Does Agricultural Extension Help Improve Farmers' Socioeconomic Conditions? Empirical Evidence Using Large Survey Data from Haiti

La vulgarisation agricole contribue-t-elle à améliorer les conditions socio-économiques des agriculteurs ? Résultats empiriques tirés d'une large enquête en Haïti

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ABSTRACT. The role of agricultural extension (AE) is largely documented. It is particularly welcome for economic development in countries like Haiti, where a significant portion of the population is engaged in agriculture. However, it remains undocumented in Haiti. In this empirical study, we analyzed a large sample of 1374 farming households to unveil whether access to AE helped them secure a higher socioeconomic situation. According to our findings, 32.0% of the sample had access to AE during the five years before the survey. The significant factors associated to such access were location, agricultural training, telephone use, financial and social inclusion. The farming households who benefited AE were less food insecure than their counterparts with no such innovation or information access. In addition, this access helped farmers earn higher income (both agricultural and total income). The study recommends that the government should put in place policies that encourage AE for farmers while paying attention to the type of innovations provided. AE programs should value ICT like telephone use and target marginal areas.

RÉSUMÉ. L'importance de la vulgarisation agricole est largement documentée. Elle est particulièrement mobilisée pour le développement économique de pays comme Haïti, où une part importante de la population travaille dans l'agriculture. Cependant, elle reste peu documentée en Haïti. Dans cette étude empirique, nous avons analysé un large échantillon de 1 374 ménages agricoles afin de déterminer si l'accès à la vulgarisation agricole a contribué à améliorer leur situation socio-économique. Selon nos résultats, 32.0 % de l'échantillon ont eu accès à la vulgarisation agricole au cours des cinq années précédant l'enquête. Les principaux facteurs associés à cet accès étaient la localisation, la formation agricole, l'utilisation du téléphone, ainsi que l'inclusion financière et sociale. Les ménages agricoles ayant bénéficié de la vulgarisation agricole étaient moins touchés par l'insécurité alimentaire que ceux n'ayant pas accès à ces innovations ou à ces informations. De plus, cet accès a permis aux agriculteurs d'accroître leurs revenus (tant agricoles que totaux). L'étude recommande au gouvernement de mettre en place des politiques encourageant la vulgarisation agricole auprès des agriculteurs, en faisant attention au type d'innovations proposées. Les programmes de vulgarisation agricole devraient valoriser les TIC, comme l'utilisation du téléphone, et cibler les zones marginalisées.

KEYWORDS. Agricultural extension, innovation, access, socioeconomic, farmer, Haiti.
MOTS-CLÉS. Vulgarisation agricole, innovation, accès, socioéconomique, agriculteur, Haïti.

1. Introduction

Agricultural extension (AE) is well documented for its impacts on enhancing agricultural development. It contributes to expanding the skills and knowledge of farmers, enhancing rural livelihoods, achieving food security, and creating more efficient farmer-based organizations [SWA 08]. [CHR 10] defines AE as "all the different activities that provide the information and advisory services that are needed and demanded by farmers and other actors in agrifood systems and rural development". [RHE 13] emphasized the role of agricultural information to the farmers in order to enhance

agricultural production. More broadly, several of the Sustainable Development Goals (SDGs) can be associated with AE ([DAV 16]; [DUT 25]; [GFR 15]). This include ending poverty (SDG 1), achieving zero hunger (SDG 2), promoting good health and well-being (SDG 3), ensuring gender equality (SDG 5), fostering decent work and economic growth (SDG 8), and building climate resilience (SDG 13).

Because agriculture is critical to the lives of over half a billion rural people, especially in developing countries, AE plays a important role in addressing issues such as food security, farmer income, and agricultural sustainability [DAV 16]. This role becomes more crucial for farmer's socioeconomic condition and rural livelihood with the harmful impacts of climate change [ONG 25]. Although the AE concept can be understood as a linear process, like the previous concept of technological transfer, it must be placed in a systemic framework where the farmers can be part of the co-design process ([DAV 16]; [JUL 23]).

Despite the recognized socioeconomic purpose of AE, there are few studies to bring empirical evidence on its impacts on farmers' socioeconomic conditions. In developing countries like Haiti, large public programs targeting smallholder farmers have been implemented, often with international donors' financial support. In the meanwhile, the agricultural sector continues to decline in terms of total contribution in the gross domestic product (GDP), particularly in Haiti where the annual percentage of the GDP dropped from 16.5% in 2020 to 14.4% 2025 [IHSI 25a]. Even the AE access remains low. Data gathered by FAO shown low AE access in terms of fertilizers used in Latin America and the Caribbean, Sub-Saharan Africa and South Asia [FAO 17]. Therefore, there is a necessity to assess the AE access, determinants and outcomes in the lives of the farmers.

In the context of Haiti, as in other developing countries, previous attempts to analyze AE were limited to localized projects. A previous analysis done by [ARI 13] using data from the 2008-2009 general agricultural census could not discuss the relation between AE and socioeconomic outcomes because of the lack of such data in the census. The authors run poorly specified model with data for only three out of ten geographic departments. In this study, we used a large dataset from five out of ten departments to answer the following three research questions: What was the percentage of farmers with access to AE in Haiti in the last five years? Did access to AE help farmers improve their socioeconomic conditions? What farmers' characteristics were associated with the probability of having access to AE in Haiti in recent years? Based on the literature and logical socioeconomic thinking, we formulated the following three hypotheses: 1) Less than 50% of the Haitian farmers benefited from AE programs during the last five years; 2) The farmers who had access to AE were more likely to be food secure than those without such access; 3) The farmers who acceded to AE were socioeconomically included, trained, and exposed to the media.

The rest of the article is structured into five sections. First, we briefly review the literature on AE with focus to its definition, its socioeconomic outcomes and its accessibility drivers. Second, we present the research methodology with details on the study area, the sampling techniques, the model and the data analysis. In the third section, the main results are presented in response to the research questions and the hypotheses. The results are discussed, in the section four, with relation to the existing literature. The fifth section concludes with appropriate public policy recommendations and future research.

2. Background literature

2.1. *Agricultural extension and socioeconomic outcomes*

FAO defines agricultural extension as "systems that should facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agri-business, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices" [CHR 10]. This system of innovation approach places the farmer and other actors of the agrifood system in a

context of multi-actors where AE will provide them the technology, information and advisory services they need and demand [CHR 10]. This FAO definition goes beyond the old perspective of the one-way technology transfer to include technical knowledge, facilitation, brokering and coaching of different actors in order to improve market access, risk management and environment protection. Therefore, AE is aimed to socioeconomic outcomes leading to rural development.

In the case of Haiti, the ministry of agriculture classified AE services in nine categories: (i) advisory services related to seed/crop selection, (ii) arboriculture techniques, (iii) soil preparation and conditioning, (iv) livestock, (v) aviculture, (vi) apiculture, (vii) aquaculture, (viii) post-harvest techniques, and (ix) commercialization [MAR 12]. Using the aforementioned classification, categories (i) to (viii) transfer information and knowledge to farmers and provide them with guidance on farm management skills, while category (ix) may give farmers business management skills and facilitate their linkage to value chains and markets [MAR 12].

In the context of the developing countries where farming and rurality often rime with poverty and food insecurity, the main AE goals are ensuring food security, enhancing rural livelihoods, and protecting natural resources ([BAB 13]; [SAH 25]). These socioeconomic outcomes are strategic for the economic development in the developing world. Therefore, the states often play a central role in AE. However, this role has evolved [CHR 10].

In many developing countries, AE services have long been structured around state agencies. However, with the implementation of the structural adjustment program, several state agencies have been dismantled. In the case of Haiti, after three decades of suspension of AE governance, due to market liberalization [MCG 06], the ministry of agriculture created, in 2020, a new direction for agricultural extension, in the continuation of previous programs and plan for agricultural extension [MAR 11]. The new AE master plan [MAR 24] remains limited with low integration of non-public actors in order to create a national system of AE. As in many developing countries, AE is still linked with donor-driven projects instead of a national structured system [PAU 24].

Despite de structural role of the public sector in AE, it is no longer synonymous of public sector agencies [CHR 10]. In the contrary, there is a plurality of actors intervening in the AE [SAH 25]. In the context of Haiti, previous attempt to analyze of the AE system confirmed this plurality of actors, but with no coordination between them [MAX 17].

When focused specifically on farming households, official data reveal a harsh reality. People occupied in the agricultural sector are mostly poor and food insecure. Report from governmental office showed, in the case of Haiti, that farming households (who mostly live in rural areas) are more food insecure than their counterparts living in urban areas [CNS 23]. This appears to be both unjust and unfair for the farmers whose responsibility is to feed the population while they have long been left uneducated, unsupported and, as a result, food insecure. This situation supports the claim for agricultural extension which can play a pivotal role in reducing rural poverty and food insecurity, and supporting livelihood diversification ([MAX 17]; [ONG 25]).

From 2011 to 2021, a new start in AE has been observed in Haiti. A growing number of public programs included an AE component, such as the technology transfer program in agriculture (PTTA, 2011-2016), the project to strengthen agricultural public services (RESEPAG, 2012-2019), and the technological innovation for agroforestry and agriculture program (PITAG, 2019-2024). Important funding was allocated to AE through these three recent programs, but their socioeconomic consequences for the farmers and their households are yet to be studied.

Previous study in other countries have found positive impact of AE on food security [BRE 23], particularly through agricultural productivity increases [PAN 18]. [KAU 24] recently analyzed data from the national sample census of agriculture of Tanzania and found a significant positive correlation between using agricultural extension services and increased farm productivity and food security. Other

studies addressed the effect of AE on productivity, income, technology adoption, climate change adaptation, etc. ([AND 07]; [ANT 21]; [OYI 20]. It would interesting to analyze the relation between food security and AE for the Haiti which appears to be the most food in secure in the Caribbean, while recent AE programs have been implemented.

2.2. *Agricultural extension and socioeconomic outcomes*

Farmers' access to AE is both based on their demand and the existing AE services. Since the pluralistic approach of AE in many countries, including Haiti., different actors are contributing to shaping the AE systems [SAH 25]. This includes state agencies with their international donors, local non-governmental organizations, farmers' organizations, cooperatives and other producers' non-profit organizations, input dealers, research organizations, etc. Output buyers and food processors, as well as corporate agrifood industries are also involved in AE in order to ensure their supply [CHR 10].

With the rise of the participatory approaches, the access to AE is becoming more and more inclusive [WIJ 24]. From the central role of the AE agent, there has been a shift toward participatory methods like Training and Visit system (T&V), Farming Systems Research (FSR), and Farmer Field Schools (FFS) [WIJ 24]. In this paradigm shift, the farmer plays a more important role. He can become an AE agent in his turn among other local farmers. Several cases of lead farmers or farmer-to-farmer AE has been documented, particularly in Africa ([BOY 22]; [FIS 18]; [KAN 21]; [KIP 15]; [SOU 16]). Their role is considered as complementary to formal AE services [KIP 15].

Access to agricultural extension services is often shaped by multiple socioeconomic, social and institutional, and demographic factors, which influence how effectively farmers can benefit from knowledge transfer and innovation. Previous study argued that access to agricultural extension services is determined by a combination of farmer-specific and systemic factors. Socioeconomic characteristics include education level, farm size, and income ([ABD 26]; [ARI 13]; [NAG 21]). Agricultural education has been found to be an important factor of AE access in Haiti [ARI 13]. In India, it was that observed better-resourced farmers tended to have greater access to information and training opportunities [NAG 21]. Demographic characteristics such as gender dynamics also play a critical role in access to AE, with female farmers frequently facing structural barriers due to cultural norms, limited mobility, and lower recognition of their contribution to agricultural productivity ([GEM 23]; [JOS 24]).

Furthermore, social inclusion and institutional arrangements are important systemic influencing factors to access AE. For example, the availability of private versus public extension services can affect AE access, as private providers may prioritize commercially viable farmers, leaving smallholders underserved [ABD 26]. Likewise, participation in farmer organizations, and access to communication technologies, proximity to extension offices often collectively shape the inclusiveness and effectiveness of extension delivery ([ABD 26]; [CAM 95]). Use of information and communication technology may also influence farmers access to AE [OYI 20], particularly when they are not socially included.

This research focuses on the case of Haiti where agricultural productivity remains an important issue [AUG 24]), as well as food security and poverty [PAU 22]. Previous study has claimed AE as possible strategy to reduce food insecurity in the country [MAX 17]. In the meanwhile, new challenges have emerged for climate change adaptation [DUV 24] and resilience to multifaceted crises [BAL 24]. Using a relatively large sample, we helped filling the gap about the socioeconomic effects of AE in the particular case of Haiti, while looking for new factors affecting AE access.

3. Methodology

3.1. *Study area, questionnaire, and data collection*

The study area is in the Republic of Haiti which shares the island of Kiskeya with the Dominican Republic, in the Greater Antilles archipelago of the Caribbean Sea. Haiti is the largest country in the Caribbean with an estimated population of 11,867,032 as of 2024 [HIS 25b], and a land area of 27,750 km2. Economically, Haiti remains the poorest country in the LAC region and among the poorest countries in the world with a GDP per capita of 2,142.6 current USD. Most of the population is engaged in the agricultural sector whose contribution to the GDP rated 14.4% in 2025 [HIS 25a], and the almost half of the population suffered food insecurity [FSI 23].

The primary data analyzed in this study was collected in 2021 among 1374 farms located in five geographic departments or regions (out of a total of ten in the country). These five regions targeted by the governmental agricultural program called Technological Innovation for Agroforestry and Agriculture Program (PITAG) were: the North, the North-East, the South, Grande-Anse and the upper Artibonite. According to [PAU 24b], only the North, North-East and South are partially irrigated, and agricultural mechanization was used by 60.9% of the farms in the five regions in 2021. The PITAG was a public program with two main components: research and development, agricultural extension. It closed in 2024, and since then, the government started a similar program entitled Rural Productivity and Connectivity Program with a Territorial Approach (PAPAIR). The latest is focused only in incentives extension program, as part of the application of the new national agricultural extension plan [MAR 24].

An average of 3 municipalities was retained from each region totaling 15. A minimum of 16 and a maximum of 388 farmers were selected from each municipality. The sample was stratified through age and gender of the farmers, farm size, production systems, and agro-ecological diversification. To ensure data accuracy, printed questionnaires were filled out during face-to-face conversation. The questionnaire was designed and supervised by senior researchers, with junior researchers' assistantship.

A stratified four-stage sampling strategy was adopted to select respondents: regions or geographic departments, municipalities, farms, and farmers. They were both beneficiaries and non-beneficiaries of AE. All the respondents were farmers with significant experience and a cultivated land. The sampling design is similar to recent studies in Haiti ([GAB 24]; [JOS 24]; [PAU 24b]).

The selection of the respondents used an areolar sampling technique to ensure a representative number in each stage and socioeconomic characteristics. The respondents were asked a large range of information including demography, household composition and activities, household expenses and lifestyle, different occupations and income, education level, farm characteristics, agricultural activities, social interactions, access to innovations, access to credit and remittances, food security, and obviously access to agricultural extension. Additional information was also asked about the type of products (input, credit, etc.) or services (technical assistance, advisory, etc.) received, and the type of the AE providers (government, NGO, enterprise, etc.).

3.2. *Variables and data analysis*

The dependent variable was AE. All the respondents were asked the following question: Did you or any member of your household benefited from any development program or any public intervention during the last five years? According to their answer, the AE variable was recorded as "Yes" or "No". And follow up questions included the name of the program, the donor, the type of assistance they received, the requirements and recipients' satisfaction. Based on the type of assistance, we coded the access to agricultural extension as a binary variable with "Yes" or 1 if a farmer or his household received any type of agricultural extension (service or product or tool) from any type of organization,

and “No” or 0 otherwise. In our sample, the different types of agricultural extension included seeds, livestock, fertilizers, tools, cash, etc.

Multiple covariates were analyzed, based on the literature and our logical thoughts. The continuous variables in the dataset were transformed into scale, such as age, number of trees, income, etc. All variables were constructed based on previous similar studies.

SPSS V.20 software was used to perform all analyses. We performed different statistical and econometric analyses including frequency distribution, bivariate and multivariable regression analysis. Farmers and households’ socio-economic characteristics are described in a frequency distribution table. We used Pearson’s $\chi 2$ to perform bivariate analysis to assess if there were significant associations between AE and key socioeconomic characteristics or variables.

Finally, we conducted multivariable analysis through binary logistic regression, based on bivariate significant association. We present the results with adjusted ORs (AORs), at 95% CI.

3.3. *Statistics and model*

To answer the first two research questions, we conducted statistical analyses using the Chi-2 test and t-test to compare farmers who benefited from AE with their counterparts without such access. All tests were performed with a 5% confidence interval.

To identify the farmers’ characteristics associated with the probability of accessing AE, we used a model grounded in agricultural development theory for farming in developing countries. In such countries with a high level of poverty, public interventions in the agricultural sector often aim to increase agricultural productivity, with the potential to increase farm income and alleviate food insecurity [ONG 25]. In the context of neoliberal economic perspectives, in poor countries like Haiti, public intervention like agricultural extension programs is limited, particularly after structural adjustment measures [MCG 06]. Agricultural extension is now provided mostly by non-governmental actors and governmental agencies funded by international donors [MAX 17]. In the particular case of Haiti, the return to AE programs has been justified by severe food security issues ([CNS 23]; [MAX 17]). Therefore, two major outcomes of AE access are food security and economic income. These two variables are analyzed through a t-test comparison, as mentioned above.

The estimated model aimed to identify the farm and farmer’s characteristics that are associated with the AE access. AE access was defined as the use of agricultural services or products offered by a public program in agriculture during the past five years before the survey.

The model estimated for the identification of the associated characteristics of the access to AE is formulated assuming that for a farmer *i*, the choice to participate in public programs leading to the AE access is based on a utility analysis. The farmer *i* participates in AE if his/her utility is expected to be superior to a threshold δ, otherwise he/she does not if his/her utility is anticipated to be inferior or equal to this threshold. The Utility function U_i^* can be explained by a deterministic part which is a vector X_i of observable characteristics and an error term (ε_i). For the farmer i this utility function can be written as follow:

$$U_i^* = \alpha + \beta X_i + \varepsilon_i \quad [1]$$

The error term is supposed to be independent and identically distributed, as follow: $\varepsilon_i \sim N(0,1)$. The rule of decision, for each farmer *i*, is to make the choice that anticipate a maximization of his/her utility function. To study the personal characteristics of a farmer (and his/her farm) that explain their choice to AE, we first define a binary variable y_i that measures their choice, as follow:

$$y_i = \begin{cases} 1, if\ U_i^* > \delta\ (the\ farmer\ i\ participated\ in\ agricultural\ extension) \\ 0, if\ 0 \leq \delta\ (the\ farmer\ i\ did\ not\ participate\ in\ agricultural\ extension) \end{cases} \quad [2]$$

This choice cannot be estimated by a linear model, since this endogenous variable can have only two values: 0 or 1. The variable Y_i takes the value 1, if the farmer accessed agricultural extension and 0 if he/she did not. In this case, the endogenous variable of the model is dichotomous. The linear multiple regression standard models can be written as:

$$Y_i = \alpha + \beta X_i + \varepsilon_i \quad [3]$$

Estimating this binary model implies being certain that the predictions will fall into the interval (0, 1). And, as the number of observations (1374) is high enough to make us confident to assume that the error term is distributed normally, therefore we opted for a Logit model for interpretation easiness using adjusted odd ratio (AOR). The form of the equation to be estimated is then:

$$P(Y_{ij} = 1) = F(m + \beta X_{ij}) \quad [4]$$

In this relation, F is a cumulative density function given by:

$$F(m + \beta X_{ij}) = \int_{-\infty}^{(m+\beta X_{ij}} \frac{1}{\sqrt{2\pi}} e^{-z^2} dz. \quad [5]$$

The parameters m and β of the model are estimated using methods numerical maximization of the logarithm of the likelihood function which is written as follow

$$ln[L, Y, \beta] = \sum_{i=1}^{J} \left[Y_i\ ln\ ln\left[F(m + \beta X_{ij}\right]\right] + (1 - Y_i) ln\left[1 - F(m + \beta X_{ij}\right] \quad [6]$$

The vector of explanatory variables X_i includes characteristics related to farmers and their farm profiles. It also includes variables related to the external environment such as community variables related to the municipalities, and access to the media. The estimated model can be simply written as follow:

$$Y_i = \beta_0 + \beta_1 Community + \beta_2 Farm + \beta_3 Farmer + \beta_4 Household + \varepsilon_i \quad [7]$$

Where Y_i denotes AE access for the farmer *i*; and β_0 denotes the intercept, $\beta_1 \ldots \beta_4$, the estimation parameters, and ε_i the error term. The following tables 1 and 2 display the variables description through univariate analysis.

4. Results

4.1. *Background characteristics of the surveyed farming households*

The analyzed data (from 1374 farming households) was well balanced among the regions, with 10.3% in Grand'Anse, 13.2% in Nord-Est, 16.4% in Nord, 24.3% Sud, and 35.7% in Artibonite. The two last regions include the main irrigated areas in the country. At the municipal level, they were particularly concentrated in Saint-Michel de l'Attalaye (around 16%) which is one of the largest municipalities of the country, and Torbeck (around 13%). Saint-Michel de l'Attalaye is located in the Artibonite region, and Torbeck is in South.

Among the farming households, more than 3/4 was managed by men. In addition, more than 30% of the farmers surveyed were over 55 years old.

Socio-economic characteristics	Description	Modalities	Frequency	Percentage (%)
Gender	Gender of the farmer	Female	227	16.50
		Male	1147	83.50
Age	Age group of the farmer	Young farm manager (<45 years old)	403	29.33
		Mature farm manager (45-55 years)	374	27.22
		Older farm manager (>55 years)	527	38.36
Location	Name of the municipality where the farm is located	Beaumont	47	3.40
		Corail	54	3.90
		Pestel	41	3.00
		Camp-Perrin	77	5.60
		Cayes	125	9.10
		Torbeck	116	8.40
		Marmelade	103	7.50
		St Raphael	70	5.10
		Dondon	73	5.30
		Grande-Rivière du Nord	71	5.20
		Trou-du-Nord	98	7.10
		Perches	69	5.00
		Limonade	26	1,90
		Maniche	16	1.20
		Saint-Michel	388	28.20
Mobile phone	Access of the farming	No	380	27.66

	household to telephone	Yes	994	72.34
TV	Access of the farming household to television	No	1043	75.91
		Yes	320	23.29
Radio	Access of the farming household to the radio	No	777	56.55
		Yes	596	43.38
Internet		No	1165	84.79
		Yes	209	15.21
Smartphone		No	1052	76.56
		Yes	322	23.44
Education	Tercile of number of the farming household members with a level of education above secondary school	No education (at least secondary) in the household	318	23.14
		Only one person with more than secondary education	464	33.77
		More than 2 workers with education above secondary level	590	42.94
Agricultural training	Level of agricultural training of the farmer	No agricultural training	976	71.03
		Agricultural training seminar	355	25.84
		Agricultural technical school	36	2.62
		Agricultural university training	7	0.51
Specialization	Level of agricultural specialization of the farming household	specialized on their farm (80-100% of the total time)	391	28.46

		diversified on and off farm (50-80% of the total time)	324	23.58
		diversified off-farm (<50% of the total time)	626	45.56
Social inclusion	Member of an agricultural organization	No	1042	75.84
		Yes	332	24.16
Labor exchange		No	632	46.00
		Yes	742	54.00
Irrigation	Access to irrigation	No	1119	81.44
		Yes	255	18.56
Mechanization	Access to power tiller and/or plough	has no access	953	69.36
		has low access	353	25.69
		has high access	58	4.22
Livestock size	Tercile of size of livestock based on the number of Tropical Livestock Units (UBT)	Very few (< 2 UBT)	867	63.1
		Few (2–3.6 UBT)	278	20.2
		Important (> 3.6 UBT)	229	16.7
Land tenure	Level of the number of plots with secure land tenure (purchase, gift, definitive sharing)	Few or no plots with secure tenure	749	54.51
		Low number of plots with secure tenure	99	7.21
		High number of plots with secure tenure	522	37.99
Access to credit	Access to credit	No	936	68.12

		Yes	434	31.59
Remittance	Reception of remittance	No	818	59.53
		Yes	555	40.39
Food security	Level of food security (in terms of access)	Food and nutritional security	64	4.66
		slightly food and nutrition insecure	461	33.55
		moderately food and nutrition insecure	370	26.93
		Severely food and nutrition insecure	470	34.21
Adaptation to climate change	adapted practices directly or indirectly to climate change	No	161	11.72
		Yes	227	16.52
Savings	Saving practice (save money regularly)	Yes	505	36.80
		No	869	63.20
Farm economic performance	Is the farm income negative or positive	No	1218	88.65
		Yes	156	11.35
Total			**1374**	**100.00**

Table 1. *Qualitative socioeconomic description of the farms*

Most of the farms in the sample were led by men, as shown in Table 1. Farmers are mostly in senior age. They had access to mass media mainly through radio. Labor exchange was common among the sample study. Very few of the farms were irrigated and around thirty percent of them had access to mechanization. The majority of the farmers were not trained for the profession of farming.

Table 2 below confirms that the average age of the farmers is more than 51 years. The farms are of limited size, less than 2 ha, and are fragmented in different plots. Even though, not all the surface is cultivated. Almost all farms have livestock, but animal production is very low in comparison with crop production. A significant number of farms underperform in terms of the value of their agricultural production. Therefore, off-farm income and remittances compensate for the farms' revenue.

Socio-economic characteristics	Description	Min	Max	Mean	St.dev.
Age of the farmer	Age (in #years) of the farmer or head of the farming household	19	91	51.67	13.428
Household size	Number of persons living in the farming household	1	19	5.62	2.594
Farm size	Surface (in ha) of the farm	0.06	14.70	1.373	1.376
Cultivated farm surface	Surface (in ha) of the farm effectively cultivated	0.06	12.50	1.141	1.130
Fragmentation	Total number of plots inside the farm	1	15	3.27	1.827
Livestock	Number of Tropical Livestock Unit in the farm	0.00	30.20	1.943	2.824
Crop production	Total annual value (in million HTG) of the farm crop production	0.00	160.00	26.399	50.440
Animal production	Total annual value (in million HTG) of the farm animal production	-0.574	62.016	1.644	5.676
Off-Farm	Total annual amount (in million HTG) of Off-Farm income earned (remittance not included)	0.00	7.143	0.281	0.567
Remittance	Total annual amount (in million HTG) of remittance received	0.00	7.700	0.020	0.217
Agricultural income	Total annual amount (in million HTG) of total income	-0.673	1599.0.18	27.838	51.052
Total income	Total annual amount (in million HTG) of total income	-1.792	1598.935	37.956	51.031

Table 2. *Quantitative socioeconomic description of the farming households*

We noticed high volatility in income and production results. Farms' animal production was sometimes negative given the losses in the herds. Likewise, annual agricultural income was sometimes negative due to losses and underperformance [GAB 24].

4.2. *Comparison between farms with and without access to agricultural extension*

The level of agricultural extension (AE) access among the surveyed Haitian farming households was 32.0%, meaning that fewer than 2 households out of 6 had accessed AE during the 5 years before 2021. This result confirmed our first hypothesis, stating that less than 50% of the Haitian farmers benefited from AE programs in the last five years before the survey. In Table 3 below, we show the agricultural extension access by different socio-economic and demographic characteristics of the farming households. The AE beneficiaries mostly received agricultural inputs (seed, fertilizers, etc.) and other subsidies, such as tools or cash. Around 73.8% reported being satisfied.

Socio-economic characteristics	Modalities	Access to AE		Significant threshold
		No	Yes	
Gender	Female	147 (64.8)	80 (35.2)	0.244
	Male	788 (68.7)	359 (31.3)	
Age	Young farm manager (<45 years old)	275 (68.2)	128 (31.8)	0.246
	Mature farm manager (45-55 years)	268 (71.7)	106 (28.3)	
	Older farm manager (>55 years)	350 (66.4)	177 (33.6)	
Location	Beaumont	18 (38.3)	29 (61.7)	**0.000**
	Corail	38 (70.4)	16 (29.6)	
	Pestel	18 (43.9)	23 (56.1)	
	Camp-Perrin	38 (49.4)	39 (50.6)	
	Cayes	88 (70.4)	37 (29.6)	
	Torbeck	45 (38.8)	71 (61.2)	
	Marmelade	61 (59.2)	42 (40.8)	
	St Raphael	57 (81.4)	13 (18.6)	
	Dondon	67 (91.8)	6 (8.2)	
	Grande-Rivière du Nord	45 (63.4)	26 (36.6)	
	Trou-du-Nord	58 (59.2)	40 (40.8)	
	Perches	46 (66.7)	23 (33.3)	
	Limonade	18 (69.2)	8 (30.8)	
	Maniche	6 (37.5)	10 (62.5)	
	Saint-Michel	332 (85.6)	56 (14.4)	
Mobile phone	No	331 (87.1)	49 (12.9)	**0.000**
	Yes	604 (60.8)	390 (39.2)	

TV	No	706 (67.7)	337 (32.3)	0.571
	Yes	222 (69.4)	98 (30.6)	
Radio	No	584 (75.2)	193 (24.8)	**0.000**
	Yes	351 (58.9)	245 (41.1)	
Internet	No	767 (65.8)	398 (34.2)	**0.000**
	Yes	168 (80.4)	41 (19.6)	
Smartphone	No	773 (73.5)	279 (26.5)	**0.000**
	Yes	162 (50.3)	160 (49.7)	
Education	No education (at least secondary) in the household	450 (76.3)	140 (23.7)	**0.000**
	Only one person with more than secondary education	214 (68.2)	101 (31.8)	
	More than 2 workers with education above secondary level	267 (57.5)	197 (42.5)	
Agricultural training	No agricultural training	731 (74.9)	245 (25.1)	**0.000**
	Agricultural training seminar	182 (51.3)	173 (48.7)	
	Agricultural technical school	18 (50.0)	18 (50.0)	
	Agricultural university training	4 (57.1)	3 (42.9)	
Specialization	specialized on their farm (80-100% of the total time)	237 (73.1)	87 (26.9)	0.056
	diversified on and off farm (50-80% of the total time)	267 (68.3)	124 (31.7)	
	diversified off-farm (<50% of the total	410 (65.5)	216 (34.5)	

	time)			
Social inclusion	No	778 (74.7)	254 (25.3)	**0.000**
	Yes	157 (47.3)	175 (52.7)	
Labor exchange	No	449 (71.0)	183 (29.0)	**0.028**
	Yes	486 (65.5)	256 (34.5)	
Irrigation	No	805 (71.9)	314 (28.1)	**0.000**
	Yes	130 (51.0)	125 (49.0)	
Mechanization	has no access	643 (67.5)	310 (32.5)	0.095
	has low access	238 (67.4)	115 (32.6)	
	has high access	47 (81.0)	11 (19.0)	
Livestock size	Very few (< 2 UBT)	617 (71.2)	250 (28.8)	**0.000**
	Few (2–3.6 UBT)	186 (66.9)	92 (33.1)	
	Important (> 3.6 UBT)	132 (57.6)	97 (42.4)	
Land tenure	Few or no plots with secure tenure	480 (64.1)	269 (35.9)	**0.000**
	Low number of plots with secure tenure	60 (60.6)	39 (39.4)	
	High number of plots with secure tenure	392 (75.1)	130 (24.9)	
Access to credit	No	681 (72.8)	255 (27.2)	**0.000**
	Yes	250 (57.6)	184 (42.4)	
Food security	Food and nutritional security	30 (46.9)	34 (53.1)	**0.000**
	Slightly food and nutrition insecure	285 (61.8)	176 (38.2)	
	Moderately food and nutrition insecure	260 (70.3)	110 (29.7)	

	Severely food and nutrition insecure	357 (76.0)	113 (24.0)	
Adaptation to climate change	No	152 (94.4)	9 (5.6)	**0.000**
	Yes	180 (79.3)	47 (20.7)	
Savings	No	575 (66.2)	294 (33.8)	0.050
	Yes	360 (71.3)	145 (28.7)	
Farm economic performance	No	809 (66.4)	409 (33.6)	**0.000**
	Yes	126 (80.8)	30 (19.2)	
Total		**935 (68.0)**	**439 (32.0)**	

Table 3. *Farms' access to AE according to different qualitative characteristics*

Chi-2 analysis revealed, in the above Table 3, that farms with access to AE were significantly different with those without such access in terms of: location, exposure to the media through telephone and radio, education, previous agricultural training, social inclusion, labor exchange practice, irrigation, land tenure, access to credit, food security status and adaptation to climate change. We found no significant difference between the two groups in terms of gender and age of the farmer, access to mechanization, and farm specialization. As the result showed a higher percentage of food secure farming households in the groups who benefited from AE than their counterparts with no such access, and conversely, a higher percentage of food-insecure farming households food insecure in the groups who did not benefit from AE access than their counterparts with such access, our second hypothesis was partly confirmed.

T-test results displayed in Table 4 revealed that the quantitative characteristics that made a difference in terms of farm access to agricultural extension were the size of the livestock or the animal production, the level of fragmentation of the farm, the remittances, crop production, and total income, but not the farm size, nor the level of Off-farm income of the farming households. Therefore, the second hypothesis was partly confirmed. Farmers who benefited from AE access achieved higher agricultural production or income than those without such access. This result brings additional confirmation to our second hypothesis.

Socio-economic characteristics	Description	Access to AE		Significant threshold
		No	Yes	
Age of the farmer	Age (in # years) of the farmer or the head of the farming household	51.47 (13.565)	52.11 (13.131)	0.419
Household size	Number of persons living in the farming household	5.57 (2.564)	5.72 (2.657)	0.331
Farm size	Surface (in ha) of the farm	1.340 (1.307)	1.443 (1.512)	0.200
Cultivated farm surface	Surface (in ha) of the farm effectively cultivated	1.119 (1.061)	1.189 (1.265)	0.312
Livestock	Number of Tropical Livestock Unit in the farm	1.671 (2.151)	2.522 (3.824)	**0.000**
Fragmentation	Total number of plots inside the farm	3.15 (1.742)	3.52 (1.974)	**0.001**
Crop production	Total annual value (in million HTG) of the farm crop production	25.029 (58.578)	29.315 (25.412)	**0.059**
Animal production	Total annual value (in million HTG) of the farm animal production	1.288 (4.779)	2.401 (7.173)	**0.001**
Off-Farm	Total annual amount (in million HTG) of Off-Farm income earned (remittance not included)	0.262 (0.518)	0.258 (0.530)	0.910
Remittance	Total annual amount (in million HTG) of remittance received	0.012 (0.035)	0.036 (0.381)	**0.049**
Agricultural Income	Total annual amount (in million HTG) of agricultural income	26.089 (59.055)	31.563 (26.698)	**0.018**
Total income	Total annual amount (in million HTG) of total income from all sources	26.203 (59.033)	31.688 (26.673)	**0.018**

Table 4. *Farms' access to AE according to different quantitative characteristics*

4.3. *Factors associated with access to agricultural extension*

We estimated the model (7) with logistic regression, using the qualitative variables with significance at 5% from the table 3. We used Wald specification through backward stepwise for the estimated model. The tests on the quality of the model showed that it was globally significant. Their explanatory power expressed by the pseudo R squared of Cox & Snell and Nagelkerke allows us to consider they were useful to study the farms' access to AE. The test for multicollinearity revealed that all the models had acceptable variance inflation factor (VIF). All VIFs ranged between 1.041 and 1.610 for the variables, and the mean VIF was less than 1.210 for all the models. The factors associated with the access to AE are presented in the following Table 5.

The results revealed that the significant factors associated with the probability of AE accessibility were: location, exposure to the media through the use of the telephone, level of agricultural training, social inclusion, and credit access.

Farmer and farm characteristics	Coefficient Beta	Sig. (p-value)	Adjusted Odds Ratio (AOR)	95% CI
Municipality				
Beaumont = Ref.				
Corail	-1.265	*0.006***	0.282	0.115-0.693
Pestel	-0.291	*0.537*	0.748	0.297-1.882
Camp-Perrin	-0.774	*0.069*	0.461	0.200-1.061
Cayes	-1.691	*0.000****	0.184	0.084-0.404
Torbeck	-0.205	*0.615*	0.815	0.367-1.808
Marmelade	-0.987	*0.013****	0.373	0.171-0.814
St Raphael	-2.577	*0.000****	0.076	0.029-0.198
Dondon	-3.02	*0.000****	0.049	0.016-0.147
Grande-Rivière du Nord	-0.92	*0.029***	0.398	0.174-0.912
Trou-du-Nord	-0.685	*0.091**	0.504	0.228-1.116
Perches	-1.202	*0.005****	0.301	0.129-0.701
Limonade	-1.264	*0.028***	0.283	0.091-0.874
Maniche	-0.222	*0.740*	0.801	0.217-2.962
Saint-Michel	-1.729	*0.000****	0.177	0.082-0.384
Telephone use				
No=Ref.				
Yes	0.787	*0.000****	2.197	1.420-3.400
Agricultural training level				
No agricultural training=Ref.				
Agricultural training seminar	0.606	*0.000****	1.834	1.325-2.538
Agricultural technical school	0.531	*0.201*	1.701	0.753-3.839
Agricultural university training	0.381	*0.672*	1.464	0.251-8.535
Livestock				
Very few (< 2 UBT)=Ref.				
Few (2–3.6 UBT)	0.282	*0.099*	1.326	0.949-1.854

Important (> 3.6 UBT)	0.344	*0.062*	1.410	0.983-2.023
Labor exchange				
No=Ref.				
Yes	0.243	*0.086*	1.276	0.966-1.684
Access to irrigation				
No=Ref.				
Yes	0.375	*0.051*	1.455	0.999-2.119
Access to credit				
No=Ref.				
Yes	0.508	*0.000****	1.662	1.258-2.197
Participation in agricultural organizations				
No=Ref.				
Yes	1.085	*0.000****	2.959	2.184-4.008
Model fitness				
Log-likelihood	1378.102			
R-square of Nagelkerke	0.308			
Test of Hosmer-Lemeshow				
Chi-2	8.936			
p-value	0.348			

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 5. *Farms and farmers' characteristics associated with the probability of having AE access*

5. Discussion

Our results revealed that the level of access to agricultural extension was 32.0% among the surveyed Haitian farming households, when asking for the last five years before 2021. This level is lower than recent finding in Nigeria [ABD 26] but it is higher than the one (less than 15%) observed by [ARI 13] in the case of Haiti. It reflects the average regional level and shows progression probably linked to public policy implementation in the agricultural sector during the last decade. Information provided by the respondents showed that AE access was for free, therefore there may be little solvability for a "fee-for-service" AE in the country.

Farming households who benefited AE were less likely to suffer severe food security. This confirms previous works in Uganda [BRE 23] and in Tanzania [KAU 24]. It supports the Haitian claim for AE as food security strategy [MAX 17].

Farmer demographic characteristics such as gender and age were not significant factors influencing their access to AE. This result is in contradiction with previous study [KAU 24], but it confirms previous AE study in Haiti [ARI 13]. In fact, most Haitian farmers are known to be aged persons (the

average in our sample was over 50 years), with limited participation of young people in the agriculture [MAR 12]. In terms of gender, a slightly growing percentage of women are leading farming households in Haiti and efforts made by feminists to help women integration in different socioeconomic activities may have rewarding results. In addition, most of the AE programs actually include a quota for female beneficiaries, therefore it is not surprising that gender is no longer an accessibility driver AE.

Farmer's level of agricultural training was an important factor of access to AE. This result confirms the knowledge effect underlined by [ARI 13]. It also sheds light on the possible network effect according to which social capital is an important asset to connect farmers to AE agents and services providers. Because of the lack of professionalization of the farming activities, the large majority of the farmers have not been trained. In this situation, the reception of any short training seminar can make an important difference in farmers' behaviors and conditions.

Among other socioeconomic characteristics that were associated with the access to AE, there were exposure to the media (through the use of the telephone) and financial inclusion (credit access). With the expansion of telephone outreach in Haiti during the last two decades [LAG 13], and considering the importance of ICT in the AE [KHA 24], telephone represents a useful tool for AE. When farmers are not already connected to AE agents, having a telephone that can be used both as radio and for internet access, is an important information tool of connection to AE programs. In Nigeria, AE agents are proficiently using ICT foster digital AE services [OYI 20]. This result adds to the literature and creates room for digitalization of AE in Haiti.

Access to credit opens possibility to reach other resources including innovation and technology, particularly those offered by input dealers. Our result showed a positive relation between such financial inclusion and AE access. It is previously argued that most Haitian farmers do not have access to credit ([PAU 16]; [PAU 25]). This result is consistent previous case study in Tanzania [KAU 24].

Farmers who participated in local agricultural organizations were more likely to have access to AE. This result confirms recent research in Nigeria [ABD 26]. Social inclusion and exposure to institutions conveyed by farmers' organization are important community characteristics for farmers in terms of access and use of AE. In addition, we investigated the fact that those organizations used community-based institutions to shape members behaviors and practices. Such social inclusion both creates social capital, human capital and institutional capital for farmers [JOS 24]. Therefore, this was the main factor influencing access to AE. It opens possibilities both for farmer-to-farmer extension [SIL 22] and adoption of innovation provided by AE programs [SHI 21].

Our results revealed that location is an important factor influencing the access to AE. Farmers in municipalities where there are agricultural lowlands with irrigation (Torbeck, Saint-Raphael, etc.) or agricultural highlands with important pluviometry (Beaumont, Camp-Perrin, etc.) were more likely to access AE. This result confirms previous study [ARI 13] and reflects the territorial discriminatory provision of agricultural services both by private and public sectors, and NGOs too. As AE access improve farmers' socioeconomic conditions, discriminatory AE provision among regions or municipalities may have negative impacts in terms of inequality reduction and rural development.

6. Conclusion

In this article, we aimed to investigate whether access to agricultural extension (AE) leads to better socioeconomic outcomes for farmers, and to analyze what farm and farmer's characteristics were associated with this access. Through bivariate and multivariate analysis, using a large sample survey data, we found that 32.0% of Haitian farming households had access and used AE. Those AE users were also more likely to be food secure and less likely to suffer severe food insecurity than their counterpart with no such access. In addition, they were also the farmers who used climate adaptation

practices more in their farm. These results are very promising in the context of aggravating climate change.

We found no significant difference between age and gender and the probability to access AE. However, location, agricultural training, telephone use, financial and social inclusion were important factors associated to AE access. These findings confirm our hypotheses and contribute to the literature on AE, particularly for Haiti. The results also offer justification for targeted AE programs in the Haitian agriculture. This is all the more important given that the country is continuously facing food insecurity, socioeconomic depression and political instability for several years.

Based on the findings, the government and its financial partners and the private sector and the NGOs are encouraged to support intervention in AE using both ICT and existing social networks of farmers to help improve socioeconomic conditions in rural Haiti where poverty is known to be more acute [MER 19]. More precisely, the ministry of agriculture should take advantage from the telephone and internet expansion to implement its Agri-Ext application with the support of the Inter-American Institute for Cooperation on Agriculture (IICA). Through such application, information and advisory could be exchanged with farmers in different topics, particularly in adaptation to climate change, good agricultural practices, etc.

Indeed, since 2021, the Haitian ministry of agriculture has initiated new AE program that may increase the level of AE access among farmers. However, as long as the programs target the same regions, they might not reduce significantly the unequal territorial accessibility to AE. The ministry also undertook the renewal of its AE master plan for the next ten years (2025-235) [MAR 24] after participatory assessment of the previous AE plan [PAU 24]. Nevertheless, this new framework of AE policy is yet to be implemented, due to the previously mentioned political instability leading to an important decrease in donors' contribution. Despite these limitations, the government managed to bring together the different actors into a workshop on AE methods. This three-day workshop was held in November 2025 gathered more than a hundred participants who shared field experience, learned lessons and discussed new approaches to foster AE in the country [MAR 26].

Although this research is based in large sample and used strong analysis, it suffers limitation. First, it use cross-sectional data, therefore it was not possible to understand causal inferences. As it was a survey, it was not possible to measure the effects of AE access on agricultural productivity. Only production and food security were measured, based on farmers' declaration.

Future research should assess governmental AE programs using randomization techniques to ensure unquestionable results. Such research need to focus both on agronomic, socioeconomic and environmental outcomes of AE. Finally, it would be interesting to capture the farmers' capacity and the willing-to-pay for "fee-for-service" AE.

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