HiLL PUBLISHING

Scientific Access, 2026, 2(1), 29-34
https://www.hillpublisher.com/journals/sa/
ISSN Online: 3068-7500

Analysis of Determinants of Maize Cultivation Profitability Among Farmers in Fizi (South Kivu, DRC)

Jeanine Ndihokubwayo[1,*], Abdalah Riziki Dunia[2], Victor Barantota[3], Fariji Bonane[2], Nkorukwishaka Rebecca[2], Nkeshimana Barnissade[4], Ndikumana Janvier[4]

[1]Department of Administrative and Economic Sciences, Hope Africa University, Bujumbura 238, Burundi.
[2]Master in Community Development, Hope Africa University, Bujumbura 238, Burundi.
[3]Department of Educational Sciences, Hope Africa University, Bujumbura 238, Burundi.
[4]Master in Public International Law, Hope Africa University, Bujumbura 238, Burundi.

How to cite this paper: Jeanine Ndihokubwayo, Abdalah Riziki Dunia, Victor Barantota, Fariji Bonane, Nkorukwishaka Rebecca, Nkeshimana Barnissade, Ndikumana Janvier. (2026) Analysis of Determinants of Maize Cultivation Profitability Among Farmers in Fizi (South Kivu, DRC). *Scientific Access*, 2(1), 29-34.
DOI: 10.26855/sa.2026.03.004

Received: January 25, 2026
Accepted: February 27, 2026
Published: March 31, 2026

[*]**Corresponding author:** Jeanine Ndihokubwayo, Department of Administrative and Economic Sciences, Hope Africa University, Bujumbura 238, Burundi.

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Abstract

This investigation assesses the socioeconomic and technical determinants of maize cultivation profitability among 373 farmers in Fizi (South Kivu, DRC). A cross-sectional survey was conducted across five groupings in the Mutambala sector, followed by a statistical analysis comprising descriptive statistics and multiple linear regression. Principal constraints on profitability were identified as restricted access to agricultural credit (59%), low availability of improved seeds (45%), pressure from devastating diseases (39%), and climatic disruptions (60%). The econometric model reveals positive and significant effects of training, agricultural extension, and financial resources on revenues, whereas education level exerts no significant impact. With an R2R^2R2 of 0.29, unobserved structural factors influence farm performance. These findings underscore the imperative to enhance credit access, agricultural extension, and adoption of improved varieties to elevate profitability and local food security.

Keywords

Agriculture; poverty; food security; profitability

1. Introduction

Situated between 1°36’ and 5° south latitude and 26°47’ and 29°20’ east longitude, South Kivu province, particularly Fizi territory, possesses undeniable agricultural assets and extensive arable lands. Its pluviometric characteristics and vast plains and plateaus favor agricultural production. Fizi territory exhibits substantial agricultural potential, encompassing 34,700 km², of which 86.6% constitutes arable soil (30,050.2 km²); maize cultivation occurs year-round across the entire territory (mid- and high plateaus as well as plains) [1].

Furthermore, advances in poverty reduction have not equated to economic and social equality, indicating that economic growth over recent decades has failed to effectively address exclusion. For instance, the poorest populations have observed no improvement in livelihoods over the past 30 years. While inter-country inequality has declined, intra-country disparities between rural and urban areas, as well as between males and females, have widened [2].

Agriculture remains the cornerstone of rural African economies and the primary income source for rural inhabitants. In 2010, the agricultural sector accounted for 54.2% of Africa's active population, compared to 54.4% in East Asia, 13.5% in South Asia, 65% in least-developed countries, and 40.6% globally [3].

Maize cultivation thrives in diverse environments and soil types but yields optimal results on well-drained, deep, loamy soils rich in plant nutrients and organic matter. Annually, maize ranks as the most produced cereal worldwide, with approximately 850 million tons harvested from 162 million hectares, yielding an average of 5.2 t/ha. The United States and China dominate production, contributing 37% and 21% of global output, respectively [4].

The agricultural sector is universally acknowledged as possessing the greatest potential for poverty alleviation and combating food insecurity. Enhanced understanding of agricultural value chains constitutes a foundational step for in-depth reflection on Congolese agriculture, long subjected to adverse effects of armed conflicts, sectoral disorganization, financing shortfalls, and climatic perturbations [5].

Agriculture serves as the principal lever for rural poverty reduction in African contexts [6]. In the DRC, agro-ecological potential is substantial, yet yields remain low [7]. In South Kivu, maize constitutes a strategic crop for local food security. Human capital theory posits that investments in training enhance productive efficiency [8]. Moreover, studies on agricultural innovation indicate that adoption of improved varieties hinges on credit access and extension services [9, 10].

1.1 Materials and Methods

The study was conducted in the Mutambala sector. A sample of 373 farmers was selected using the Raosoft formula [11] from an estimated population of 12,400 maize farmers, per territorial inspection reports for Fizi. A cross-sectional survey employed a structured questionnaire. Data were analyzed via SPSS 22, utilizing descriptive statistics and multiple linear regression to evaluate the effects of socioeconomic and technical variables on maize-derived revenues.

2. Conceptual Definitions

2.1 Maize Cultivation

Maize constitutes a summer crop with growth occurring during the hottest periods of the year. Water stress must be avoided during flowering and the fertilized flower development stages. Maize roots are relatively fine and superficial, lacking the capacity to access deep water reserves [12]. Maize is an annual herbaceous tropical plant of the Poaceae family, widely cultivated as a cereal for its starch-rich grains and as forage. Per Katsaka, maize ranks among the three most demanded grasses globally; its grains, consumed fresh or dry, serve human alimentation and animal feed (as provender, forage, or silage; 40-60 t/ha green matter harvestable at the "dough grain" stage).

2.2 Poverty

Per [13], poverty encompasses multiple dimensions of deprivation linked to the inability to meet human needs, including consumption, food security, health, learning, rights assertion, secure and dignified living, and decent work. Poverty alleviation also aligns with environmental protection and sustainable development imperatives, alongside the reduction of gender inequalities across dimensions. The World Bank (2010) characterizes poverty as hunger, homelessness, untreated illness, illiteracy, unemployment, future uncertainty, and day-to-day survival. Poverty manifests variably by location and time, representing a call to action for adequate food, shelter, education, healthcare, violence protection, and community voice.

2.3 Food Security

Food security prevails when all individuals, at all times, physically, economically, and socially have access to sufficient, safe, and nutritious food to meet energy and nutritional needs for active, healthy lives. This 1996 FAO-endorsed definition insists on four dimensions: availability (sufficient production and supplies), access (economic and physical), utilization (nutritional quality and hygiene), and stability (resilience to shocks like crises or climate variability). It emphasizes individuals over national stocks, distinguishing from mere productive self-sufficiency [14, 15].

2.4 Agricultural Profitability

Agricultural profitability denotes a farm's capacity to generate sufficient, sustainable income post-deduction of all costs (inputs, energy, labor, equipment). It quantifies economic performance by relating realized or anticipated revenues to engaged resources, differentiating economic profitability (over total capital, financing-independent) from financial profitability (over equity capital) [16].

3. Results and Discussion

Table 1 indicates a minimum respondent age of 18 years, a maximum of 80 years, a mean of approximately 35 years, and a standard deviation of 13.5. The standard deviation, as a dispersion measure, quantifies age variability; the average inter-respondent age difference is at least 13.5 years. The population exhibits youthfulness and diversity, with predominance in the 26-30 years cohort (28%), consistent with African rural dynamics featuring reduced urban migration among young adults. The standard deviation of 13.5 reflects moderate age dispersion, typical of agricultural households where seniors remain active [17]. This aligns with rural South African studies reporting similar means tied to familial stability [17].

Table 1. Age of Respondents

Age Group	Effective	Frequency	Percentage
18-25 years	90	0.24	24
26-30 years	103	0.28	28
31-40 years	80	0.21	21
41+ years	100	0.27	27
Total	373	1	100

Note. Minimum age = 18 years; maximum = 80 years; mean ≈ 35 years; standard deviation = 13.5.

Table 2. Household Size

Variable	N	Minimum	Maximum	Sum	Mean	Std. Dev.
Household Members	373	1	14	1730	4.63	3.034

Note. Maximum size reflects extended family cohabitation in rural areas like Mutambala.

Descriptive statistics for household size indicate a minimum of 1 dependent per household and a maximum of 14. This elevated maximum derives from extended family cohabitation in the Mutambala sector, Fizi territory, where parents, children, and extended kin share parcels or kitchens. Mean household size is 4.63, with a standard deviation of 3.034. The mean of 4.63 falls below sub-Saharan rural averages (>5), yet the elevated standard deviation (3.03) signals heterogeneity from polygamy and extended families. Nigerian rural studies link such sizes to heightened poverty vulnerability, with households >5 members exhibiting 22–30% greater poverty incidence [18]. In Fizi, this mirrors insecurity adaptations via familial cohesion.

Table 3. Respondents' Marital Status

Marital Status	Effective	Frequency	Percentage
Married	262	0.70	70
Single	50	0.13	13
Divorced	29	0.08	8
Widow(er)	32	0.09	9
Total	373	1	100

Note. Early marriage (from 18 years) predominates in Mutambala.

Results indicate 70 % married respondents, attributable to the mean marriage age of 18 years in the Mutambala sector, Fizi territory, aligning with the sample minimum age. Singles comprise 13%, divorced 8%, and widow(er)s 9%. The elevated married rate (70%) stems from precocious cultural norms, congruent with Congolese rural surveys where 74% of household heads are married, bolstering patriarchal stability [19]. Widow(er) (9%) and divorced (8%)

rates reflect mortality and political instability, as in South Kivu, where female widowhood affects monoparental households [20]. This corresponds to DRC theses on marital status, wherein extended families buffer risks [21].

Table 4. Primary Occupation of Household Head

Primary Occupation	Effective	Frequency	Percentage
Farmer/Herder	359	0.962	96.2
Driver	5	0.01	1
Civil Servant	3	0.008	0.8
Student	6	0.02	2
Total	373	1	100

Table 4 confirms 96.2% of respondents are farmers/herders, reflecting universal landholding in the Mutambala sector, Fizi territory, where field labor sustains livelihoods. Drivers and civil servants each represent 1 %, and students 2 %, as village children cultivate fields (e.g., 5-10 a.m.) to fund schooling before classes. The 96.2 % farmer/herder dominance affirms Fizi's subsistence economy, sustaining >70% of the population amid conflicts [22]. This mirrors South Kivu, where family smallholdings prevail amid land scarcity [23]. FAO studies highlight how such rural dependence exacerbates poverty through limited diversification [24].

Table 5. Respondents' Education Level

Education Level	Effective	Frequency	Percentage
None	127	0.34	34
Post-Fundamental	60	0.16	16
Literate	48	0.13	13
Primary	36	0.1	10
Fundamental	91	0.24	24
University	11	0.03	3
Total	373	1	100

Table 5 delineates respondents' education levels: 34 % lack formal education, primarily females, due to historical male prioritization in the Mutambala sector, Fizi territory. Fundamental level accounts for 24 %, literacy 13 %, primary 10 %, post-fundamental 16 %, and university 3 %. The 34% illiteracy rate, concentrated among females, reflects DRC rural education crises (97% "learning poverty" by age 10), exacerbated by conflicts and gender biases [25]. The 3 % university rate aligns with limited secondary access in South Kivu. Local theses attribute this to poverty and school distances [26].

Table 6. Economic Constraints on Maize Production Promotion

Constraints	Total Effective	Effective		Frequency		Percentage	
		yes	no	yes	no	yes	no
Lack of Credit	373	221	152	0.59	0.41	59	41
Lack of Improved Seeds	373	168	205	0.45	0.55	45	55
Devastating Diseases	373	145	228	0.39	0.61	39	61
Labor Shortages	373	75	298	0.20	0.80	20	80
Lack of Market Outlets	373	22	351	0.06	0.94	6	94
Lack of Agricultural Inputs	373	16	357	0.04	0.96	4	96
Difficult Conservation	373	14	359	0.04	0.96	4	96
Insufficient Processing Infrastructure	373	11	362	0.03	0.97	3	97

Table 6 presents frequencies and percentages of economic constraints on maize promotion. Results indicate credit scarcity (59%) as the primary barrier to yield enhancement, as insufficient funds impede seed purchases and arable land leasing. Improved seed shortages (45%) rank second, devastating diseases (39%) third, constraining maize promotion in the Mutambala sector, Fizi territory. Remaining constraints exhibit marginal percentages. Descriptive analysis confirms 59% lack agricultural credit, 45% improved seeds, and 39% face diseases. Multiple linear regression demonstrates positive influences of training, extension, and finance on revenues, consistent with Ethiopian [27] and Rwandan [28] studies. The low R2R^2R2 implies unmeasured structural constraints, such as market access and soil quality [29].

4. Conclusion

This study substantiates that maize profitability in Fizi hinges principally on three factors: agricultural credit access, improved seed availability, and technical extension. Econometric analysis reveals significant positive impacts of training and financial means on revenues, validating human capital theory in Congolese agriculture. Identified constraints signify systemic failures in local agricultural systems. Credit inaccessibility (59%) highlights rural financial limitations, while seed shortages (45%) expose input supply chain deficiencies. These structural challenges curtail technical innovation adoption and perpetuate low-productivity traps.

5. Recommendations

In the short term, the following is to be done:

Bolster rural credit systems: Establish agriculture-specialized microfinance institutions with maize cycle-adapted products.

Enhance seed access: Develop local certified seed distributor networks and train producers on utilization.

Intensify agricultural extension: Deploy field agents for proximate technical support.

For the short term, we recommend:

Develop adapted varieties: Promote research on locally disease- and climate-resilient maize strains.

Structure markets: Organize producers into cooperatives to strengthen bargaining power and product transportation. Technical training: Implement decentralized agricultural training centers to augment producer competencies.

For the long term, we recommend the following: Infrastructure development: Upgrade transport routes and storage systems to minimize post-harvest losses. Value chain integration: Establish local processing units for added value creation.

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