
Household Vulnerability and Poverty in the Bikoro Territory in Democratic Republic of Congo: Analysis of the Macro and Microeconomic Shocks of the 2018 Ebola Epidemic

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Abstract: On May 8, 2018, the Democratic Republic of Congo officially declared the occurrence of the ninth episode of Ebola Virus Disease in the territory of Bikoro, Equateur province. This epidemic has caused enormous damage to the province's economy and also to the standard of living in households. The deterioration in the economic fabric has led to inflationary pressures, weakened the capacity to mobilize tax revenues and increased the potential risks to the viability of public finances at provincial level. Further more, it has seriously threatened food security and plunged many already vulnerable households into extreme poverty. Overall, the slowdown in economic activity in all sectors resulting from the combined effects of the fall in aggregate demand and the demobilization of factors of production will lead to: a fall in the overall supply of products, particularly agricultural products, with a consequent increase in food insecurity; a reduction in wage and non-wage household incomes and a worsening of poverty. Tax revenues have also fallen, worsening the public deficit and debt sustainability. The scarcity of basic products has fueled speculation on the market, leading to high price inflation and even the destabilization of the macroeconomic framework at provincial level. Material and monetary poverty, the sector of activity and high household size are the main determinants of poverty. The impact of the epidemic has affected agricultural production and, ultimately, household income. The reallocation of household expenditure is eloquent proof of vulnerability.

Keywords: Epidemic, Ebola, Poverty, Vulnerability, Incidences, Households, Market

1. Introduction

The province of Equateur is a small economy based on agriculture and forestry, with over 80% of the population dependent on fishing and agriculture [1-3]. The loss of harvests and agricultural production due to the shock of the Ebola epidemic is expected to have a negative impact on household income, food security, employment, poverty and household purchasing power (due to higher prices resulting from the scarcity of products on the market), reversing the

development gains of previous years and jeopardizing the prospects for development and achieving the sustainable development goals (SDGs) by 2030. [4-5]. The erosion of household incomes and savings due to the increased cost of food, other household expenses and health care during the epidemic is expected to lead to a decline in aggregate household consumption, particularly by poor households. Meanwhile, the uncertainties and restrictions imposed on businesses will cause them to reduce or postpone their demand for local and imported inputs during this period, as

well as their non-essential investments. This fall in aggregate demand (consumption, investment, industrial inputs, etc.) will force businesses (industrial, small-scale local producers, peasant farmers) to adjust their working hours and/or reduce their workforce, further affecting production in all the economic sectors mentioned above. In the same vein, the fall in aggregate demand should also have a negative effect on imports, and that of production factors (particularly in the outward-looking sector) on exports. Alongside these cyclical economic effects, there are also longer-term structural economic effects [6]. Worsening poverty, combined with food insecurity, the relocation of businesses and the lack of economic opportunities for households in the absence of post-Ebola support policies, will drive young people (aged 15-49) and other working people to migrate to the major urban centers [7-8, 11]. Also, the disarticulation of the economic system in general, and the application of new, more secure production practices and standards will change and impact the labor market, reduce private investment, and modify production and consumption patterns, in a long-term perspective. The direct and indirect effects of the EVD shock on households will be felt through several channels. Firstly, the sharp rise in mortality and morbidity, which causes considerable loss of life, usually in the most productive segment of the working population, and puts severe pressure both on household incomes and on the healthcare system and its resources. Secondly, financial and human resources from the Government and partners earmarked for other infectious diseases and social programs are being diverted to fund the fight against the epidemic. This diversion affects the national capacity to fight other endemic diseases (malaria, chikungunya, tuberculosis, yellow fever, HIV, etc.) and to fund other vital health services such as the expanded program on immunization and antenatal care. Beyond the health sector, social services and support for vulnerable people could also be affected. The same applies to certain community programs aimed at the rural poor [9-12].

2. Methodology

This study uses a mixed-method approach, inspired by the United Nations Economic Commission for Africa (UNECA) in 2014, the World Bank and the United Nations Development Program (UNDP) [13-17]. This approach combines descriptive analysis of statistical data provided by the National Institute of Statistics and the public services of Equateur province, as well as data from the post-Ebola household survey, coupled with a logit-type econometric model.

3. Results

3.1. Macroeconomic Impacts

Macroeconomic impacts are assessed through the repercussions of the epidemic on: (i) economic growth prospects; (ii) economic activity and production; (iii) cross-

border and local trade; (iv) price fluctuations; and (v) public finances. The impact of the epidemic on: (i) economic growth prospects; (ii) economic activity and production; (iii) cross-border and local trade; (iv) price fluctuations; and (v) public finances.

3.1.1. Impact on Economic Growth Prospects

The Ebola epidemic has not had a perceptible impact on the country's economic growth prospects. Estimates of the country's economic growth rate based on the situation at the end of September 2018 remained virtually unchanged from those at the end of March 2018. The estimated economic growth rate for 2018 stood at 4.14% at the end of September 2018 compared with 4.2% at the end of March 2018, a slight decline of 0.06 growth points. At sectoral level, the impact of the Ebola virus disease assessed in terms of contribution to growth for the dominant sectors and economic branches of the Equateur province economy, namely agriculture and manufacturing, is very low compared with the other sectors. Agriculture saw a slight decline of 0.06 percentage points in growth, from 0.3 percentage points at the end of March 2018 to 0.24 percentage points at the end of September 2018. The same applies to the contribution of the secondary sector, which fell from 0.7 growth points to 0.37 points, a drop of 0.33 growth points. These slight declines in growth can be explained by the underperformance seen in the main agricultural export products, of which the province of Equator is one of the country's leading producers. These include cocoa, coffee and palm oil, where cumulative national production in the first three quarters of 2019, compared with the same period in 2018, fell by 11.9% for cocoa, by 1.4% for logs and rose slightly by 2.7% for palm oil. This low level of impact of the EVD on growth prospects can be explained by a combination of factors, namely the province's low contribution to the country's GDP and the short period of persistence of the epidemic.

Table 1. Growth forecasts for the DRC in 2018 (in growth points).

Business sector	Estimates		Variance
	March	September	
GDP growth (at constant prices)	4.2	4.14	-0.06
Sector contributions			
Primary sector	2.4	3.58	+1.18
Agriculture	0.3	0.24	-0.06
Mining	2.1	3.34	+1.33
Secondary sector	0.7	0.37	-0.33
Tertiary sector	1.5	0.45	-1.05
Product taxes	-0.4	-0.26	+0.14

3.1.2. Impact on Economic Activity and Production

The EVD epidemic wiped out the province's production structures and led to a drop in output and economic activity. The drop in export production has dampened the province's main sources of economic growth. Production of the main export products fell drastically, especially forestry and agricultural exports, notably cocoa and coffee, which are grown in the epicenter of the epidemic in Bikoro. During this period, the quantity of declared timber fell by 90%, as did the production of cocoa (-33%), coffee (-25%) and 25% (-12%).

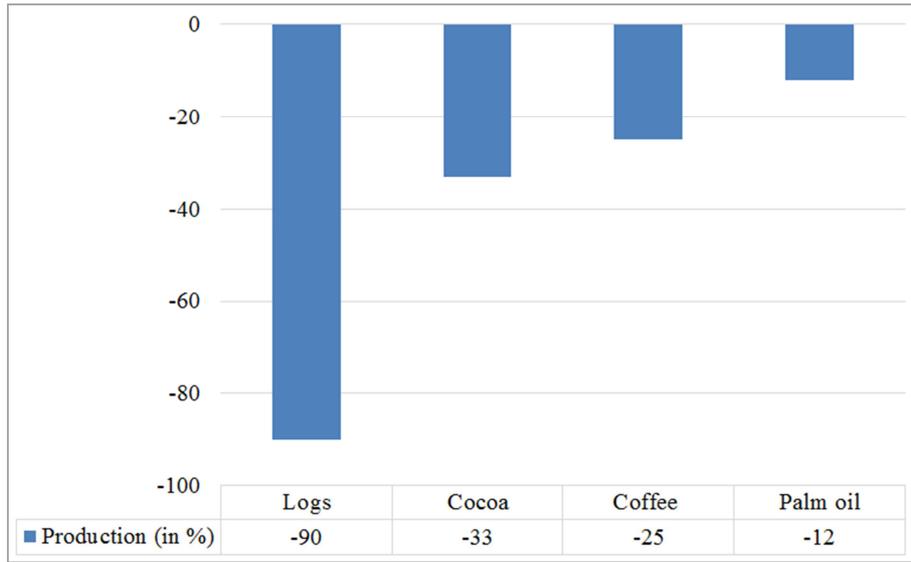


Figure 1. Decline in main export products during Ebola.

The decline in activity in the transport sector has paralyzed trade and the mobility of goods and people. The EVD has reduced the vital role played by transport in the province's economy. The transport of goods and the movement of people have been affected on all routes - air, river and road. The impact of the EVD on the tourism sector has also been mixed, as this sector is underdeveloped and under-exploited

in Equateur province. At the start of the epidemic, there was a drop-in hotel activity, with losses of up to 60% of monthly turnover due to the suspension of travel or the confinement of the affected territory. On the other hand, there was a spectacular recovery in the tourism sector when the response teams arrived, which put pressure on hotel supply.

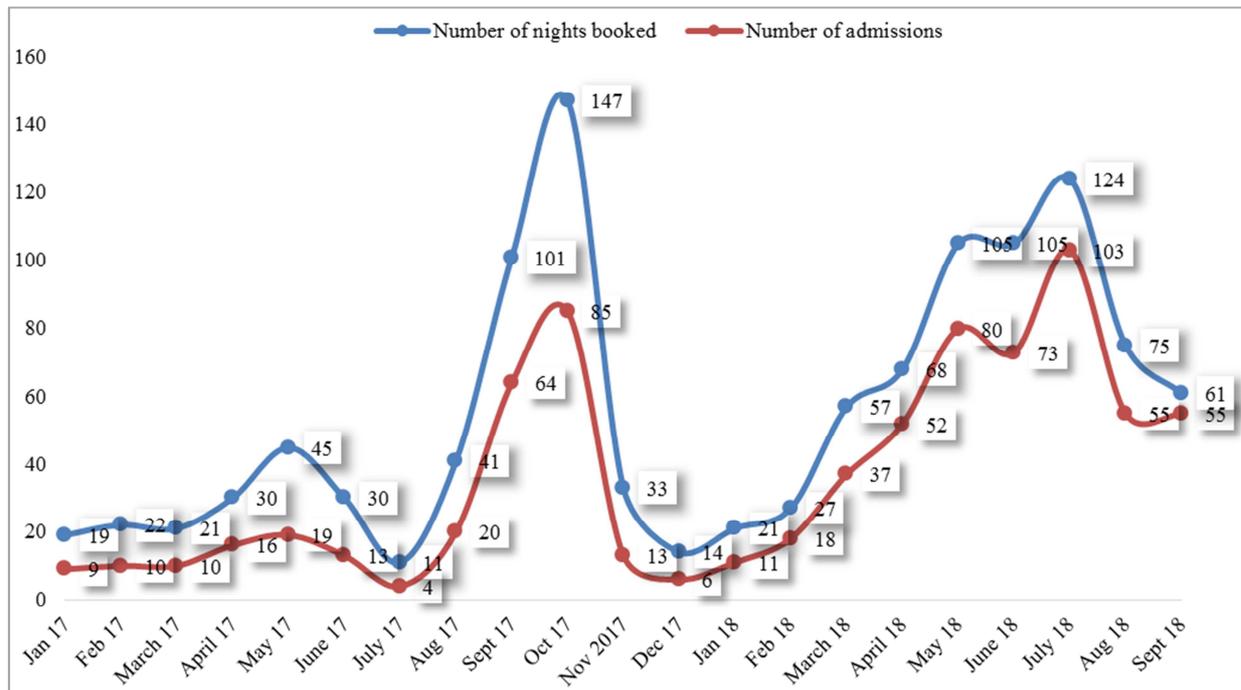


Figure 2. Impact of the epidemic on hotel business.

3.1.3. Impact on Cross-Border and Local Trade

EVD has profoundly affected trade, reducing its capacity to facilitate trade and its role as an engine of economic growth. The decline in turnover and loss of trade flows in all

cross-border and local markets is estimated at nearly 10% of provincial GDP. The losses in trade flows are around 60 to 80% for cross-border markets and 50 to 65% for local markets.

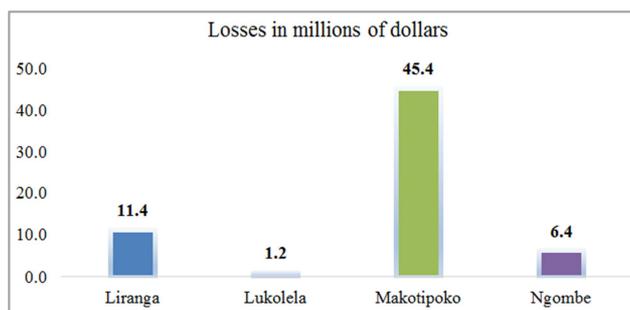


Figure 3. Loss of trade flows in cross-border markets during Ebola.

3.1.4. Impact on Price Fluctuations

The shock of the EVD led to a significant rise in prices and high volatility during the epidemic. This deteriorated livelihoods and reduced household purchasing power, thereby increasing the vulnerability of poor households. To capture the rise in prices, we considered a basket of 24 staple food items drawn from the 42 products generally used by the National Institute of Statistics (INS), which account for almost 70% of the household budget. An analysis of price trends for the main staple food products reveals two contrasting trends, as follows:

- a) sharp price rises for cereal products (starchy foods), smoked fish and vegetables;
- b) a drop in bushmeat products, miscellaneous products and fuel products, particularly firewood and charcoal.

Overall, price fluctuations were more marked for food than non-food products. The prices of local foodstuffs (cassava, local rice, plantains, etc.) have risen considerably, in contrast to imported or non-essential products (imported rice, wheat flour, onions, charcoal, etc.), because during the epidemic people are more concerned with basic products than non-essentials. These variations in the prices of the main products following the Ebola shock can be explained by the law of supply and demand on the one hand, and income and substitution effects on the other, the main factors: the disruption of production activities, the closure of borders and quarantine measures in the affected area of Bikoro, the drop in trade and cross-border trade, and the resulting depreciation in the exchange rate of the national currency, as well as budgetary pressures.

3.1.5. Impact on Public Finances: Weakened Capacity to Mobilize Tax Revenues and High Risk of Budgetary Unsustainability

The Ebola epidemic has had a major impact on budgetary resources, leading to a deterioration at the level and viability of provincial public finances. The weakening of economic production capacity, particularly in the main economic sectors (agriculture, forestry, the agri-food industry, transport, trade, etc.), has led to a reduction in budget revenue mobilization capacity, pressure to increase operating expenditure at the expense of investment expenditure, and the province's exposure to an increase in public debt and the risk of over-indebtedness. The onset and persistence of the epidemic have led to a fall in the province's tax revenues. Compared with their level in the second quarter of 2018, the province recorded significant revenue shortfalls, with a fall of almost 35% in the

second quarter of 2019 in provincial taxes and fees collected by the Provincial Revenue Office of Ecuador, 27% in revenues collected by the Provincial Department of Administrative, State and Participation Revenue and 25% in provincial customs revenues for the same period.

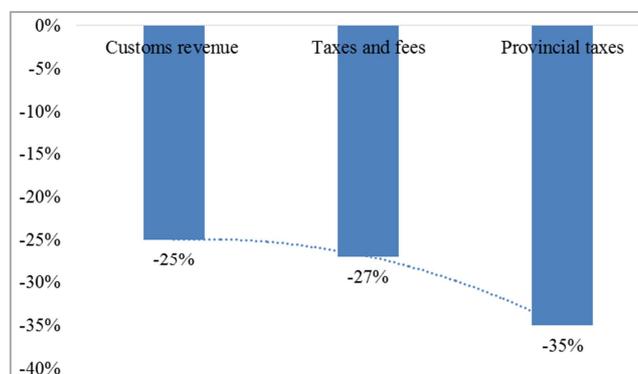


Figure 4. Loss of tax revenue during the epidemic.

3.2. Microeconomic Impacts

The microeconomic impacts of the EVD is assessed using five indicators: (i) loss of household income; (ii) food insecurity; (iii) difficulties in accessing basic social services; (iv) employment; and (v) poverty. At household level, the survey shows that the EVD has had major socio-economic effects. The loss of production and productivity in the short and medium term due to the considerable slowdown in economic activity has had very negative effects on household income, food security and employment, with corollary adverse effects on children's school performance and access to health services. In addition, the econometric estimation of the risk of poverty highlights several microeconomic determinants that explain the vulnerability of households to the shock of the EVD, and confirms a high risk of households in Bikoro falling into extreme poverty.

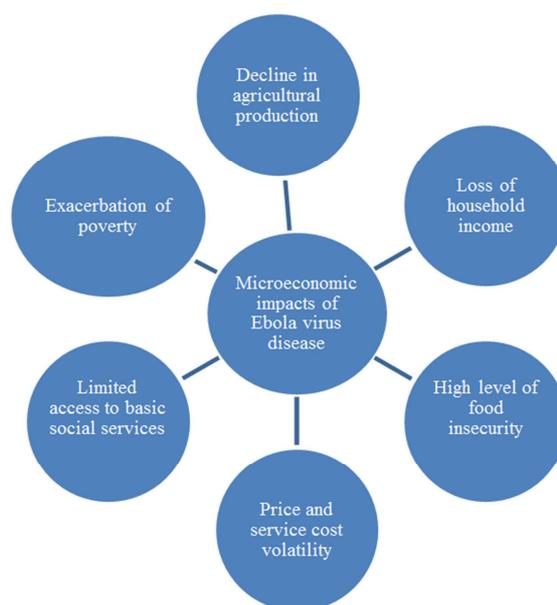


Figure 5. Microeconomic impacts of EVD.

The microeconomic results obtained shed additional light on the macroeconomic results noted above, and corroborate the disastrous consequences of the EVD on the short, medium and long-term development prospects of the country, the province and the affected communities. So, in addition to the health response, the Government and its development partners are being called on to support the affected communities and territories in the medium and long term, with a view to creating the conditions for their return to the path of sustainable development.

3.2.1. Loss of Household Income

Household income sources are not very diversified. In recent decades, there has been a sharp decline in the number of wage earners, with the closure of several agropastoral businesses. The survey clearly showed that, during the Ebola period, household income fell sharply in Bikoro territory compared with the pre-Ebola period, with a sharp drop for farming households (-55%) and traders (-42%). For the same income, some characteristics such as household composition, number of members and household size have a direct impact on the standard of living. In absolute terms, during Ebola, households in Bikoro territory as a whole, with an average size of around 6.6 people, reported an estimated average monthly income of CDF 37,944 or CDF 1,264.8 per person per day (USD 0.77), well below the poverty line set internationally at USD 1.9 (CDF 3,097) per day.

3.2.2. Food Insecurity

The effects of EVD on food insecurity during the epidemic can be explored through several channels [18-20], including: the drop in agricultural production; the drop in food reserves; the availability of food on local markets; and the variability of commodity prices.

a) The fall in agricultural production

The drop in production has had a serious impact on households' ability to meet their food requirements, both in terms of quantity and quality, with adverse effects on children and the elderly. To cope with this drop in agricultural production, households have changed their eating habits (almost completely replacing imported foodstuffs with local products and have reduced the number of meals they eat each day (an average of one meal a day instead of three previously).

b) Falling food reserves

Household food reserves in Bikoro territory were dangerously depleted during the epidemic, resulting in high levels of food insecurity faced by households. The proportion of households with food reserves before and during the outbreak of the Ebola epidemic was just 8.1%. After the epidemic, the same situation of food insecurity was observed in the same proportions in the territory of Bikoro. This situation simply reveals dysfunctions and disruptions in the traditional agricultural production chain, justifying the drop in production and therefore in household food reserves in Bikoro territory.

c) Food availability on the local market

Households that are able to resort to products sold on the

local market remain unsatisfied for a number of reasons. Faced with a shortage of the usual products for local consumption as a result of the drop in agricultural production, households are having difficulty coping with the high price of substitute food products because of their low income and low purchasing power. Humanitarian aid, for its part, has not been able to respond satisfactorily to make up the shortfall. Just over two out of ten households (23.6%) in the Bikoro area reported that basic products were available on local markets.

d) Variability in commodity prices

During the epidemic, the average price of the main food and manufactured products rose sharply. This pressure on commodity prices is thought to be the result of the imbalance between supply and demand for products on the market and the restrictions on movements both within the country and on inland waterways. These have drastically eroded household purchasing power and led to widespread food insecurity.

Table 2. Structure of household expenditure.

Expenditure structure	During outbreak	After outbreak
Nutrition	91.6%	93.3%
Health care	3.4%	3.3%
Children's schooling	1.0%	1.6%
Other expenses	4.0%	1.8%
Total	100.0%	100.0%

3.2.3. Difficulties in Accessing Basic Social Services

a) Access to education: sharp rise in the cost of schooling for children

Through its negative effects on the education sector (school closures, pupil and teacher absenteeism, dropping out of school altogether, etc.), the Ebola epidemic can have a long-term adverse effect on human capital training and labour productivity. Although short-lived but very severe, the ninth episode of the EVD has hit the education sector in Equateur province hard through the rise in schooling costs, against a backdrop of a drastic fall in household incomes as a result of the drop in agricultural production, their main source of income. Households considered school costs to be high during the epidemic, with around 80% of households surveyed judging the cost of sending children to school to be very high during the Ebola period.

b) Access to health services: fall in the cost of health services during Ebola, but less than the fall in income

During the outbreak of the epidemic, health care costs per household per month fell significantly compared with the pre-epidemic period, before rising slightly in the post-epidemic period. This positive indicator is merely a misleading embellishment that is the result of the incentive measures adopted during the response (free consultations, provision of medicines and inputs, etc.) to rapidly contain the epidemic and avoid any risk of it spreading to neighbouring territories. These incentives require significant financial investment. Given the lack of resources to support this policy, these incentives for access to basic healthcare were short-lived, given the short duration of the pandemic, thanks to the funding provided in large part by the DRC's technical and

financial partners. Immediately after the official end of the pandemic, the upward trend in costs was clearly perceptible. However, despite the fall in medical costs, household access to healthcare has remained limited to a specific package of care. Household income has fallen so dramatically that the fall in healthcare costs will not have had as noticeable an impact. Further more, apart from the drugs used to prevent and combat Ebola, which were paid for by the government and technical and financial partners, the other drugs used to combat endemic diseases (malaria, tuberculosis, etc.) were not subsidised. Only one out of five households interviewed in the period before and after Ebola reported that essential medicines had been disrupted in the health facilities in Bikoro and the surrounding area.

3.2.4. Employment

Just as concretely, 80% of households said they had reduced their daily working hours by almost 70% during the

epidemic. This is a real demobilization at the expense of agricultural production. Several other factors led to a reduction in the daily working time of farmers, including the collapse in demand, restrictions on the mobility of people and goods, the postponement or cancellation of agricultural production activities, and so on. All this has led to a fall in employment and in the total productivity of the provincial economy. The exact extent of this decline has not been quantified, due to a lack of reliable statistical data.

3.2.5. Poverty

The effects of the EVD on household income poverty remain glaring and multidimensional. Firstly, the population is poor. Secondly, average household incomes are very low, below the poverty thresholds. Finally, there are income disparities that confirm the inequalities between households. Given this varied profile, the risk of post-Ebola extreme poverty is also highly varied, depending on a number of factors.

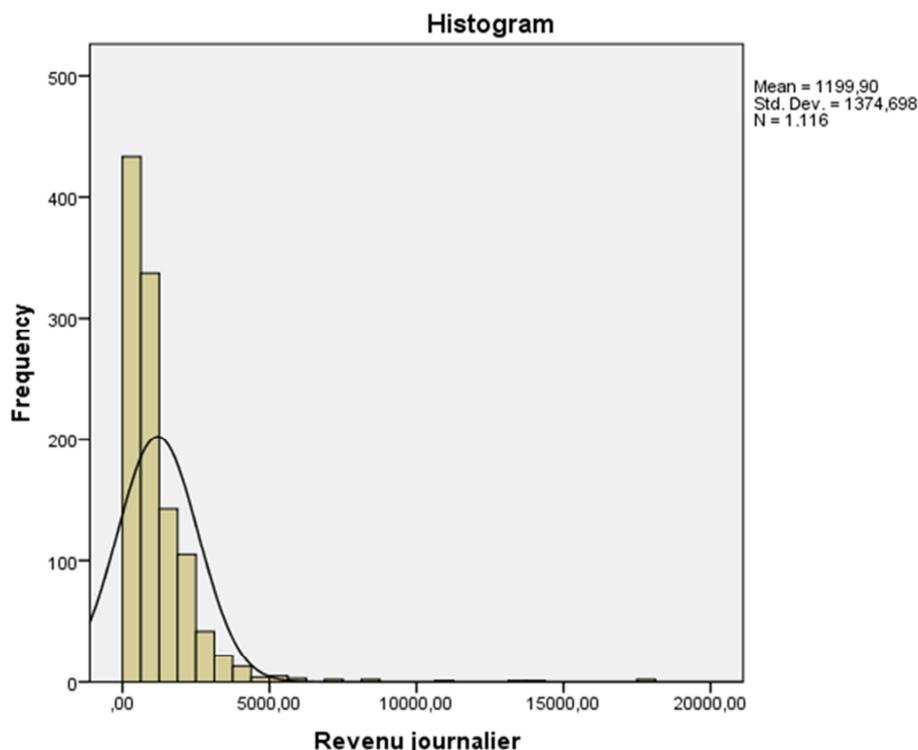


Figure 6. Daily household income.

Available statistics show that Equateur province is one of the poorest in the DRC [21-22]. The incidence of poverty is very high (78.6%). The economy is heavily dependent on the primary agricultural sector, which employs more than 80% of the working population. The shock of the EVD should therefore naturally expose households in Equateur in general, and those in the Bikoro area in particular, to the risk of deepening poverty. Survey data shows that average daily household income in the post-Ebola period fell to CDF 1190 (USD 0.743) per day per household, three times below the internationally agreed extreme poverty line (USD 1.9 /day). The survey also showed that the incidence of post-Ebola poverty was around 73%, compared with a

provincial average of 78.6% and a national average of 63% [23-24]. This high level of poverty is certainly a reflection of the province's lagging development, but also and above all of the impact of the Ebola pandemic on household income and livelihoods. It is in this context that an assessment of the risk of impoverishment of households in these two areas is estimated, using logistic regression. This risk is analyzed using 6 predictors or microeconomic factors that explain (post-Ebola) poverty, in particular household standard of living as captured by housing comfort, household size as estimated by the total number of children, the activity of the head of household, income from the sale of agricultural products, trends in foodstuffs and

basic manufactured goods, and the structure of expenditure. The general model described in the equation below provides an estimate of the risk of post-Ebola poverty, based on the microeconomic determinants that explain post-Ebola poverty. The Z value classifying the household according to whether or not it is exposed to the risk of post-Ebola poverty depends on the value of the intercept or the level of an average household (calculated by estimation), increased by the effects of living conditions and housing comfort (WI), the number of people or household size (Taillmen), the activities of the head of household (Activit_{CM}), the volume of sales and consequent income (Ventes), the perception of price trends (Evolut_{prtx}), and the type of expenditure made (Depenses). The model to be estimated is specified as follows:

$$z = 8,414 - 2,878 WI + 2,094 Taillmen - 0,978 Activit_{CM} + 0,095Ventes + 0,217 Evolut_{prtx} + 0.589 Depenses$$

Analysis of the results of the estimates of household

poverty and vulnerability shows that:

1. Material poverty, as measured by the level of housing comfort, exposes the members of these households to the direct and indirect effects of EVD, compared with households considered to be non-poor.
2. The professional occupation of the head of household is also a factor that differentiates the risk of post-Ebola extreme poverty. In relative terms, according to the regression estimates, households and shopkeepers are respectively 10 and 5 times more at risk of poverty than wage-earning households.
3. Within households, the risk of post-Ebola extreme poverty varies according to the level of income from the sale of agricultural and other products, both on the local market and elsewhere in nearby towns. This raises the question of the fragility of these communities, which are traditionally dependent on certain primary agricultural products that are vulnerable to external shocks (bushmeat, subsistence farming, etc.).

Table 3. Estimation the risk of poverty in post-Ebola households according to different characteristics.

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Exp(B)	Exp(B)	Exp(B)	Exp(B)	Exp(B)	Exp(B)
Predictors _1						
Standard of living quintile						
Low	51.250**	402.966**	425.225**	470.758**	550.550**	618.656**
Medium	12.608**	64.317**	60.483**	65.585**	70.622**	83.888**
High (reference)	1.000	1.000	1.000	1.000	1.000	1.000
Predictors _2						
Household size						
Low (1-4)		0.014**	0.0900**	0.009**	0.007**	0.005**
Medium (5-8)		0.407**	0.307**	0.319**	0.292**	0.268**
High (9 and +) (reference)		1.000	1.000	1.000	1.000	1.000
Predictors _3						
Occupation of Head of Household						
Agriculture			2.001 ^{ns}	2.240*	2.259*	2.179 ^{ns}
Civil servant			0.299*	0.302**	0.274**	0.261**
Small business (reference)			1.000	1.000	1.000	1.000
Predictors _4						
Sales						
Low				1.012 ^{ns}	1.039 ^{ns}	0.986 ^{ns}
High				0.217**	0.254**	0.282**
Not precise (reference)				1.000	1.000	1.000
Predictors _5						
Price trend						
Decreased					0.496**	0.456**
Unchanged					1.339 ^{ns}	1.096 ^{ns}
Increased (reference)					1.000	1.000
Predictors _6						
Post Ebola income allocation						
Food						0.757 ^{ns}
Health care						1.768 ^{ns}
Children's schooling						8.231 ^{ns}
Other expenses (reference)						1.000

Legend: ***: p<0.01; **: p<0.05; *: p<0.10; ^{ns}: not significant

4. Conclusion

The Ebola shock directly affected agricultural production and, ultimately, household income. The reallocation of household

expenditure is evidence of vulnerability. The reconsideration of the status of civil servants (regular salaries and mechanization), the revival of agro-pastoral businesses, the opening up of tracks and the strengthening of trade, and access to microfinance are all possible solutions for community support. Similarly, low

incomes cannot cover the needs of household members. This situation is all the more noticeable in large households with a large number of members, particularly children. Girls' access to schooling and women's access to sexual and reproductive health predispose them to greater participation in the domestic economy and at community level. Several lessons can be drawn from these results. The most important is that, in addition to the Ebola health crisis, household poverty has deepened. If the first is overcome by a vigorous response, the second reconstitutes the focus of the new re-emergence of the pandemic. Within the natural focus of the Ebola virus, households are quite often poor, with high-risk practices and habits. Sustainable interventions and efficient policies require resources to be mobilized to prevent this scourge rather than always responding to emergency imperatives. The official end of EVD is only really a victory if it is followed by the provision of care for extremely poor households.

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Conflicts of Interest

The authors declare no conflicts of interest.

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