Weinberger and Lumpkin (2007) showed that vegetable production in six Asian countries used on average 297 labor-days per hectare per season against 116 labor-days for cereal production. This indicated how functional food gathering specifically carrot farming provides employment to the people through various job opportunities generated by this farming.

4.4 The extent to which carrot farming improved nutrition, health, education and housing conditions

This section provides a detailed findings from the respondents regarding the extent to which carrots farming has improves nutrition, health, education and housing condition of the people in Nyabihu district. Table 6 presents the views of respondents that were measured by using Likert scales:

Table 6: The extent to which carrots farming improves nutrition, health, education and housing conditions

Item	Always		Often		Sometimes		Rarely		Never	
	n	%	n	%	n	%	n	%	n	%
Cooking and eating carrots in diet	51	42.9	62	52.1	6	5	-	-	-	-
Improve food security in the household	39	32.8	74	62.2	6	5	-	-	-	-
Farming Carrots enables to access a variety of food types	39	32.8	74	62.2	-	-	-	-	-	-
Farming carrots enables to eat more than two times per day	33	27.7	73	61.3	13	10.9	-	-	-	-
Farming carrots enables paying for medical insurance and bills	72	60.5	46	38.7	1	0.8	-	-	-	-
Farming carrots enables paying children's school fees	21	17.6	51	42.9	45	37.8	2	1.7	-	-
Farming carrots enables buying children's school materials	26	21.8	30	25.2	59	49.6	4	3.4	-	-
Farming carrots enables purchasing school uniforms for kids	29	24.4	38	31.9	43	36.1	9	7.6	-	-
Farming carrots enables paying children's school feeding	10	8.4	48	40.3	57	47.9	3	2.5	1	0.8
Farming carrots enables to rehabilitate house	2	1.7	14	11.8	80	67.2	21	17.6	2	1.7
Farming carrots enables buying house materials	2	1,7	17	14.2	69	58	29	24.4	2	1.7
Farming carrots enables expanding or annexing house	3	2.5	2	1.7	45	37.8	60	50.4	9	7.6

Source: Field data, 2022 **n= Number of respondents**

Refer to Table 6, the majority of respondents rated with always, often and sometimes that carrots farming improves nutrition, health, education and housing conditions. Cooking and eating carrots in diet; improvement in food security in the household; and access to a variety of food types and ability to eat more than two times per day due to farming carrots were rated often by the majority with 52.1%; 62.2%; 62.2%; and 61.3% respectively. On the other hand, majority of the respondents

(60.5%) also rated that carrots farming always enables paying for medical insurance and bills while 42.9% of respondents said that often carrots farming enables paying children's school fees. Furthermore, the majority of the respondents rated that sometimes carrots farming enables buying children's school materials, purchasing school uniforms for kids, paying children's school feeding, rehabilitating house, buying house materials and expanding or annexing house with 49.6%; 36.1%; 47.9%; 67.2%; 58%; and 37.8% of respondents respectively.

These results were approved by the information collected from a respondent interviewed by a researcher who said that '*the money from carrots help to afford food and to vary, food diet*". This indicates how functional food gathering specifically carrots farming provides income to the people that help them to address household problems. According to Kotilainen et al. (2006), functional food gathering provides not only basic nutrition but also an extra health benefit. Concerning the ways carrots farming has improved education, one respondent interviewed said that "*carrots farming is more important to support education of my children. I always use money from carrots to pay school materials and fees for my children*". Carrot farming genarates income opportunities to the people, which in return help them to improve socio-economic wellbeing by paying medical insurance and bills in order to access medical and health care services.

4.5 Challenges faced by carrots farmers in Nyabihu district

This section provides the challenges faced by carrots farmers in Nyabihu district. Table 7 presents the views of the respondents about the challenges by carrots farmers using Likert scale items.

Table 7: Challenges faced by carrots farmers

Challenges faced by farmers	Strongly Agree		Agree		Neutral	
	n	%	n	%	n	%
Land shortage	87	73.11	39	26.89	-	-
Pest and diseases	98	82.35	21	17.65	-	-
Unstable price of farm input	38	31.93	81	68.7	-	-
Lack of market information for carrots	31	26.05	88	73.95	-	-
Soil erosion and landslides	64	53.78	55	46.22	-	-
Insufficient proper storage facilities	17	14.29	95	79.83	7	5.88
Excessive rainfall	76	63.83	43	36.17	-	-

Source: Field data, 2022

According to Table 7, the respondents indicated with strongly agree that land shortage, pest and diseases, soil erosion and landslides and landslides, excessive rainfall are the challenges to carrots farming by 73.11%; 82.35%; 53.78%; and 63.83% respectively. On the other hand, unstable price of farm input, lack of market information for carrots, and lack of market information for carrots are indicated with agree by 68.7%; 73.95%; and 79.83% of respondents.

In relation to these findings, Duguma (2008) argue that shortage of land and water, insufficient and poor quality feed, and regular disease epidemics (Beed2014) are major constraints that restrict output from farming. One of the staff of cooperative of carrots farmers said that *"shortage of land is a big barrier tomost farmers because production depends on the size of cultivated land, the more you cultivate on big land the higher the production.*" This indicates that land can limit the farmers for earning more productions as well as income. In a similar vein, climate change affects the global environment as well as future local crop output in some particular places, it is significantly less under the control of individual farmrs (Lobell & Burke 2009).

Lack of market information is another challenge faced by farmers as shown by one respondent: *"we don't know the quantity needed at the market where we sell almost our carrots and even exact price. Information about market situation encourage farmers to produce more.*" Some farmers are not aware of the existing markets of their products and the prices offered in these markets. Due to a lack of crucial market knowledge, middlemen take advantage of farmers. Farmers sometimes produce more than the market will accept, which leaves them without a buyer for their goods. This deters them from making more.

5. Conclusion

The study contributes to existing stock of knowledge and suggested implications for farmers in functional food farming in Nyabihu district. The study is significant because it identifies the difficulties experienced by farmers of carrots and provided recommendations that will motivate policy makers to look for solutions to these problems in order to increase carrots productivity and improve farmers' socio-economic well-being. According to the study's findings, farmers who specialize in the production of functional foods face a number of significant obstacles. These include a lack of land and water, a lack of adequate feed, frequent disease, soil erosion and landslides, an abundance of rain during the rainy season, and an unstable price for agricultural inputs.

The livelihoods and socio-economic wellbeing of farmers improved thanks to functional food cultivation. This suggested that encouraging people to engage in carrot growing would not only increase agricultural output but also decrease family food insecurity and poverty while increasing options for revenue generating. Specifically, encouraging people to grow carrots will improve their socio-economic conditions.

The promotion of reduced costs through the use of machines in farm activities is necessary for functional food farming to maintain its influence on the socioeconomic wellbeing of farmers and to be more productive. The government provides some inputs to farmers (seeds and fertilizers), and feeder roads are built in agricultural areas. Modern farming methods, knowledge transfer and information sharing, and education are other measures to mitigate the challenges faced by farmers. People should engage in functional food farming as it will enable them to maximize their potential for improving their standard of life, improving their economic situation, and increasing production.

6. Recommendations

Based on the findings of the study, the following recommendations are made:

To encourage farmers to adopt the functional food farming in rural areas as a tool for them to improve their socio-economic wellbeing, different mechanisms and methods such as cutting-edge equipment should be used. This will enable to determine the type and amount of fertilizers that are necessary to apply as well as the particular crop that is best suited for the soil. There is also a need to subsidize storage facilities, irrigation, and mechanized equipment for agriculture.More trainings should be organised for the farmers in order to keep them up to date on the latest technology, pests and illnesses affecting crops.

Different stakeholders such as; government, private sector, NGOs should work in synergy to create a favorable condition that empower and support farmers to fully and effectively participate in functional food farming. District and Sector Agronomists and Local Leaders have to plan for special programmes to support functional food farmers in addressing existing challenges.

7. Conflict of Interest

Authors declare that no conflict of interests exist.

References

Allardt, E. (1993). Having, loving, being: An alternative to the Swedish model of welfare research. *The quality of life*, *8*, 88-95.

Australian Bureau of Statistics (2013). Measures of Australia's Progress –Aspirations for our nation: A conversation with Australians about progress, Consultation report, cat. no. 1370.0.00.002.

Bakti, I., Sumaedi, S., Astrini, N., Rakhmawati, T., & Yarmen, M. (2019). Consumers' expectation towards functional foods: An exploratory study. In *Proceedings of the 16th ASEAN Food Conference, Bali, Indonesia* (pp. 15-18).

Beed, F. D. (2014). Managing the biological environment to promote and sustain crop productivity and quality. *Food Security*, *6*(2), 169-186.

Bhat, H. A. (2019). Trends and Growth in Area, Production and Productivity of Apples in India from 2001-02 to 2017-18. *Research Ambition an International Multidisciplinary e-Journal*, *4*(I), 13-23.

Bradburn, N. (1969). *The structure of psychological well-being.* Chicago: Aldine.

Burdock, G. A., Carabin, I. G., & Griffiths, J. C. (2006). The importance of GRAS to the functional food and nutraceutical industries. *Toxicology*, *221*(1), 17-27.

Camfield, L., Streuli, N., & Woodhead, M. (2009). What's the Use of Well-Being in Contexts of Child Poverty-Approaches to Research, Monitoring and Children's Participation? *Int'l J. Child. Rts.*, *17*, 65.

Chand, R., Raju, S. S., & Pandey, L. M. (2008). Progress and potential of horticulture in India. *Indian Journal of Agricultural Economics*, *63*(902-2016-67340).

Cheber, D. (2018). Smallholder Agricultural Commercialization for Income Growth and Poverty Alleviation: A Review from Ethiopian Context. *College of Agriculture and Veterinary Medicine, Department of Rural Development and Agricultural Extension, Jimma University Ethiopia, PO Box*, *307*, 2225-0565.

DeFelice, S. (2007). DSHEA versus NREA (The Nutraceutical Research and Education Act) and the three nutraceutical objectives. *The Foundation for Innovation of Science in Medicine, Commentaries*.

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological bulletin*, *125*(2), 276.

Dodge, R., Daly, A., Huyton, J., & Sanders, L. (2012). The challenge of defining wellbeing. *International Journal of Wellbeing,* 2 (3), 222-235. doi:10.5502/ijw.v2i3.4

Duguma, B. (2022). Farmers' perceptions of major challenges to smallholder dairy farming in selected towns of Jimma Zone, Oromia Regional State, Ethiopia: possible influences, impacts, coping strategies and support required. *Heliyon*, *8*(6).

El Sohaimy, S. A. (2012). Functional foods and nutraceuticals-modern approach to food science. *World Applied Sciences Journal*, *20*(5), 691-708.

Forsé, M., & Langlois, S. (2014). *Sociologie du bien-être*. PUF.

Greenberg, J. A., Bell, S. J., Guan, Y., & Yu, Y. H. (2011). Folic acid supplementation and pregnancy: more than just neural tube defect prevention. *Reviews in obstetrics and gynecology*, *4*(2), 52.

IFIC (2009). *Functional foods now*. International Food Information Council. Washington, DC.

ILSI, S. (1999). Assessment and potential health benefits of food components based on selected scientific criteria. Isothiocyanates. *Crit. Rev. Food Sci. Nutr*, *39*, 245-257.

Jana, M. M., Nadgauda, R. S., Rajmohan, K., & Mascarenhas, A. F. (1994). Rapid somatic embryogenesis from the nucelli of monoembryonic mango varieties. *In Vitro Cellular & Developmental Biology-Plant*, *30*, 55-57.

Javanmardi, J., & Emami, S. (2013). Response of tomato and pepper transplants to light spectra provided by light emitting diodes. *International Journal of Vegetable Science*, *19*(2), 138-149.

Joosten, F. J., Dijkxhoorn, Y., Sertse, Y., & Ruben, R. (2015). *How does the fruit and vegetable sector contribute to food and nutrition security?* (No. 2015-076). LEI Wageningen UR.

Kansky, J. (2017). Benefits of well-being: Health, social relationships, work, and resilience. *Journal of Positive Psychology and Wellbeing*, *1*(2), 129-169.

Kaur N and Singh D P (2017). *Appetite Deciphering the consumer behavior facets of functional foods*: a literature review 112 167-187.

Keyes, C. L. M. (1998). Social well-being. *Social psychology quarterly*, 121-140.

Keyes, C. L.M. & Shapiro, A. D. (2004). Social well-being in the United States: A descriptive epidemiology. *How healthy are we*, 350-372.

Key-Roberts, M. J. (2009). *The impact of a positive social media intervention on social well-being* (Doctoral dissertation, University of Kansas).

Kotilainen, L., Rajalahti, R., Ragasa, C., & Pehu, E. (2006). Health enhancing foods. *World Bank*.

Kulshrestha, D., & Agrawal, K. K. (2019). An econometric analysis of agricultural production and economic growth in India. *Indian Journal of Marketing*, *49*(11), 56-65.

Küster-Boluda, I., & Vidal-Capilla, I. (2017). Consumer attitudes in the election of functional foods. *Spanish Journal of Marketing-ESIC*, *21*, 65-79.

Kwak, N. S., & Jukes, D. J. (2001). Functional foods. Part 1: the development of a regulatory concept. *Food Control*, *12*(2), 99-107.

Lajolo, F. M. (2002). Functional Foods: Latin American perspectives. *British journal of nutrition*, *88*(S2), S145-S150.

Law, M., Steinwender, S., & Leclair, L. (1998). Occupation, health and well-being. *Canadian Journal of Occupational Therapy*, *65*(2), 81-91.

Layard P. R. G., (2006), Happiness: Lessons from a New Science, London, Penguin.

Llena-Nozal, A., Martin, N., & Murtin, F. (2019). The economy of well-being: Creating opportunities for people's well-being and economic growth.

Lobell, D. B., & Burke, M. (Eds.). (2009). *Climate change and food security: adapting agriculture to a warmer world* (Vol. 37). Springer Science & Business Media.

McCallum, F., & Price, D. (Eds.). (2015). *Nurturing wellbeing development in education: From little things, big things grow*. Routledge.

Menrad, K. (2003). Market and marketing of functional food in Europe. *Journal of Food Engineering*, *56*(2-3), 181-188.

MINICOM (2011) *Rwanda National Export Strategy* (NES). Kigali: Ministry of Trade and Industry. April.

Mishra, R., Tripathi, A. D., Singh, R. B., Tomar, R. S., Wilson, D. W., & Smail, M. M. (2022). Estimates of functional food and nutraceutical availability in the world, with reference to food peroxidation and food safety. *Functional Foods and Nutraceuticals in Metabolic and Non-Communicable Diseases*, 23-42.

Mittal, S. (2007). *Can horticulture be a success story for India?* (No. 197). Working paper.

Morrison, J. L., & Regnault, T. R. (2016). Nutrition in pregnancy: optimising maternal diet and fetal adaptations to altered nutrient supply. *Nutrients*, *8*(6), 342.

Musabanganji, E., Maniriho, A., Kayisire, P., & Nyalihama, C. (2019, March). Regional Trade and Competitiveness of Rwandan Agriculture: Empirical Analysis of Selected Priority Foodstuffs. In *EPRN 5th Annual Economic Conference*.

OECD (2011), *How's life? Measuring Well-Being*, OECD Publishing, Paris.

OECD (2013), *Guidelines for Micro Statistics on Household Wealth*, Report of the OECD Expert Group on Household Income, Consumption and Wealth Statistics, OECD Publishing, Paris.

Pramanik, K. K., Sharma, S. K., & Kishore, D. K. (2005). Easy technique for multiplication of kiwifruit plants to meet the demand. *Easy Technique for Multiplication of Kiwifruit Plants to Meet the Demand*, 1000-1004.

Roberfroid, M. (2011). Defining functional foods and associated claims. *Functional foods*, 3-24.

Roberfroid, M. B. (2000). Concepts and strategy of functional food science: the European perspective. *The American journal of clinical nutrition*, *71*(6), 1660S-1664S.

Sánchez, M., & Barrena Figueroa, R. (2004). *El consumidor ante los alimentos de nueva generación: alimentos funcionales y alimentos transgénicos* (No. 1102-2016-90787, pp. 95-127).

Shah, H. & Marks, N. (2004). A well-being manifesto for a flourishing society. *Journal of Public Mental Health*, *3*(4), 9-15.

Umulisa, P. (2022). Impact of agricultural transformation policy on food security: Case study of selected smallholder farmers in Gicumbi District, Northern Province, Rwanda.

UNECE (2011). Canberra group handbook on household income statistics.

Vukasović, T. (2017). Functional foods in line with young consumers: Challenges in the marketplace in Slovenia. In *Developing new functional food and nutraceutical products* (pp. 391-405). Academic Press.

Wani, R. A., Jahangeer, A. B., Hakeem, H. A., Qazi, S. R., Basu, Y. A., Umer, I., ... & Prasad, V. M. (2013). Influence of differential combinations of fertilizer and manure combinations on vegetative growth, yield and quality of strawberry (Fragaria x annanassa Duch.) cv. *Intl. J. Current Microbiology Appl. Sci*, *6*(11), 3396-3404.

Weinberger, K., & Lumpkin, T. A. (2007). Diversification into horticulture and poverty reduction: a research agenda. *World development*, *35*(8), 1464-1480.

Williams, M., Pehu, E., & Ragasa, C. (2006). Functional foods: opportunities and challenges for developing countries.

World Bank (2013). Agricultural Development in Rwanda. Available online at: https://www.worldbank.org/en/results/2013/01/23/agricultural-development-in-rwanda