

Trend and factors associated with household food security in Rwanda, 2012-2018: An economic perspective

Dushimimana Jean de Dieu and Habinshuti Vital

ABSTRACT

Most developing countries experienced food security issues caused by different factors. In order to counter food insecurity, the Rwandan government has implemented different policies aimed at improving food security situation among its citizens. This study aims to investigate trends and potential factors associated with household food security in Rwanda from 2012 to 2018. We used data from the Comprehensive Food Security and Vulnerability Analysis survey (FSVA2012 to 2018), and a cross-sectional population-based survey that is conducted every two years by the National Institute of Statistics of Rwanda. Following prior work, we define a variable that indicates household food security as binary. We assess the overall trends in household food security in Rwanda and then conduct bivariate analysis across a range of policy-relevant demographic and socioeconomic variables. We then incorporate key variables in multivariable analysis to identify those factors that are independently associated with household food security. The trend showed that household food security increased from 70.9% (2012) to 81% (2018). Factors associated with household food security are household size, education level of household head, livestock possession, wealth index, having vegetable garden (akarima k'igikoni), and owned land size. Based on study findings, household food security situations in Rwanda have improved considerably. Reinforcing ongoing national policies to address food insecurity issues, while also working to reduce poverty among citizens, will empower Rwanda to reach all of its overall economic goals.

Keywords: Food Security in Rwanda, Food Security, food consumption, households

Disclaimer

Ideas and views expressed in this paper are solely those of authors and do not necessarily reflect the views of ERN Rwanda. EPRN is a network of researchers which facilitates members to publish their research papers for discussion and exchange purposes.

1. INTRODUCTION

According to the United Nations' Committee on World Food Security, food security is defined as the means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

A household is classified as moderately or severely food insecure when at least one adult in the household has reported to have been exposed, at times during the year, to low quality diets and might have been forced to also reduce the quantity of food they would normally eat because of a lack of money or other resources.

Zero hunger is the second Sustainable development goal. The target is to ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious, and sufficient food[1]. For countries to be able to achieve this important milestone, they have to include and implement policies aimed at reaching this goal. Nearly 690 million people are hungry, or 8.9% of the world population whereas up by 10 million people in one year and by nearly 60 million in five years. The number of people affected by severe food insecurity shows a similar upward trend. In 2019, close to 750 million or nearly one in ten people in the world were exposed to severe levels of food insecurity[2]. Considering the total affected by moderate or severe food insecurity, an estimated 2 billion people in the world did not have regular access to safe, nutritious, and sufficient food in 2019. The world is not on track to achieve Zero Hunger by 2030. If recent trends continue, the number of people affected by hunger would surpass 840 million by 2030[2].

In sub-Saharan Africa, the prevalence of undernourishment appears to have risen from 20.8% to 22.7% between 2015 and 2016, and the number of people undernourished rose from 200 to 224 million, accounting for 25% of the 815 million people undernourished in the world in 2016. concomitantly, the proportion of the population with severe food insecurity has risen in the region[3].

In Rwanda, 38.2 % of the population continues to live below the poverty line and almost one-fifth is food insecure. Levels of stunting among young children remain very high at 33%[4]. Agriculture is the backbone of the economy, with 89% of rural households practicing small-scale farming[5]. Poor rainfall, drought, floods, and the limited amount of land that is suitable for agriculture,

alongside pests and diseases, continue to pose risks to food security[5,6]. Food access in Rwanda is determined primarily by seasonal patterns, where during harvest periods people are well fed and they are underfed during the off season. Seasonality also affects market prices as prices tend to go higher during the off season[7].

To improve food security, the government has taken many progressive steps including agriculture production enhancement that was limited by low agriculture productivity attributed to low use of inputs. To overcome these challenges, the government has subsidized the farmers through the Crop Intensification Program (CIP). Under CIP, the use of improved seeds by farmers has risen from 3% to 40%. Fertilizer use increased from 4 Kg/Ha in 2006 to 30 Kg/Ha in 2013, while fertilizer availability increased from annual quantities of 8 000 tons to 35 000 tons[8]. Investing in land management and related training to farmers has been essentially improved productivity [6,8]. Since 2010, under World Bank support over 7 200 hectares of marshlands and nearly 30 000 hectares of hillsides have been sustainably rehabilitated. This has directly contributed to increases in maize yields from 1.6 tons/ha to nearly 5 tons/ ha, potato yields from 7 tons/ha to 20 tons/ha, and rice yields from 3 tons/ha to 7.9 tons/ha[8]. Moreover, the trend indicating that the Proportion of undernourished in the total population decreased from 45.2% in 2007 to 37.3% in 2014[8].

The Rwandan Government, through the National Strategy for Transformation (NST1), aspires to modernize and increase the production of agriculture and livestock. It is expected that this initiative will yield results that will increase the availability of food production and consumption in Rwanda. In addition to that, it is expected that Rwanda will increase food exports especially to regional markets[9]. This progress is related to comprehensive reforms and innovations designed with community engagement and the private sector to strengthen the agriculture system, including but not limited to some of the following strategies: *work with the private sector to increase the surface of consolidated and irrigated land and promote agricultural mechanization, promote new models of irrigation scheme management, increases the land area covered by terraces and ensure their optimal use, enhance farmers' access to improved seeds, promote research and develop new seed varieties, attract private sector and farmers to invest in flagship projects in the livestock sub-sector and put in place mechanisms to increase access to finance for farmers*[9].

A lot of efforts have also been put into trade logistics in general and agricultural trade logistics in particular. Despite all this progress in the agriculture system, food insecurity and malnutrition persist among some Rwandans[4]. As of now, few studies have been done on food security in Rwanda. However, very few of them have looked at the determinants of food security in Rwanda. Therefore, based on the research gaps in this particular area, this paper aims to investigate the trend and factors associated with Food Security in Rwanda between 2012 and 2018 by using data from the Comprehensive Food Security and Vulnerability Analysis survey (FSVA) surveys conducted between 2012 and 2018.

The knowledge of food security trend and factors is gaining momentum as it helps countries regularly monitor how food secure are households or the countries at large. It helps policy makers to take appropriate actions and policies that will make the country more food secure.

2. METHODOLOGY AND MODELING

2.1.Data and sample size

In this study, we mainly used secondary data from the Comprehensive Food Security and Vulnerability Analysis (CFSVA). Data was collected in 2012, 2015, and 2018 by the National Institute of Statistics of Rwanda in collaboration with the World Food Program (WFP). The CFSVA comprises a nationally representative sample of 7498, 7500, and 9,709 households in 2012, 2015, and 2018 respectively[1–2]. Both surveys were targeting the only head of the household or someone else in the selected household who have full information about family members and food security situation.

2.2.Variables description

Outcome variable: In this study, the dependent variable is food security status which was calculated based on the Consolidated Approach for Reporting Indicators of Food Security (CARI)[13]. Food security index (FSI) classifies households into four standard descriptive groups: food secure, marginally food secure, moderately food insecure, and severely food insecure [13].

The food security Index computation process was done by the National Institute of Statistics of Rwanda in collaboration with the World Food Program and reported in the final database. For binary logistic regression, we combined those groups into two groups by transforming the dependent variable into a binary variable. Food secure and marginally food secure have given one code representing that household is food secured while moderately food insecure, and severely food insecure given a code of zero which represent food insecure (Table 1).

Independent variables: Based on the literature, we selected explanatory variables to be used in the model which represent different characteristics of the household. A variable like age, gender, marital status, and education level of head of household are key factors that stand for household human capital [10–12]. We included these variables in the model to control for human capital endowments at the household level. Regarding physical capital, we included livestock possession, owning a vegetable garden/plot, and owned land size used to control the effect of components of food production [14]. Variables like erosion protection, access to irrigation, and the use of chemical fertilizers and insecticides used to control the environmental effect[15]. Access to credit can be used as a means of consumption smoothing in case of food shortage by households. The wealth index indicates the economic capability of a household to afford the food. Land consolidation is used to capture the effect of available programs to boost food production[16]. Household size is used to capture the effect of family planning on household food security situation [17].

Table 1: List of variables used in bivariate and multivariate analysis

Variables	Variable label
Dependent Variable	
Household Food security status	1=food secure, 0=food insecure
Independent Variables/Covariates	
1. Demographic characteristics of the household head	
Age	1=15-24, 2=25-34, 3=35-44, 5=45&Above
Gender	1=Male, 2=Female

Marital status	1=Married/Partner, 2=Divorce/Separated/Single
Education Level	1=No school, 2=Primary, 3=Secondary&above
Household size	1=1-3, 2=4-6, 3=7&Above
2. Social-economic variables	
Access to credit	1=Yes, 0=No
Livestock possession	1=Yes, 0=No
Wealth index	1=Poor, 2=Medium, 3=Wealthiest
Owning a vegetable garden/plot	1=Yes, 0=No
Land consolidation	1=Yes, 0=No
Erosion protection	1=Yes, 0=No
Use of chemical fertilizers/insecticides	1=None, 2=Fertilizers or Insecticides, 3=Both
Access to irrigation	1=Yes, 0=No
Owned land size	1=0-0.5ha, 2=0.5-1ha, 3=1-2ha 4= 2ha &above

3. EMPIRICAL RESULTS

Data analysis

After transforming the dependent variable into a binary variable, we conducted summary statistics by using a proportion of food security by selected explanatory variables. Also, we conducted Pearson chi-square tests to examine the association between food security status by several independent predictor variables (Table 1). The choice of the explanatory variables was based on variables collected and available in the CFSVA data sets and on the literature reviews on factors influencing household food security. In the end, we performed logistic regression analysis to find out the factors associated with household food security. We included in the model all variables that were statistically significant at 10%. During regression analysis, all variables with a p-value of less than 0.05 are considered as the factors associated with household food security. We present the results in the form of odd ratio, and their corresponding 95% confidence intervals. Besides, we computed the Hosmer-Lemeshow goodness of fit test to evaluate the performance of our binary logistic regression model. The analysis process was done using STATA (version 16).

Table 2: Bivariate analysis: distribution of food secured households by selected explanatory variables, Rwanda CFSVA 2012-2018

Explanatory variables	Year 2012			Year 2015			Year 2018		
	N	%	P-value	N	%	P-value	N	%	P-value
Overall	5310	70.9		5819	77.6		7829	80.6	
The age group of head of household			0.191			0.036			0.001
15-24	161	66.8		122	68.9		169	75.8	
25-34	1226	72.5		1282	78.5		1534	78.5	
35-44	1157	71		1364	77.9		2097	82.8	
45& Above	2766	70.3		3051	77.5		4029	80.6	
Gender of a head of household			0.000			0.000			0.000
Male	3913	73.3		4373	79.8		5864	82.4	
Female	1397	64.9		1446	71.6		1965	75.8	
Marital status of head of household			0.000			0.000			0.000
Married/partner	3777	73.3		4237	79.8		5707	82.7	
Divorce/Separated/Single	1533	65.5		1582	72.2		2122	75.6	
Household size			0.002			0.000			0.000
1-3	1409	70.0		1525	73.4		2115	78.2	
4-6	2672	69.8		2936	78.0		4114	80.6	
7& Above	1229	74.3		1358	81.8		1600	84.3	
The education level of head of household			0.000			0.000			0.000
No school	1754	64.6		1670	68.5		1932	71.6	
Primary	2880	72.6		3264	79.4		4559	81.9	
Vocational	131	77.1		184	86.0		191	91.0	
Secondary or higher	545	85.2		689	95.4		1018	95.1	
Access to credit			0.000			0.000			0.000
No	4389	69.8		4500	75.4		6046	78.4	
Yes	893	76.3		1303	86.1		1758	89.1	
Livestock possession			0.000			0.000			0.000
No	1510	66.9		2582	71.8		2655	78.7	
Yes	3800	72.6		3237	83.0		5174	81.7	

Wealth index quantiles			0.000			0.000		0.000
Poor	1702	59.1		2210	64.1		2550	68.7
Medium	2189	74.4		2557	85.6		2757	87.2
Wealthiest	1329	87.1		1052	98.8		1449	97.6
Owning a vegetable garden/plot			0.000			0.000		0.000
No	2109	67.1		2057	72.7		2596	77.4
Yes	3201	73.6		3762	80.5		5233	82.3
Having Consolidated Land			0.004			0.892		0.000
No	3312	69.5		3378	77.3		4500	80.1
Yes	1102	73.4		835	77.5		1266	84.3
Erosion protection			0.124			0.019		0.000
No	1810	69.4		2129	76.0		1786	77.8
Yes	2604	71.2		2081	78.7		3980	82.5
Use of Fertilizers/insecticide			0.000			0.000		0.000
None	1417	66.3		1722	72.6		3787	79.5
One of fertilizer or insecticides	2546	71.6		2027	79.2		1028	83.5
Both	451	79.3		714	84.0		751	87.6
Access to Irrigation			0.001			0.000		0.012
No	4191	70.1		4264	76.4		5234	80.6
Yes	223	79.4		336	84.4		532	84.7
Cultivated land size			0.000			0.000		0.000
0-0.5ha	3369	66.6		2256	70.0		6350	78.3
0.5-1ha	1005	75.7		985	85.7		898	90.5
1-2ha	688	83.5		754	89.2		438	95.0
2ha and Above	248	86.7		225	93.8		143	96.6

Source: Authors calculation

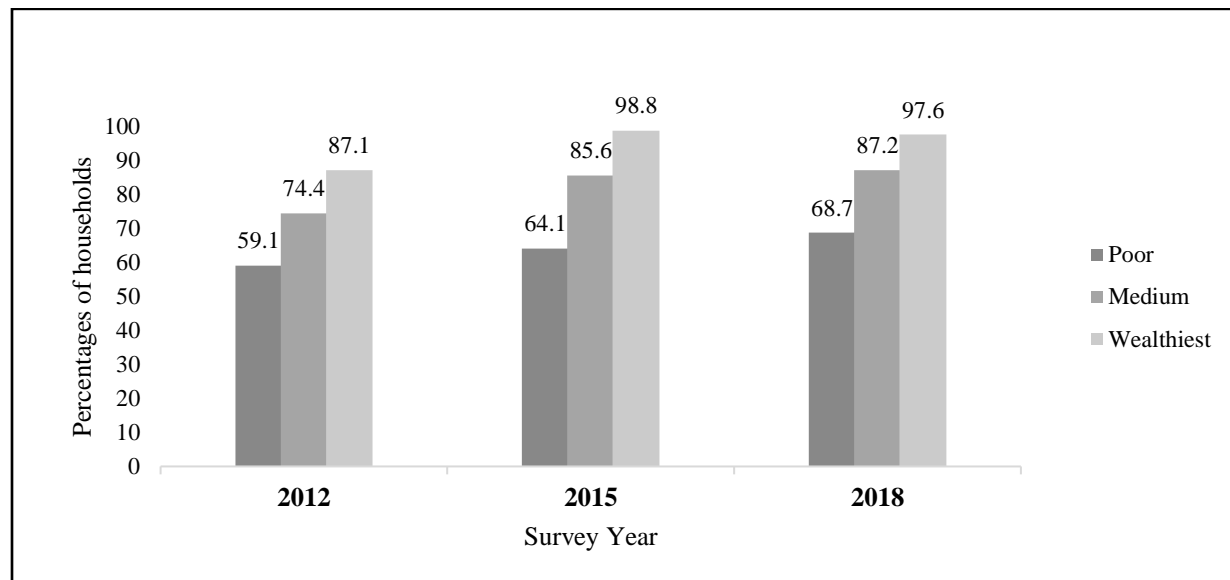
Based on chi-square test results, some demographic factors were associated with food security across all years. The food security rate was high among the families headed by males than those headed by females. It is remaining relatively high and improved among households headed by males from 2012 to 2018(73.3% to 82.4% respectively). Gender was found to be associated with food security(p-value<0.001). We found that marital status was associated with food security and households headed by married heads were more secured than those headed by unmarried heads(p-value<0.001). Household size was associated with food security(p-value<0.05). The educational level of the head of the household was the key factor that is related to food security. The households

headed by the heads with at least secondary education and above were more secured than those households headed by a head with no education in all periods (p-value<0.001).

In this study we have initiated physical capital variables such as livestock possession, owning vegetable garden/plots, and owned land for farming. There is a significant improvement in food security for households that possess livestock than those who don't possess livestock from 2012 to 2018. For those households who possess livestock, remained relatively high and improved food security situation from 76.3% to 89.1 respectively. While those households without livestock improved but remained lower compared to those who possess livestock with 69.8% (2012) to 78.4% (2018). Livestock possession was associated with food security(p-value<0.001). Owning a vegetable garden or plots was statistically significant and associated with food security(p-value<0.001). households owning large land sizes were more secured than those with small land sizes. The improvement in food security in all periods indicates that those households owned at least 2hectars and above remained relatively more secured from 2012 to 2018(86.7% vs 96.6% respectively). The land size was found to be associated with food security(p-value<0.001).

For the environment protection variables, the food security situation improved among those farmers who accessed irrigation from 79.4% (2012) to 84.7% (2018). While among farmers with erosion protection improved food security situation from 71.2% (2012) to 82.5% (2018). Access to irrigation was associated with food security at all periods (p-value<0.05). Other variables like the use of fertilizers and insecticide were significantly associated with food security in all periods (p-value<0.001). food security improved highly among those who accessed credit relative to those who didn't. We found a highly significant improvement in food security among the wealthiest households relative to the poor households (p-value<0.001, across all years).

Figure 1: Food secured households vs Wealth quantiles



To estimate household wealth and to allow a comparison between previous CFSVA surveys, a wealth index was developed based on a principal component analysis (PCA) to categorize households into quintiles (poorest, poor, medium, wealthy, and wealthiest), each representing 20 percent of the household population[13]. We combined poorest and poor into poor, medium, and wealthy to medium then wealthiest not changed. Trends of Food security among poor citizens increased from 59.1% (2012) to 68.7% (2018). There is significant improvement overtime in food security in Rwanda Figure 1.

Multivariable analysis results: Factors associated with food security

In multivariable analysis, we employed only variables that were statistically significant at 10% across all years in bivariate analysis (Table 1). Then to investigate the factors associated with food security, selected variables are: Gender of the head of household, education level of head of household, marital status of head of household, household size, access to credit, wealth index, owning vegetable garden/plots, use of fertilizers and insecticides, access to irrigation and owned land size.

Table 3: Odds Ratios (ORs), Standard errors and Marginal effects at 95% Confidence level for factors associated with food security status Rwanda CFSVA 2012-2018

Predictors	Year 2012		Year 2015		Year 2018	
	OR	95% CI	OR	95% CI	OR	95% CI
Gender of head						
Male	Ref		Ref		Ref	
Female	1.025	[0.79-1.33]	0.863	[0.62-1.19]	1.102	[0.77-1.58]
Marital status of head						
Married/partner	Ref		Ref		Ref	
Divorce/Separated/Single	0.819	[0.63-1.06]	1.022	[0.74-1.42]	0.830	[0.58-1.19]
Household size						
1-3	Ref		Ref		Ref	
4-6	0.775***	[0.67-0.89]	0.933	[0.78-1.42]	0.752***	[0.63-0.90]
7& Above	0.677***	[0.56-0.81]	0.676***	[0.54-0.84]	0.644***	[0.51-0.82]
The education level of head						
No school	Ref		Ref		Ref	
Primary	1.103	[0.97-1.25]	1.187**	[1.02-1.38]	1.076	[0.92-1.26]
Vocational	1.273	[0.84-1.94]	1.446	[0.89-2.36]	2.555***	[1.25-5.21]
Secondary or higher	1.306	[0.93-1.84]	2.021***	[1.21-3.36]	2.468***	[1.46-4.17]
Access to credit						
No	Ref		Ref		Ref	
Yes	1.039	[0.88-1.23]	1.295***	[1.06-1.58]	1.462***	[1.19-1.80]
Livestock Possession						
No	Ref		Ref		Ref	
Yes	1.363***	[1.18-1.57]	1.790***	[1.55-2.07]	1.297***	[1.09-1.54]
Wealth index quantiles						
Poor	Ref		Ref		Ref	
Medium	1.811***	[1.60-2.06]	2.257***	[1.93-2.64]	2.489***	[2.11-2.93]
Wealthiest	3.655***	[2.89-4.62]	20.74***	[9.12-47.2]	7.724***	[5.0-11.94]
Owning a vegetable garden/plot						
No	Ref		Ref		Ref	
Yes	1.152**	[1.02-1.32]	1.380***	[1.19-1.60]	1.201**	[1.03-1.40]
Use of Fertilizers/ Insecticides						
None	Ref		Ref		Ref	
fertilizer or insecticides	0.972	[0.85-1.10]	1.026	[0.88-1.20]	1.016	[0.84-1.24]
Both	1.268*	[0.99-1.62]	1.171	[0.93-1.48]	1.268*	[0.98-1.64]
Access to Irrigation						
No	Ref		Ref		Ref	
Yes	1.382**	[1.01-1.88]	1.148	[0.84-1.58]	1.031	[0.78-1.36]

Owned land size

	Ref		Ref		Ref	
0-0.5ha						
0.5-1ha	1.406***	[1.21-1.63]	1.961***	[1.61-2.39]	2.052***	[1.57-2.68]
1-2ha	1.865***	[1.52-2.29]	2.193***	[1.71-2.81]	2.886***	[1.81-4.61]
2ha and Above	1.903***	[1.32-2.74]	2.587***	[1.44-4.65]	5.760***	[1.8-18.47]

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Concerning the binary logistic model results, some of the demographic factors were not statistically significant. Gender of the head of household and his/her marital status was not significant (p-value>0.05, across all years). However, the education level of the head of the household was statistically significant. Households headed by a head with secondary or higher level were 2 to 2.5 times more likely to be secured compared to the households headed by a head with no education in 2015 and 2018 respectively (p-value<0.001). While this disparity was not statistically significant in 2012. Household size was found to be a significant factor associated inversely with food security. Households with 7 and above members had lower odds of being food secured compared to those households with members between 1 to 3 with OR=0.68 in 2012 and 2015, while OR=0.64 in 2018 (p-value<0.001, across all years). The odds of being food secured were also lower for families with 4 to 6 members relative to those households with members between 1 to 3 with OR=0.78 in 2012 and OR=0.75 in 2018 (p-value<0.001 for both years). There was no statistical significance in 2015.

Physical capital factors were found to be significant across all periods (p-value<0.05). To possess livestock for a household increases the odds of being food secured relative to a household without livestock (OR=1.4 in 2012, OR=1.8 in 2015, and OR=1.3 in 2018). Households with vegetable garden/plots had higher odds of being food secured than those households without vegetable garden/plots (OR=1.2 in 2012 and 2018, while OR=1.4 in 2015). The households owning land size of 0.5 hectare or higher estimated to be 1.4 to 6 times more likely to be food secured compared to households with land size less than 0.5ha.

Other factors, regarding access to credit, the model revealed that household accessed credit had higher odds of being food secured relative to the households without access (OR=1.3 in 2015 and OR=1.5 in 2018, p-value<0.001 for both years). While there was no significant difference found in 2012 among those who accessed credit and those who didn't. About the use of fertilizers and

insecticides, there was no significant difference among users and non-users (p -value > 0.05). The users of irrigation systems had significant higher odds of being secured relative to non-users in 2012 (OR=1.4, p -value < 0.05). However, there was no significant difference between users of irrigation system and non-users in 2015 and 2018. The study revealed that households with medium wealth index estimated to had more than twice the odds of being food secured compared to the poor households (OR=1.8 in 2012, OR= 2.3 in 2015 and OR=2.5 in 2018, p -value < 0.001 across all years). While Wealthiest households were estimated to had 4 to 21 times more likely to be food secured than poor households (p -value < 0.001 , across all years).

Discussion

This study revealed that there is a series of different factors associated with food security in Rwanda. Our analysis provided significant evidence that there is an improvement in the country's food security indicators and provides guidance to the policy makers regarding the factors that need to be prioritized to expunge food insecurity in the country. Furthermore, poor families are at risk of suffering more than other groups of the population. Specifically, we found that the use of fertilizers and insecticides, irrigation, and consolidated land have a positive influence on food security but their contribution was not statistically significant across all years. Moreover, household size was found to be negatively associated with food security.

Our study results are in the same line with other prior work examining the factors associated with food security in Rwanda and providing a more comprehensive time trend analysis. There are cross-sectional studies conducted to identify the factors associated with food security similarly found that education level, household size, access to credit, livestock possession, vegetable garden/plots, wealth index, and owned land size are the factors associated with food security [18–20]. A study conducted in three rural districts in Rwanda revealed that wealth quantiles were associated with food security [21].

The factors associated with food security among households in Rwanda are comparable to those observed in other countries. A study conducted in Zambia revealed that variables like the education level of the household, owned land size, and livestock possession are associated with food security [22]. Another study in rural central Uganda found that households with more land size and smaller household sizes are more food secure [23]. We found that there is no significant difference between female and male-headed households. Contrary to our findings studies in Tanzania and

Kenya revealed that female-headed households are less food secure compared to male-headed households [24,25]. Furthermore, a study conducted in South Africa found that the education of the head of household is associated with food security[26]. A study in the Oromiya region of Ethiopia revealed that education level, access to credit, livestock holdings, and land holdings were associated with food security[27]. There is another similar result from a cross nations study in Nepal, Malawi, Tanzania, Uganda, and Madagascar revealed that wealth index is associated with household food security[28]. studies in Pakistan identified similar results, indicating that the education level of head of household and family size are associated with food security[29,30]. A study from central America similarly found that education is associated with food security[31].

However, poverty status is the main factor to influence the food security situation. Our study revealed that there is a significant improvement for both poor households and the wealthiest households in food security. While poor households that were food secure shift from 59.1% (2012) to 68.7% (2018) and wealthiest households shift from 87.1% (2012) to 97.6% (2018). Furthermore, our results suggest the importance of owning a vegetable garden/plot to reduce the burden of food insecurity, livestock possession, and family planning, owning land size, access to credit, and education level of head of household are necessarily suitable to handle the challenges that prohibit the citizens to fight against food insecurity.

Moreover, there are different policies, programs, and strategies set to improve food security as well as to eradicate poverty in Rwanda. These policies/strategies including National Strategy for Transformation/NST1, Vision 2020 Umurenge program /VUP established in 2008, Strategic Plan for the Transformation of Agriculture/PSTA established in 2004[9,32–35]. Signs of socio-economic transformation have emerged as the labor force moves from agriculture to higher productivity services and industry[9]. These are expected to increase household income as well as improvement in food security. Additionally, both improvement in formal education, adult literacy program, and technical and vocational education to address the limited education of current heads of households, may also help to prevent the continuation of these gaps among them[9,36].

There are particular programs for vulnerable households including VUP and Girinka that were designed to support poor families to improve their food security situation as well as to eradicate poverty. VUP contains different components including direct support that provides unconditional monthly cash transfers, Expanded Public Works that provides part-time employment, Asset

transfers providing small livestock, agricultural inputs, small-scale agricultural processing equipment, and small equipment for off-farm micro-enterprise development. Also, through its component of financial support with a microcredit scheme, it provides small loans at low-interest rates to individuals or groups. While the Girinka program providing one cow per family that brings nutrition, providing a stable income and manure to assist small scale cropping activities. Further, to curb the food insecurity burden on children, the government distributes food and vitamin supplements using Fortified Blended Food (FBF), one Cup of milk per child, to those already affected by malnutrition. It works with the private sector to increase the surface of consolidated and irrigated land and promote agricultural mechanization [9]. Besides, there is a promotion of the kitchen garden approach with smallholder farming households as one of the key programs along with others to address food insecurity and chronic malnutrition in Rwanda [37].

To enhance food production, MINAGRI initiated ICT for Rwanda Agriculture (ICT4RAg) a Strategy that can permit the optimized application of inputs, thereby reducing the adverse impacts of agriculture on the environment. This can help to enhance efficiency in food production and obtain higher outputs for lower inputs. In addition, some basic information is provided through ‘smart nkunganire system’ which helps farmers to access inputs and e-soko which is a market price system, they are both targeting improvement in small and large-scale agricultural production and increase linkage to remunerative markets through ICT, thus leading to improved food security[38]. It will be essential to set a strong monitoring system that can validate the accuracy and progress of these policies and initiatives to mitigate the food insecurity issues in Rwanda.

There were several limitations to this study. Some key variables have been modified and others removed over the period. Moreover, datasets have more similar variables computed for different purposes which require to be vigilant during the data cleaning process. The data collected in CFSVA contains only information from families living in households, not for homeless and refugees. This may lead us to underestimate the food security trend. Almost the data collected are self-reported by respondents themselves, there is no way to confirm whether it reflects the real current situation of a household.

This study did not include all potential factors such as household income, remittance, rainfall satisfaction index, distance to market, and the main road, market price, and transportation cost. For further analysis, there is a need for experimental or panel data analysis with all those specified

potential variables to explore deeply trend and the factors associated with food security for better informing policymakers and different programs underway to curb food insecurity.

4. Conclusion

Historically, Rwanda faced food shortages and a high rate of malnutrition among children aged less than 5 years, which has been causing stunting. A trend showed that poor families are found to be mostly exposed to food insecurity with marginal improvement from 2012 to 2018.

This is mainly due to the continued hike in the prices of commodity products which is caused by the increased number of consumers on the local market. In addition to that, a considerable portion of local food production has been exported to DRC, which erodes the food stocks in the country.

It is important to note that some rural and urban families have limited knowledge in preparing a balanced diet. This has also led to the malnutrition.

Our study provides strong results to inform policymakers that though some progress has been made, food insecurity is still rampant for low-income households and this trend is likely to continue if the local production of food commodities or the import of good quality but low price food commodities are not availed. In addition to that, the government should also consider using subsidies and other incentives to lower the price of commodities.

Through government programmes like the National Strategy for Transformation (NST1), emphasis has been put on development of agricultural sector, which will improve the level of food security. In addition to that, the Sustainable Development Goal 2 (Zero Hunger), though it is difficult to achieve in the foreseeable future, it is hoped that food security will be significantly improved in the coming years.

BIBLIOGRAPHY

- [1] WB 2017 World Bank, End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- [2] FAO, IFAD, UNICEF, WFP and WHO 2020 The State of Food Security and Nutrition in the World 2020
- [3] FAO 2017 *Regional Overview Food Security and Nutrition Report 2017 Africa The food security and nutrition-conflict nexus: building resilience for food security, nutrition and peace* (Accra, Ghana)
- [4] NISR 2020 *Rwanda Demographic and Health survey* (Kigali, Rwanda)
- [5] WFP 2020 *Rwanda Country Brief, September 2020*
- [6] World Vision 2014 *Addressing Food Insecurity in Rwanda* (Australia)
- [7] Minecofin 2019 *Rwanda Voluntary National Review (VNR) Report* (Kigali, Rwanda)
- [8] FAO 2016 *Rwanda Country Fact Sheet on Food and Agriculture Policy Trends, Country situation and role of agriculture*
- [9] MINECOFIN 2017 *The Republic of Rwanda 7 Years Government Programme: National Strategy for Transformation (NSTI)* (Kigali, Rwanda)
- [10] Obayelu A E 2012 Households' food security status and its determinants in the North-Central Nigeria *Food Econ.* **9** 241–56
- [11] Sekhampu T 2013 Determination Of The Factors Affecting The Food Security Status Of Households In Bophelong, South Africa *Int. Bus. Econ. Res. J.* **12** 543
- [12] Oduniyi O S and Tekana S S 2020 Status and Socioeconomic Determinants of Farming Households' Food Security in Ngaka Modiri Molema District, South Africa *Soc. Indic. Res.* **149** 719–32
- [13] NISR and WFP 2018 Rwanda 2018 Comprehensive food security and vulnerability analysis 1–152
- [14] Eigenbrod C and Gruda N 2015 Urban vegetable for food security in cities. A review

- Agron. Sustain. Dev.* **35** 483–98
- [15] Popp J, Petó K and Nagy J 2013 Pesticide productivity and food security. A review *Agron. Sustain. Dev.* **33** 243–55
- [16] USAID 2014 *Assessment of the Economic, Social, and Environmental Impacts of the Land Use Consolidation Component of the Crop Intensification Program in Rwanda Final Report*
- [17] Ellen S and Rhonda S 2015 *Impacts of family planning on food security* (Washington, DC: Futures Group, Health Policy Project)
- [18] Gill T, Kaeser A, Ader D, Urban E and Bucyana T 2019 *Determinants of Household Food Security in Musanze District, Rwanda* vol 6
- [19] Napoleon N J, Mung'atu J K, Marcel N, Felix H, Christophe G and Dieu H jean de 2016 Modeling key determinants of the household food security in Rwanda: Probit regression approach *Int. J. Math. Phys. Sci. Res.* **4** 85–94
- [20] Bolarinwa O D, Ogundari K and Aromolaran A B 2020 Intertemporal evaluation of household food security and its determinants: evidence from Rwanda *Food Secur.* **12** 179–89
- [21] Nsabuwera V, Hedt-Gauthier B, Khogali M, Edginton M, Hinderaker S G, Nisingizwe M P, Tihabyona J D D, Sikubwabo B, Sembagare S, Habinshuti A and Drobac P 2016 Making progress towards food security: Evidence from an intervention in three rural districts of Rwanda *Public Health Nutr.* **19** 1296–304
- [22] Nkomoki W, Bavorová M and Banout J 2019 Factors Associated with Household Food Security in Zambia *Sustainability* **11** 2715
- [23] Semazzi J B and Kakungulu M 2020 Household determinants of food security in rural Central Uganda *African J. Agric. Res.* **16** 1245–52
- [24] Kassie M, Wagura Ndiritu S and Shiferaw B 2012 Determinants of Food Security in Kenya, a Gender Perspective *AgEcon search/Research Agric. &Applied Econ.* 31
- [25] Mason R, Ndlovu P, Parkins J R and Luckert M K 2015 Determinants of food security in

- Tanzania: gendered dimensions of household headship and control of resources *Agric. Human Values* **32** 539–49
- [26] Grobler W C J 2015 The Determinants Of Urban Food Security: Insights From A Low Income Neighborhood In South Africa *Proc. Int. Acad. Conf.*
- [27] Habtewold T M 2018 Determinants of Food Security in the Oromiya Region of Ethiopia : *Heshmati A., Yoon H. (eds) Economic Growth and Development in Ethiopia. Perspectives on Development in the Middle East and North Africa (MENA) Region.* (Springer, Singapore) pp 39–65
- [28] Hjelm L, Mathiassen A and Wadhwa A 2016 Food and Nutrition Policy Measuring Poverty for Food Security Analysis: Consumption-Versus Asset-Based Approaches *Food Nutr. Bull.* **37** 275–89
- [29] Abdullah, Zhou D, Shah T, Ali S, Ahmad W, Din I U and Ilyas A 2019 Factors affecting household food security in rural northern hinterland of Pakistan *J. Saudi Soc. Agric. Sci.* **18** 201–10
- [30] Ahmed U I, Ying L, Bashir M K, Abid M and Zulfiqar F 2017 Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan ed F Mertens *PLoS One* **12**
- [31] Alpízar F, Saborío-Rodríguez M, Martínez-Rodríguez M R, Viguera B, Vignola R, Capitán T and Harvey C A 2020 Determinants of food insecurity among smallholder farmer households in Central America: recurrent versus extreme weather-driven events *Reg. Environ. Chang.* **20** 1–16
- [32] RGB 2018 *Assessing Girinka program(2006-2016). citizen perspectives* (Kigali, Rwanda)
- [33] NISR 2018 *National Institute of Statistics of Rwanda (NISR), VUP Report* (Kigali, Rwanda)
- [34] Minaloc and Minecofin 2007 *Government of Rwanda Vision 2020 Umurenge An Integrated Local Development Program to Accelerate Poverty Eradication, Rural Growth, and Social Protection EDPRS Flagship Program Document*

- [35] MINAGRI 2018 *Planning for Wealth, Ministry of Agriculture and Animal Resources republic of Rwanda* (Kigali, Rwanda)
- [36] MINEDUC 2008 *Technical and Vocational Education and Training (TVET) policy in Rwanda* (Kigali, Rwanda)
- [37] Sommers P and Schalkwijk L 2017 *Kitchen Garden Guidelines, agriculture technical assistance facility*
- [38] MINAGRI 2016 *ICT for Rwanda in agriculture/ ICT4RAg Strategic Plan (2016-2020)* (Kigali, Rwanda)