RFS

ISSN 2695 6462

ESTUDIOS

Who are and where are the Rwanda's poorest? A Small Area Estimation Method

Mongongo Dosa Pacifique[1], **Rutagarama Ephrem**[2]

Abstract: As Rwanda is achieving its vision of moving from a low to a middle–income country during the period 2000–2020, its capability of ending poverty along the Sustainable Development Goals' era (2015–2030) mostly depends on how well the increasing prosperity will be shared among Rwandans along the way up to the 2030 horizon. Knowing those who have not yet benefited enough from the ongoing progress should help Rwanda's policy makers and other development agencies to serve that purpose. With this perspective, this work has the two major objectives of estimating poverty by sector and studying the relationship between poverty and related variables in Rwanda. We tackle the first objective with the Small Area Estimation method (SAE) and covers the second with the Poisson regression. We find that (1) most of the very poor are located within rural areas, (2) live in larger households and, (3) have female household heads.

Key words: *Rwanda, Sustainable Development Goals, poverty mapping, Small Area Estimation Method.*

Fecha de recepción: 27 de enero de 2019.

Fecha de admisión definitiva: 13 de noviembre de 2019.

[1] Associate Professor, Université Nouveaux Horizons, Faculté des Sciences de Gestion. Associate Researcher, Universidad de Cantabria, Cátedra de Cooperación Internacional con Iberoamérica.

[2] Master of Science in Economics, University of Kigali, School of Postgraduate Studies.

¿Quiénes son y dónde están los más pobres de Ruanda? Un método de estimación en áreas pequeñas

Resumen: A medida que Ruanda va logrando su visión de pasar de ser un país de ingresos bajos a ser un país de ingresos medios durante el periodo 2000-2020, su capacidad de erradicar la pobreza a lo largo de la era de los Objetivos de Desarrollo Sostenible (2015-2030) depende principalmente de lo bien que se reparta la creciente prosperidad entre los ruandeses en el camino hacia el 2030 como horizonte. Para que los responsables de las políticas de Ruanda y otros organismos de desarrollo puedan cumplir este propósito, sería de utilidad saber quiénes son los ruandeses que aún no se han beneficiado lo suficiente de los progresos en curso. Con esta perspectiva, este trabajo tiene los dos objetivos principales de estimar la pobreza por sector y estudiar la relación entre la pobreza y variables relacionadas en Ruanda. Empleamos el método de Estimación en Áreas Pequeñas (EAP) para abarcar el primer objetivo y cubrimos el segundo con la Regresión de Poisson. Encontramos que (1) la mayoría de los ruandeses más pobres se encuentran en áreas rurales, (2) viven en familias más grandes y (3) tienen a una mujer como cabeza de familia.

Palabras clave: *Ruanda, Objetivos de Desarrollo Sostenible, mapas de pobreza, Método de Estimación en Áreas Pequeñas.*

Qui sont et où sont les plus pauvres du Rwanda ? Une méthode d'estimation pour petites surfaces

Résumé: Alors que le Rwanda est en train de réaliser sa vision de passer d'un pays à faible revenu à un pays à revenu intermédiaire au cours de la période 2000-2020, sa capacité à mettre fin à la pauvreté à l'horizon des objectifs de développement durable (2015-2030) dépend principalement de la manière dont la prospérité croissante sera partagée entre les Rwandais en cours de route jusqu'à l'horizon 2030. Le fait de connaître ceux qui n'ont pas encore suffisamment bénéficié des progrès en cours devrait aider les décideurs politiques et les autres agences de développement du Rwanda à servir cet objectif. Dans cette perspective, ce travail a deux objectifs majeurs: estimer la pauvreté par secteur et étudier la relation entre la pauvreté et les variables connexes au Rwanda. Nous abordons le premier objectif avec la méthode d'estimation par secteur (SAE) et couvrons le second avec la régression de Poisson. Nous constatons que (1) la plupart des très pauvres sont situés dans les zones rurales, (2) vivent dans des ménages plus grands et, (3) ont des femmes chefs de ménage.

Mots clé: *Rwanda, Objectifs de Développement Durable, cartographie de la pauvreté, Méthode d'Estimation des Petites Zones.*

1. Introduction

Drawing on the new *2030 Agenda for Sustainable Development*, "eradicate extreme poverty for all people everywhere" is the first of the 17 *Sustainable Development Goals* (SDG). This was solemnly stated by the world's heads of state in the 2015 UN General Assembly's Declaration:

> *We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries; […]. We resolve also to create conditions for sustainable, inclusive and sustained economic growth, shared prosperity and decent work for all, taking into account different levels of national development and capacities"* (UN 2015: 6).

Despite being a promising global commitment to promoting development, is the goal of eradicating poverty realistic and achievable in a 15–year period? Many analysts find that it is not overambitious as it has been previously proven by the *Millennium Development Goals* (MDG), which successfully contributed to halve the average number of people living in extreme poverty (see, among others, ODI, 2015 and Sachs, 2015).

However, given the huge disparities in regional achievements and the differences in poverty levels across and within developing countries, such a generalisation may be misleading. In particular, one could reasonably wonder whether such a positive forecast is valid for a region such as Sub–Saharan Africa (SSA).

Recent investigations have found that at least SDG1 is feasible in developing regions including SSA provided that, as implicitly stated in the above–mentioned UN general assembly declaration, higher international solidarity compensates for cross and within–country poverty disparities (Mongongo, 2016; Fosu, 2015; ODI, 2015; UN, 2015; Sachs, 2015, Pinkovskiy and Sala–i–Martin, 2014, Tezanos, 2013). However, like these studies, most investigations have extensively conducted cross–country poverty analysis but very few –mostly within the World Bank's research framework– have elaborated on within country poverty disparities. Among them, the pioneering work of Albers et. al. (2003) proposed the Small Areal Estimation (SAE) method to assess within–country poverty distribution and successfully checked its statistical and economic explanatory power using data from Ecuador.

With the support of the United Kingdom's Department for International Development, Ghana statistical service took the lead in western and central Africa and applied the SAE method to map poverty. Later on, with the Belgian Poverty Reduction Partnership Support and that of the Bank Netherlands Partnership Program, 15 countries –including Rwanda– joined the mapping initiative (Coulombe and Wodon, 2007). Even though the initiative allowed Rwanda to gather necessary data and map poverty, the analysis has been relatively general and; thus, did precisely identify and locate the Rwanda's poorest citizens (NISR, 2017). Therefore, this paper complements the NISR's mapping with a SAE analysis aiming not only at locating the poorest but also and especially at identifying them precisely.

As Rwanda took so sufficiently advantage of the MDGs' era that it is achieving its initial vision of moving from a low to a middle–income country during the period 2000–2020 (Ministry of Finance and Economic Planning, 2019), its capability of ending poverty by 2030 mostly depends on how well this increasing prosperity is being shared among Rwandans. Hence such an investigation of the socio–geographical distribution of poverty is crucial and timely. With this perspective, this paper has the two major objectives of estimating poverty by sector and studying the relationship between poverty and related variables. While we tackle the first objective with the Small Area Estimation method (SAE), we cover the second with the Poisson regression.

The remainder of this paper is structured as follows. **Section 1** elaborates on Rwanda' performance along the MDGs' era. **Section 2** presents the analytical model and analyses poverty at province and district levels using census data. **Section 3** investigates poverty at sector level applying the SAE methods. The paper ends with a conclusion underlying our major finding and the subsequent policy recommendation.

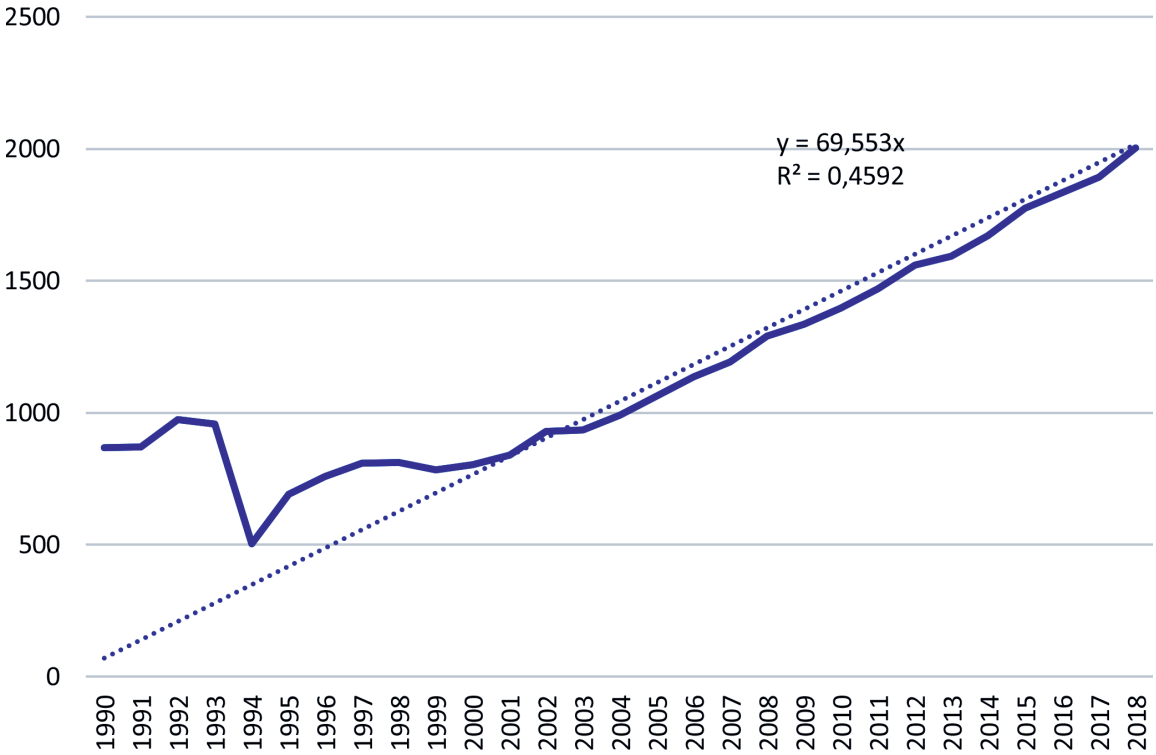
2. Rwanda's performance along the MDGs' era

This section provides an overview of Rwanda's economic development with special focus on the period 2000–2015. The first Sub–section elaborates economic progress and the second on the poverty and income distribution issues.

2.1. Economic progress

Rwanda launched in 2000 a 20–years development programme known as Vision 2020. Moving from a low to a middle–income country and reducing poverty significantly were among the major targets. While in year 2000 Rwanda had a GDP per capita of 803.37 dollars (in PPP), in 2015 it was already slightly above 1600 and reached 2003 in year 2017 (Figure 1). On average, Rwanda has been adding 69.553 dollars on its GDP per capita since year 2000. Rwanda is definitely becoming a middle–income country as planned in year 2000 (Ministry of Finance and Economic Planning, 2019). It is worth noting that the increasing trend fits nicely GDP data since year 2000. Between years 1990 and 2000, figure 1 depicts a decreasing trend. As a matter of facts, this expansion is happening since the implementation of the Vision 2020.

FIGURE 1. **Dynamic of per capita GDP (USD, Constant, PPP, 2011)**



Source: World Bank (2019).

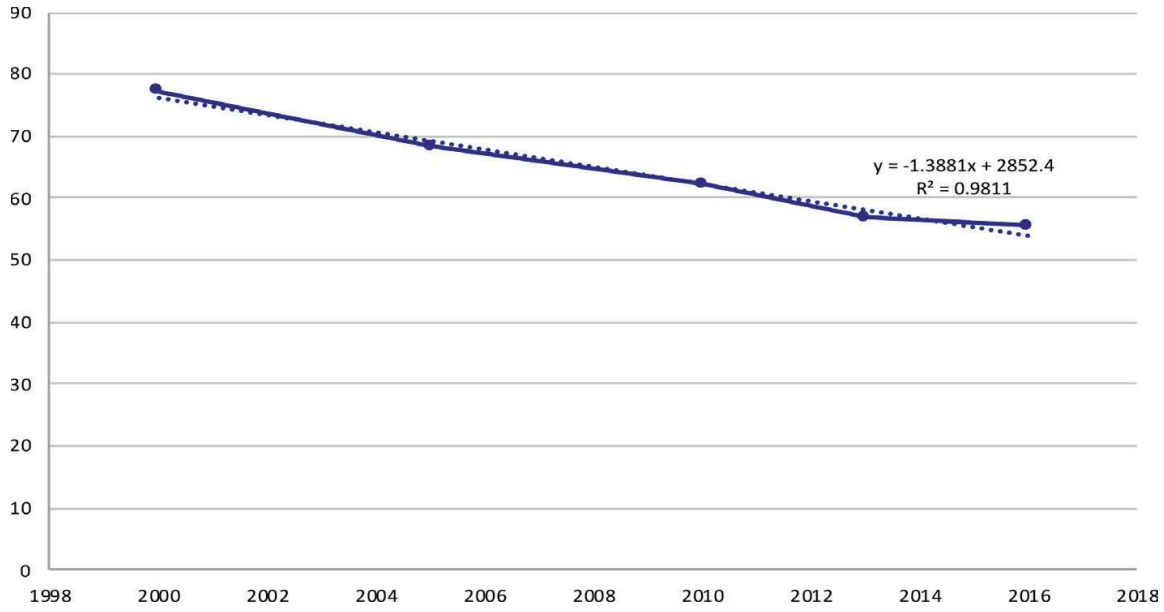
2.2. Poverty and income distribution

Besides GDP expansion, the number of the poor has been decreasing since the implementation of the MDGs and the Vision 2020. However, as illustrated on Figure 2, poverty has been falling with a slower pace than GDP expansion.

Figure 3 shows that GINI index increased between years 2000 and 2005. Since year 2005 it is decreasing. It decreased relatively faster during the period 2005–2010 than the period 2010–2017. The overall trend is decreasing but at a slower pace than per capita GDP and poverty head count ratio. This raises the inclusiveness issue.

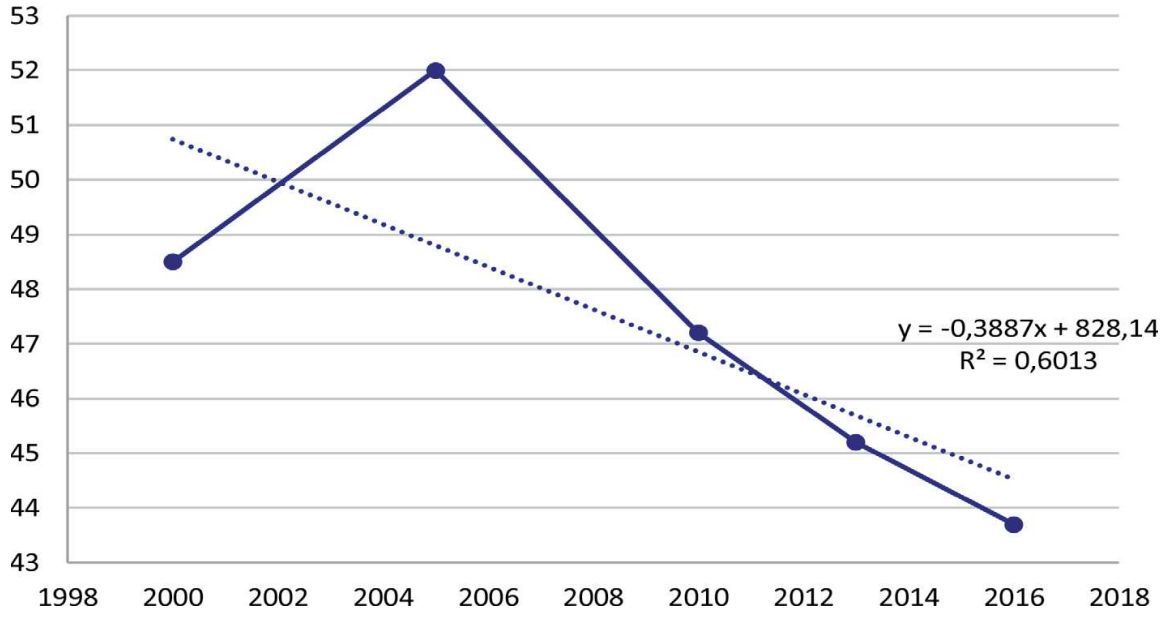
To make this increasing GDP more inclusive, policy makers and development actors have to know those who have not yet benefited enough from the ongoing economic progress. The integrated household living conditions survey (EICV3/2010–2011), Rwanda population housing census 2012 (RPHC4) provide the overall information. The following sections combine (EICV3/2010–2011) and (RPHC4)

FIGURE 2. **Poverty Headcount Ratio at $190 a day, 2011 PPP (% of population)**



Source: World Bank (2019).

FIGURE 3. **GINI Index (%)**



Source: World Bank (2018).

information within the SAE method analytical framework to determine and describe the poorest Rwandans at smaller geographical entities and relatively more accurately.

3. Methodology and data

3.1. Overview of the Small Area Estimation method

Small Area Estimation (SAE) is a family of statistical techniques estimating sub–population parameters using population parameters (Pfeffermann, 2002). Sub–populations sample sizes are too small to provide direct estimators with acceptable accuracy. SAE methods borrow strength from related areas through linking models based on auxiliary data such as census to come up with indirect estimators with acceptable accuracy (Jiang et al., 2011). EICV3/2010–2011 and RPHC4 are the main auxiliary data retained in this paper.

Methodologically, it is not realistic to keep the Ordinary Least Squares (OLS) assumption of 'normal distribution of errors' within the SAE framework. We resort to the Generalized Linear Method (GLM) which relaxes the normality assumption. Drawing on the pioneering works of Albert et al. 2003 and Coulombe and Wodon, 2007, we use the Poisson Log–Linear specification to identify and locate the poorest:

$$\ln(y_j) = \beta_0 + \sum_{i=1}^{n} \beta_i x_i + \varepsilon \quad (1)$$

y_j is a variable which captures the households' poverty status. Each x_i are social or geographical variables, such as household head's sex, household head's age, household size, persons per room, residence area, which values are susceptible to impact on households' poverty status. Applying exponential transformation on (1) we get:

$$y_i = exp^{\beta_0 + \sum_{i=1}^{n} \beta_i x_i + \varepsilon} \quad (2)$$

To estimate (2) we need measurements of y_i and x_i.

3.2. Poverty measurement

We consider the official poverty line of 118000 RWF (Ministry of Finance and Economic Planning, 2019). The household whose consumption expenditure per adult equivalent is above 118000 RWF is considered as a non–poor household and poor if it is below 118000 RWF. Based on this threshold, the following table provides the geographical distribution of poverty computed using data respectively from the integrated household living conditions survey (EICV3/2010–2011) and Rwanda population housing census 2012 (RPHC4).

TABLE 1. **Geographical distribution of poverty by provinces**

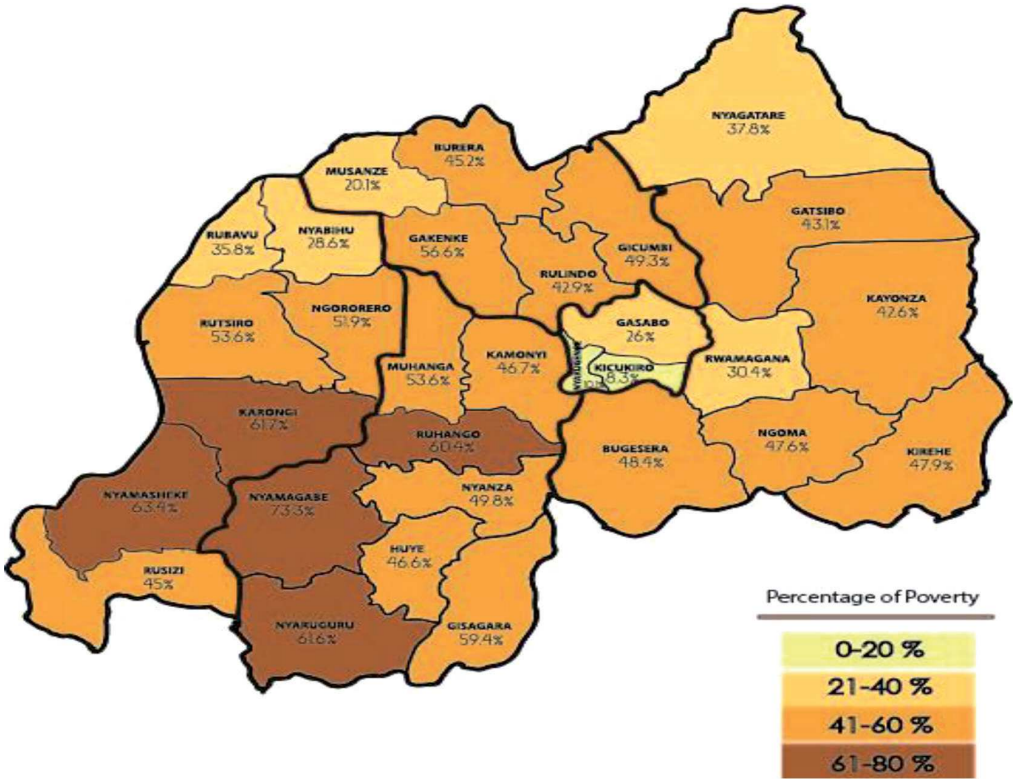
Provinces	% of poor people based on EICV3	% of poor people based on RPHC4
Kigali City	17.70	16.9
Southern Province	31.90	34.9
Western Province	37.50	38.8
Northern Province	36.70	33.4
Eastern Province	38.20	38.4
Rwanda	34.20	34.5

Source: Authors' elaboration based on NISR & EICV, 2011.

Table 1 pinpoints that Kigali city has the lowest percentage of poor people. It looks as an outlier given that other provinces have more or less twice its poverty rate. Map 1 extends poverty distribution at district level.

Map 1 suggests that poverty is concentrated in the south–west of Rwanda. Five districts in south–west have poverty rates ranging from 60% to 73% and have about 23% of the poor of the country. The better–off districts are the three districts of Kigali City (poverty is between 8% and 26% and the three districts in north–west of country (poverty is between 20% and 35%).

MAP 1. **Geographical distribution of poverty by districts**



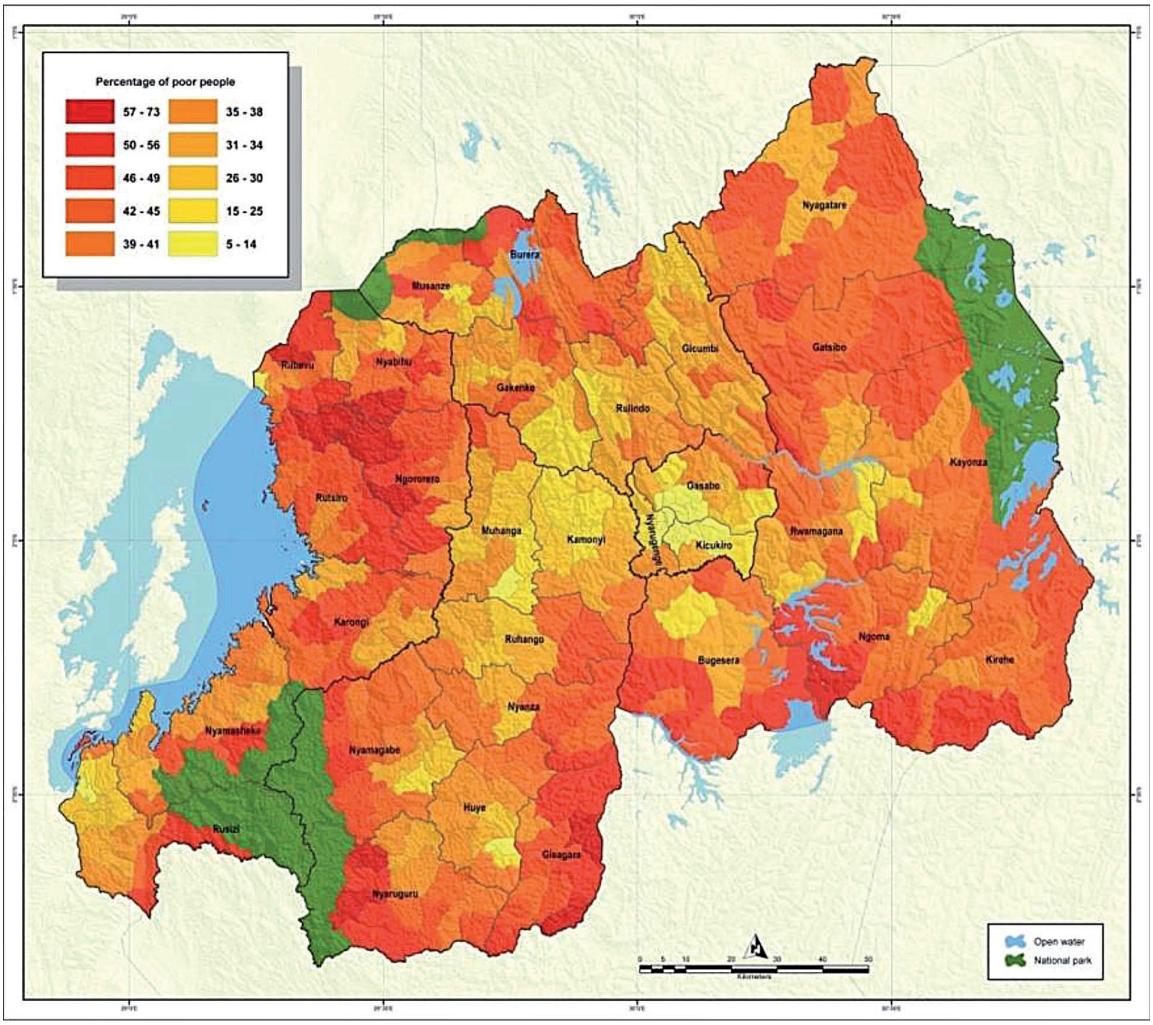
Source: EICV3.

4. Results

4.1. Poverty estimation at sector level

For economic and time constraints, EICV3 and RPHC4 could not detail poverty features at sector levels. We resort to the SAE method to locate, identify and describe poverty at sector level. We introduced and specified this method in the previous section. We practically use province and sector poverty features to get those of districts which are their respective statistical sub–populations. We use common variables from EICV3 and RPHC4 (in Eq. 1 and Eq. 2) to estimate sector–level poverty (in Eq. 1 and Eq. 2). Map 2 depicts the estimation outcome for all the 416 sectors spread in the 30 districts of the country.

MAP 2. **Geographical distribution of poverty by sector 2**



Source: EICV3 and RPHC4.

On Map 2, more color concentration indicates higher poverty rates. Table 2 presents the five poorest and five least poor sectors.

TABLE 2. **Poverty distribution by sector**

Five poorest sectors				
Sector (district)	**Non–poor (%)**	**Poor (%)**	**Total**	**Count**
Muhanda (Ngororero)	26	74	100	28247
Muringa (Nyabihu)	35	65	100	22876
Nyabirasi (Rutsiro)	37	67	100	28971
Gishubi (Gisagara)	37	67	100	24904
Nyabimata (Nyaruguru)	39	67	100	16953
Five least poor sectors				
Kicukiro (Kicukiro)	95.3	4.7	100	16450
Niboye (Kicukiro)	94.4	5.6	100	26197
Muhima (Nyarugenge)	94.3	5.7	100	29768
Rwezamenyo (Nyarugenge)	94.3	5.7	100	16763
Kimironko (Gasabo)	94	6	100	57430

Source: EICV3 and RPHC4.

Table 2 shows that the poorest sectors are in the districts belonging to the Western and Southern provinces. The least poor are all in Kigali City. This outcome is associated to different characteristics of household found in those sectors such as the household head's sex, age, marital status, education, economic activity, current employment and main occupation, type of household, type of habitat.

4.2. Relationships between poverty and household features

Table 3 provides the estimation of the impact of household features on the likelihood of being poor. It depicts the outcome of the GLM estimation under Poisson distribution with logarithmic link function as described in section 2. The estimation gives a negative intercept (β_o = −2.398). Negative estimates indicate that the associated variables decrease the likelihood of being poor and the other way around for positive estimates.

TABLE 3. **Poisson log–linear coefficients from the SAE**

Variables	Parameters	Coefficients	Standard Errors	P–Values
District	(Intercept)	–2.398	1.304	0.066
	Nyarugenge	–0.762	0.157	0.000
	Gasabo	–0.914	0.151	0.000
	Kicukiro	–0.693	0.158	0.000
	Nyanza	–0.876	0.142	0.000
	Gisagara	–0.642	0.134	0.000
	Nyaruguru	–0.004	0.111	0.972
	Huye	–0.006	0.112	0.954
	Nyamagabe	0.034	0.112	0.760
	Ruhango	–0.100	0.120	0.406
	Muhanga	0.002	0.112	0.985
	Kamonyi	–0.048	0.111	0.666
	Karongi	0.049	0.111	0.657
	Rutsiro	–0.124	0.113	0.273
	Rubavu	–0.052	0.111	0.643
	Nyabihu	–0.042	0.110	0.701
	Ngororero	–0.131	0.118	0.268
	Rusizi	–0.064	0.109	0.559
	Nyamasheke	–0.102	0.113	0.369
	Rulindo	–0.110	0.113	0.333
	Gakenke	–0.061	0.112	0.585
	Musanze	–0.148	0.113	0.192
	Burera	–0.010	0.106	0.927
	Gicumbi	–0.042	0.110	0.703
	Rwamagana	–0.009	0.107	0.935
	Nyagatare	–0.043	0.109	0.695
	Gatsibo	–0.034	0.107	0.749
	Kayonza	–0.083	0.108	0.442
	Kirehe	–0.032	0.110	0.771
	Ngoma	–0.086	0.112	0.443
	Bugesera	0[a]		

Type of habitat	Umudugudu	–0.001	0.209	0.996
	Unplanned clustered rural housing	–0.050	0.213	0.813
	Isolated rural housing	0.033	0.2121	0.877
	Unplanned urban housing	–0.079	0.217	0.716
	Agglomeration	–0.088	0.228	0.699
	Modern planned area	–0.428	0.302	0.156
	Other	0[a]		
Type of dwelling	A single house dwelling	–0.129	1.067	0.904
	A multiple household dwelling	–0.139	1.071	0.896
	Mulistoried building (flat) (3+4) (eicv4)	–0.193	1.1919	0.871
	Group of enclosed dwellings with multiple households	–0.156	1.0736	0.884
	Group of enclosed dwelling for single household	–0.045	1.0733	0.966
	Other	0[a]		
Current occupancy Status	Owner occupied	–0.041	0.451	0.928
	Tenancy (renting)	–0.021	0.479	0.965
	Dwelling provided by Employer	–0.131	0.455	0.774
	Dwelling provided free of charge	–0.048	0.524	0.927
	Temporary camp or settlement	–0.180	0.456	0.694
	Other	1.529	1.121	0.173
Type main source of water	Piped into dwelling	–0.250	0.260	0.337
	Piped into yard	–0.081	0.173	0.642
	Public standpipe	–0.031	0.161	0.845
	Borehole	–0.066	0.192	0.732
	Protected well	0.066	0.186	0.724
	Unprotected well	–0.140	0.189	0.460
	Protected spring	–0.004	0.162	0.980
	Unprotected spring	–0.002	0.166	0.992
	Rain water	0.197	0.262	0.452
	Tanker truck	0.471	0.735	0.522
	Surface water (river or lake)	0.014	0.164	0.931
	Other	0[a]		

Main source of Lightning in home	Electricity from EWSA	0.150	0.169	0.376
	electricity distributors	0.278	0.242	0.252
	Biogas	–0.703	0.835	0.400
	Generator	0.458	0.533	0.391
	Oil Lamp	0.125	0.156	0.424
	Firewood	0.022	0.158	0.887
	Candle	0.093	0.163	0.569
	Lantern (Agatadowa)	0.108	0.151	0.476
	Solar panel	–0.035	0.269	0.895
	Batteries+ Bulb	0.102	0.151	0.501
	Other (specify)	0[a]		
Primary source of cooking fuel	Firewood	0.315	0.358	0.379
	Charcoal	0.405	0.363	0.265
	Gas	0.489	0.896	0.585
	Biogaz	1.353	0.905	0.135
	Electricity	0.204	0.703	0.772
	Oil or kerosene	–27.161[b]		
	Crop waste	0.381	0.371	0.306
	Other	0[a]		
Mode of rubbish/ garbage disposal	Publicly managed refuse area	–0.378	0.467	0.418
	Rubbish collection service	–0.444	0.466	0.341
	Thrown in bushes or fields	–0.319	0.453	0.481
	Dumped in river or lake	–0.356	0.465	0.444
	Burnt	1.906	1.238	0.124
	Compost heap	–0.304	0.453	0.502
	Other	0[a]		
Type of toilet	Flush toilet	0.191	0.158	0.228
	Pit latrine with solid slab	0.013	0.075	0.861
	Pit latrine without slab	0.017	0.080	0.830
	Other	–28.766[b]		
	No toilet whatsoever	0[a]		
Have Internet connection	Yes	–0.052	0.094	0.580
	No	0[a]		
Mobile phone in household (yes/no)	Yes	0.065	0.034	0.057
	No	0[a]		

Main construction material of exterior wall	Mud bricks	0.253	0.211	0.232
	Mud bricks covered with cement	0.193	0.216	0.372
	Oven fired bricks	0.152	0.238	0.523
	Cement bricks	0.281	0.395	0.478
	Wooden planks	0.068	0.273	0.804
	Stones	–0.179	0.433	0.679
	Tree trunks with mud	0.224	0.212	0.291
	Tree trunks with mud and cement	0.115	0.222	0.607
	Other	0[a]		
Main floor material for dwelling	Beaten earth	–0.032	0.292	0.914
	Hardened dung	0.041	0.306	0.895
	Wooden floor	0.495	0.649	0.446
	Clay tiles	–0.054	0.401	0.894
	Cement	0.046	0.296	0.876
	Bricks	0.039	0.311	0.900
	Other	0[a]		
Sex of head of household	Male	–0.175	0.084	0.039
	Female	0[a]		
Household head worked for one hour in the last 7 days	Yes	0.037	0.079	0.639
	No	0[a]		
Economic Activity of Household head	Agriculture	–0.057	0.095	0.554
	Non–Agriculture	–0.069	0.096	0.478
	Not Applicable	0[a]		
Marital Status of Head of household	Married monogamously	0.283	0.091	0.002
	Married polygamous	0.224	0.105	0.034
	Living together	0.166	0.099	0.093
	Divorced	0.439	0.360	0.223
	Separated	0.032	0.084	0.705
	Single	–0.358	0.119	0.003
	Widow or widower	0[a]		

Highest diploma of household head	Primary completed	0.042	0.036	0.245
	Secondary common	0.111	0.119	0.351
	Post primary certificate	0.073	0.092	0.426
	Diploma A3, D5, D4	0.079	0.203	0.698
	Humanities Diploma	0.045	0.118	0.707
	Bachelors	–0.114	0.266	0.668
	Professional license	–0.049	0.187	0.791
	Engineer	0.279	0.518	0.590
	Masters +	–0.020	0.318	0.950
	Not applicable	0[a]		
Insurance provider of household head	RAMA	–0.031	0.110	0.781
	Mutual insurance	0.007	0.034	0.845
	Employer	–0.799	0.477	0.094
	MMI	–0.020	0.169	0.908
	Other insurance	–0.003	0.199	0.990
	None	0[a]		
Number of rooms used for sleeping	Rooms	0.093	0.022	0.000
Floor area of the dwelling (square meters)	Area in m2	0.000	0.000	0.836
Age of head of household	Age in years	–0.002	0.001	0.048
Household size	Size in m2	0.170	0.010	0.000
Persons per room	Persons/ Room	0.149	0.027	0.000

Source: EICV3/2010–2011 and RPHC4.

- Residence area: the districts of Kigali City estimates are statistically significant while almost all districts in other provinces are statistically insignificant. It implies that the residents of the districts of Kigali city are less likely to be poor than those living in districts belonging to other provinces.

- Households head sex: the households headed by males (β= –0.175) are less likely to be poor than those headed by females (β= 0.000). The households headed by females are statistically significant (P–value: 0.039).

- Number of rooms used for sleeping: the households with many rooms for sleeping are less likely to be poor. It is statistically significant where (P–value: 0.000).

- Household head's age: the household with head having the working age are less likely to be poor than those whose age is below the working age, where (β=–0.002 and P–value: 0.048).

- Household size: the household size decreases the likelihood of being poor. Its estimate is positive and statistically significant (β=0.170 and P–value: 0.000).

- Persons per room: The Number of persons in the household rooms does not increase the likelihood of being poor. Its estimate is positive and statistically significant (β=0.149 and P–value: 0.000). This implies households with higher number of persons are less likely to be poor.

As major finding, these results indicate that poverty in Rwanda is concentrated in villages, the very poor live in larger households and very often have female household heads. It is worth noting that our work is one among many works which used the SAE to obtain reliable estimates of poverty features in small areas. Among many other examples in Africa, the Statistical Services of Ghana (2000 and 2015), Uganda (2018) and South Africa (2018) used the same approach to map poverty and came up with similar results: poverty is concentrated in rural areas, larger families and being female or being in a household supported by a female increases the likelihood of being among the very poor. SAE method has been applied to many other studies of poverty and inequality distribution in other continents. For Georgia, the world bank's 2019 results indicate more poverty in municipalities and showed that very poor municipalities were close to each other. Chandra et. al. (2018) analysed the case of the Indian state of Bihar and, once again, found similar results and underlined that their findings can be used by policy makers to allocate social budget in favour of those disadvantaged people. Likewise, we believe that our findings can draw more attention and resources of local, national and international development agents those who our finding have identified as very poor.

5. Conclusion

Recent investigations have found that at least SDG1, end poverty in all its forms everywhere, is feasible in developing regions including SSA provided that higher international solidarity compensates for cross and within–country poverty disparities. However, most of those investigations have extensively conducted cross–country poverty analysis but very few–mostly within the World Bank's research framework–

have elaborated on within country poverty disparities. Among them, the pioneering work of Albers et.al. (2003) proposed the Small Areal Estimation (SAE) method to assess within–country poverty distribution and successfully checked its statistical and economic explanatory power using data from Ecuador.

Applying this method to analyse Rwanda's poverty distribution is particularly interesting and timely. As data shows that Rwanda is achieving its vision of moving from a low to a middle–income country during the period 2000–2020, its capability of ending poverty along the Sustainable Development Goals' era (2015–2030) mostly depends on how well the increasing prosperity will be shared among Rwandans along the way up to the 2030 horizon. Knowing those who have not yet benefited enough from the ongoing progress should help Rwanda's policy makers and other development agencies and actors to serve that purpose. With this perspective, our work has targeted the two major objectives of estimating poverty by sector and studying the relationship between poverty and related variables in Rwanda. It has tackled the first objective with the Small Area Estimation method and covered the second with the Poisson regression.

The results point out that poverty is concentrated in rural areas. The poorer live in larger families and often have female household heads doing traditional agriculture. This result suggests to those in charge of both the Sustainable Development Goals and the new Rwandan National Plan for Economic Transformation special efforts, attention and resources for them to make sure they are not left to their fate and, consequently, behind the world's vision of ending poverty by 2030. To fellow researchers, it suggests further investigations on the best ways of enabling them to catch up.

6. References

Albers, C., Lanjouw, J. O., Lanjouw, P. (2003): "Micro–level estimation of poverty and inequality", *Econometrica*, 71(1), pp. 355–364.

Chandra, H., Aditya K., Sud U. C. (2018): "Localised estimates and spatial mapping of poverty incidence in the state of Bihar in India–An application of small area estimation techniques", *Plos ONE,* 13(6): e0198502.https//doi.org/10.1371/journal.pone.0198502.

Coulombe, H., Wodon, Q. (2007): *Combining census and household survey data for better targeting: The West and Central Africa Poverty Mapping Initiative*, Findings Africa Region No. 280, The World Bank, Washington, D.C.

Fosu, K. A. (2015): "Growth inequality and poverty in Sub-Saharan Africa", *Oxford Development Studies,* 43(1), pp. 44-59.

Ghana Statistical Service (2015): *Ghana poverty mapping report*, Publication & Sales unit.

Jiang, J., Nguyen, T., Rao, J. S. (2011): "Best predictive small area estimation", *Journal of the American Statistical Association,* 106, pp. 732-745.

Ministry of Finance and Economic Planning (2019): *Revised Version of Vision 2020,* http://www.minecofin.gov.rw/index.php?id=148&L=132, consulted last time on the 2nd November 2019.

Mongongo, P. D. (2016): "On the measurement and use of equality weighted growth", *Iberoamerican Journal of Development Studies,* 5(2), pp. 126-139.

National Institute of Statistics of Rwanda (NISR): *Poverty Mapping Report*, 2013/14; May 2017.

Overseas Development Institute (2015): *Combining finances and policies to implement a transformative post-2015 development agenda,* European Report on Development 2015, European Commission's online publication, http://ecdpm.org/wp-content/uploads/2015-European-Report-on-Development-English.pdf (accessed for the last time on September 14, 2018).

Pfeffermann, D., (2002): "Small area estimation: new developments and directions", *International Statistical Review,* 70(1), pp. 125–144.

Pinkovskiy, M., Sala–i–Martin, X. (2014): "Africa is on time", *Journal of Economic Growth,* 19(3), pp. 311–338.

Sachs, J. (2015): *The age of sustainable development,* Columbia university press, New York.

Statistics South Africa (2018): *Poverty Mapping in South Africa*, Stats SA Library Cataloguing–in–Publication (CIP) Data.

Tezanos, S., Quiñones, A., Guijarro, M. (2013): "Inequality, aid and growth: Macroeconomic impact of aid grants and loans in Latin America and the Caribbean", *Journal of Applied Economics,* 16(1), pp. 153–177.

Uganda Bureau of Statistics (2018): *Poverty Maps of Uganda,* Technical report.

United Nations (2015): *Transforming our world: the 2030 Agenda for Sustainable Development,* A/RES/70/1

World Bank (2018): *World Development Indicators,* www.worldbank.org, consulted last time on the 25th October 2018.

— (2019): *Poverty Mapping in Georgia*, ECA Poverty and Equity Global Practice, World Bank.