

# Socio-economic factors associated with open defecation among agricultural households: a cross-sectional study in Haiti

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## ABSTRACT

**Background** Open defecation (OD) is recognised as an important public health challenge in low-income and middle-income countries. Although agriculture is the main occupation in these countries, few if any study on OD has focused on agricultural households. In order to enhance the prevention of OD and contribute to a better understanding of this health-threatening behaviour, this paper analyses the socio-economic factors associated with OD practice among agricultural households in Haiti.

**Methods** The study used primary data from 1269 households selected in 5 out of 10 geographic departments of Haiti surveyed in 2020–2021. Descriptive statistics and bivariate analysis were used to identify households' characteristics that were significantly associated with OD. In addition, a multivariate analysis was performed using binary logistic regression to study the factors associated with the probability to defecate in the open.

**Results** Findings show that one out of five (20.1%) agricultural households in Haiti practices OD. More than 26% of the households did not have any member with secondary school education level. Multivariate analysis revealed that in addition to the location, the probability of OD practices among agricultural households was correlated with socio-economic factors such as education, access to the media, plot number and livestock, level of specialisation in the agriculture, agricultural income and participation in local organisations.

**Conclusion** While Haiti is struggling with cholera among other health issues, this paper sheds light on factors associated with OD, a health-threatening and unsustainable sanitation behaviour. According to the results, in addition to toilet acquisition subsidies, awareness campaigns need to make use of mass media and local organisations particularly women and community ones. Elimination of OD among agricultural households is of great significance for better quality of foods and vegetables at watershed level.

## INTRODUCTION

Open defecation (OD) represents a major health risk in low-income and middle-income countries where it is mostly practised. It is

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Open defecation is mainly a rural phenomenon and mostly present in poor countries located in South Asia and sub-Saharan Africa.
- ⇒ Sociocultural, demographic and economic factors influence open defecation.
- ⇒ With 25.3% of the households from which 59.9% are rural, Haiti has the highest open defecation prevalence in the Latin America and the Caribbean associated with demographic and socio-economic factors.

## WHAT THIS STUDY ADDS

- ⇒ The open defecation prevalence among Haitian agricultural households was 20.1% in 2021.
- ⇒ In addition to region and access to media including internet, our results showed that agricultural household average education level, farm fragmentation, livestock, inclusion in local farm organisations were the key significant factors associated with open defecation among agricultural households in Haiti.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Our findings suggest more research and policies focusing in agricultural households, which are more often underprivileged despite their crucial role in food security. Such poor population may prioritise livelihoods other than purchasing toilets.
- ⇒ Reducing open defecation among agricultural households and sensitise farmers to dig holes for faeces disposal when in the field will have positive impact on watershed and public health.



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usually defined as the disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open spaces (like man-made waterway).<sup>1</sup> This unsustainable sanitation practice received special attention from the international community through the decision to eliminate OD practice. In 2010, access to safe drinking water and sanitation was recognised as a fundamental right by the United Nations General Assembly through

a resolution.<sup>2</sup> Five years later, in 2015, target 6.2 of the Sustainable Development Goals (SDGs) was adopted, which calls for ending OD and achieving universal access to adequate and equitable sanitation.<sup>3</sup> As of 2020, OD is still practised by approximately 494 million people worldwide.<sup>1</sup> Certainly OD practice varies significantly among countries and regions: according to available data, <1% of people defecate in the open in Europe compared with 18% in Africa and about 2% in Latin America and the Caribbean (LAC).<sup>1</sup> Despite successful efforts to reduce OD practice in the LAC, Haiti still has >20% of the population that continues to practice OD, the highest rate in the region.<sup>4</sup> Consequently, Haiti has been facing negative health consequences related to this unsustainable sanitation behaviour.

OD practice has a community-level negative health impact and represents a threat to health.<sup>5</sup> It is unsustainable as it generates direct and interactive contaminations of soil, water and air. As a consequence, people and animals in contact with these three components are exposed to aetiological agents of infectious waterborne diseases and/or intestinal parasitic infections.<sup>5</sup> Studies focusing on Global Burden of Disease Study have shown that OD is associated with several adverse public health outcomes.<sup>5–7</sup> In addition, various health studies have found that OD causes infectious excreta-related diseases, such as cryptosporidiosis, cholera and typhoid, among others, as well as soil-transmitted helminthiasis infections which have chronic effects.<sup>8–10</sup> Eliminating OD is a moral obligation for governments in low-income and middle-income countries in order to reduce environmental contamination by microorganisms such as bacteria and protozoa transmitted by water.<sup>11</sup> Neglected tropical diseases such as cholera represent a major cause of diarrhoea and a leading cause of death among children under 5 years in low-income and middle-income countries.<sup>12–14</sup> Studies on disease burden, focusing mainly on diarrhoeal diseases, have argued that inadequate drinking water, sanitation and hygiene are important risk factors.<sup>7 12 14 15</sup> In Haiti, studies have identified intestinal parasitoses in the population, particularly at schools.<sup>16 17</sup> OD practice has been found to contaminate watersheds including surface water and groundwater used for human purposes in poor countries like Haiti.<sup>18–20</sup> Among other consequences, the affected population experiences intestinal blood loss leading to iron deficiency anaemia and protein malnutrition, as in many low-income and middle-income countries.<sup>5 14</sup>

Previous empirical studies on OD both in South Asia and Africa have identified sociocultural and sociodemographic factors as the key drivers of OD. Efforts to reduce OD often face sociocultural barriers, particularly in low-income and middle-income countries.<sup>17</sup> These barriers connect community characteristics to individual behaviours, particularly when there is social pressure that can create compliance to local non-sanitary rules of behaviour.<sup>21</sup> Empirical studies conducted in India, Nepal and sub-Saharan Africa have confirmed the links between sociocultural norms and OD.<sup>22–24</sup>

Recent research in Haiti has shown empirical association between access to the media and OD.<sup>25</sup> In the literature, there is a variety of OD determinants, including: norms of latrine use,<sup>22</sup> preferences to defecate in the open instead of using a latrine,<sup>26</sup> cultural beliefs,<sup>23</sup> age,<sup>27</sup> household wealth status,<sup>28 29</sup> household size,<sup>23</sup> education of the household head,<sup>30</sup> etc. An important part of the literature have also shown that defecating in the open occurs predominantly in rural environments.<sup>29 31 32</sup> Researchers argue that in rural areas, households engaged in agricultural activities are more likely to practice OD since they spend most of their time outdoors<sup>23</sup> but they do not focus specifically on agricultural households and their characteristics. Such study calling attention to agricultural households did not bring any evidence about OD among this part of the population. Between the fertilisation utility of OD and its menace for health, there is an open debate initiated in Africa,<sup>33</sup> but it is still underdocumented for Haiti. Defecating in the field while doing agricultural activities is a major problem for the quality of products harvested with soil contact. When agricultural household is defecating in the open, it is a bigger and critical community issue. It remains necessary to go further by studying agricultural households' OD practice more specifically.

According to Guillaume *et al*,<sup>34</sup> rural Haitians are less likely than their urban counterparts to own latrines and more likely to engage in OD. This might be more critical for agricultural household which face poorer socio-economic conditions.<sup>35 36</sup> In the year 2010, after the deadly earthquake that occurred in Haiti, a cholera epidemic killed 8494 people in Haiti<sup>37</sup> and it took almost 10 years of concerted actions to break cholera in the country, and even though poor sanitation and health vulnerabilities remain.<sup>38</sup> Medical research have associated this waterborne disease spread and prevalence with hygiene and OD practice in Haiti.<sup>39</sup> After several years of containment, by the end of 2022, cholera was detected to spread again in the country, according to official release.<sup>40</sup>

OD behaviours among farmers may have an indirect negative health impact on food quality. For instance, beyond fertilisation benefits of OD by farmers,<sup>33</sup> fruits and vegetables produced and harvested manually by farmers or after contact with infected soil or infected water, represent a public health threat and an important food quality issue. In addition, in mountainous countries like Haiti where agriculture is mostly practised by poor farmers in uplands, OD represents an important environmental concern, since OD contamination can affect watersheds downward, including littoral cities.<sup>18–20</sup> Few research, if any, have collected data specifically on agricultural households in order to study the prevalence of OD among them, and analyse their characteristics associated with OD practice. Our research contributes to the literature by examining the socio-economic factors influencing the practice of OD in Haiti, the LAC countries with the highest OD rate and by focusing particularly on agricultural households.

## MATERIALS AND METHODS

### Study area

This study is focused on the Republic of Haiti, located in the Caribbean Sea and shares the west of the second largest Caribbean Island with the Dominican Republic. The Haitian population is one of the largest in the Caribbean, with an estimated 11.9 million people in 2021 living on 27 750 km<sup>2</sup>. The country is economically the poorest country in the region and agriculture is one of the most important employment sectors, although it is declining. According to World Bank data, the current per capita income was US\$1829 in 2021, after 3 years of negative economic growth.

Geographically, there are municipality disparities according to how rural a community is. The 15 municipalities selected for this study reflect those targeted by the Ministry of Agriculture in the framework of the project aimed at sharing agricultural innovation to farmers, in order to improve socio-economic conditions. Households' occupation is important for their income and possibility to buy toilets. Their activity is also important in their OD practice, according to the time spent out of the household. Respondents were selected by stratified sampling in gender, age, farm size, etc.

### Type of study and data source

This study used primary data from cross-sectional surveys conducted from October 2020 to April 2021, and implemented by a team of agro socio-economic researchers from Quisqueya University. The main objective of the survey was to provide up-to-date evaluation of agricultural households' agro socio-economic situation to better inform future interventions. More specifically, the survey collected information on household size and demographic characteristics, agricultural and non-agricultural activities, education, social and financial inclusion, households' income and expenses. It allows to investigate new factors that have not been studied in the literature.

### Sampling

The survey used a stratified sample of agricultural households from 5 out of the 10 geographic departments of Haiti. Stratification strategy was based on age and gender of the head of the households, farm size, production systems and agro ecological diversification. One thousand three hundred ninety-three households were successfully interviewed with questionnaire and 1269 were used for the study because of missing data. The later was designed and supervised by senior researchers with assistantship of young researchers. The *Household Recoded* dataset was used for our study which contains information on access to toilets and the socio-economic and demographic characteristics of households.

Our sampling and sampling design is similar to Coffey *et al.*<sup>26</sup> a study in India which selected 5 states and 13 districts. Similarly, we use a four-stage sampling strategy to select respondents: departments, municipalities, households and persons. The five departments were

those identified by the Ministry of Agriculture in the framework of the programme of innovation and technology transfer in the agriculture and agroecology. They range from the largest one (Artibonite) to the smallest or poorest one (Grand'Anse). Inside these departments or regions, an average of three different municipalities were selected. With area sampling techniques, we surveyed an average of 80 agricultural households by municipality, both male-headed and female-headed.

### Definition of variables

#### Dependent variable

The dependent variable of the study is OD. The respondents were asked a specific question about their toilet facility, and OD was one of the response modalities. The OD variable was coded 'yes' if a household practised OD, and 'no' otherwise.

#### Independent variables

The selection of covariates was done following a literature review on factors found to significantly influence OD practice in various studies conducted in low-income and middle-income countries<sup>23 27 29 32 41–43</sup> including Haiti.<sup>25</sup> Few studies have focused on farmers' or agricultural households' OD practices. We propose logical variables as indicators of farmers' activities that might influence their OD practices through time consumption, as suggested by Osumanu *et al.*<sup>23</sup> These variables were agricultural specialisation, fragmentation of their plots, livestock and average distance to their plots.

We used 15 variables as covariates in this study: department of residence, gender and age of the household head, level of education, household size, access to the mass media, number of plots and average distance between them and the house, farm size, livestock, level of agricultural specialisation, participation in local organisations, farm income, off farm income and remittance. Statistics are related to both farmers as head of the households and the whole socio-economic unit represented by the households' members. Their location, education, different sources of income and other assets such as social ones which conveys institutional capital are taken into account. To test our hypothesis, we developed appropriate variables such as distance to plots, number of plots and level of agricultural specialisation of the household members to analyse agricultural characteristics. The livestock was coded into conventional tropical livestock units (TLU also called *Unité Bovins Tropicaux* (UBT) in French), where one TLU is equivalent to 1 zebu or 12 goats. Collected data on incomes, including agricultural revenues, remittances and off farm revenues are used as a proxy of wealth. For statistical reasons, we transformed those data into scale variables. We did the same for all quantitative variables.

### Data analysis

We used SPSS V.20 software to perform statistical analysis. Statistics include frequency distribution, bivariate

and multivariate analysis. 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 the dependent variable (OD) and the independent variables. Finally, multivariate analysis was conducted using binary logistic regression, after backward variable selection procedure.<sup>44</sup> We present the results with adjusted ORs (AORs), at 95% CIs.

### Patient and public involvement

Neither patient nor public involvement was used in this research. The survey used socio-economic information from which was extracted OD information. Agricultural households' characteristics were based on farmers' declarations.

## RESULTS

### Background characteristics of agricultural households

The agricultural households' socio-economic profiles are presented in table 1. Less than two agricultural household out of 10 had a female head. Illiteracy is widespread among agricultural households in Haiti, 43.0% had no member with a minimum education of secondary school and 64.2% of them had five members or more. The farms were quite little and fragmented (59.6% with <1.5 ha, and 61.5% with 3 or more plots) and dispersed (44.1% is 30 min walking distance from the house). Much of them earned relatively important incomes and 61.2% are remittance receivers.

### Prevalence of open defecation practice among Haitian agricultural households

Table 2 presents information on OD by selected socio-economic characteristics of agricultural households. According to our sample, 20.1% of the agricultural households defecated in the open in 2021. With a household size of five to six persons in the average, this represented many people practising OD which is an unsustainable sanitation and health-menacing behaviour.

OD practice was most prevalent among farmers in the North (38.8%) and the Grand'Anse (35.1%), followed by Artibonite (21.5%). From the five geographic departments surveyed, the lower OD prevalence (8% and 5.4%) was found in the Nord-Est and the South, respectively. Among the 15 municipalities surveyed, the highest prevalence was observed in Dondon (77.2%), Beaumont (42.5%) and Grande-Rivière du Nord (42.0%), which are mostly agricultural communities. Female-headed and male-headed agricultural households had close level of OD practice (18.9% and 20.3%, respectively), and there was no considerable difference in OD practice between age levels of the households' head. Agricultural households with lower incomes, larger or more distant or more fragmented farms and more important livestock had higher prevalence of OD. Those with low participation in local associations or more specialised in their

**Table 1** Socio-economic and demographic profiles of agricultural households in Haiti

Socio-economic and demographic characteristics	N	Percentage
Region		
Nord	219	17.3
Nord-Est	176	13.9
Artibonite	427	33.6
Sud	313	24.7
Grand'Anse	134	10.6
Gender of household head		
Male	1063	83.8
Female	206	16.2
Age of household head (years)		
<45	570	4.3
45–55	2762	20.6
55 and above	2248	16.8
Education level in the household		
No one with minimum secondary	546	43.0
At least one member with more than secondary	723	57.0
Household size		
<5	454	35.8
5 and more	815	64.2
Access to the media		
Yes	722	56.9
No	547	43.1
Distance to plot in average (min)		
<30	528	55.9
>30	417	44.1
Farm size (ha)		
Up to 1.5	756	59.6
>1.5	513	40.4
Livestock (UBT)		
<2.3	507	40.0
2.3–3.6	376	29.6
>3.6	386	30.4
Plot number		
Low (<3)	488	38.5
Medium (=3)	282	22.2
High (>3)	499	39.3
Agricultural specialisation		
Specialised in the farm	302	23.8
Both in and out of the farm	366	28.8
Specialised out of the farm	601	47.4
Participation level in associations		
Low participation	845	66.6
Average and high participation	424	33.4

Continued



**Table 1** Continued

Socio-economic and demographic characteristics	N	Percentage
Agricultural income (HTG)		
Negative or low (<10 000 000)	395	31.1
Average (10–50 000 000)	616	48.5
High (>50 000 000)	258	20.3
Off farm income (HTG)		
Low (<100 000)	542	42.7
Average (100 000–200 000)	296	23.3
High (>200 000)	431	34.0
Remittances		
Yes	777	61.2
No	492	38.8
Total	1269	100.0

HTG, Haitian Gourdes; UBT, Unité Bovins Tropicaux.

farm had higher percentage of OD (23.2% and 30.5%, respectively).

In table 2,  $\chi^2$  tests show that geographic localisation, education, access to the media, social inclusion in local organisations, livestock, plots number, level of specialisation in agricultural activities, agricultural incomes and remittances were significantly associated with OD practice among agricultural households. Age and gender of agricultural household head, farm size, household size and off farm incomes were not found to be significant. Therefore, they were not included in the model.

### Factors associated with OD practice among Haitian agricultural households

Table 3 shows factors associated with OD practice among agricultural households in Haiti. The binary logistic regression, whose overall specification is statistically significant ( $p < 0.001$ ), confirms almost all trends observed in table 2. Hosmer-Lemeshow test supports that the model specification is acceptable. The model correct prediction capacity is estimated at 81%. Mean variance inflation factor (VIF) is 1.05, with all variable VIF  $< 1.1$ .

The findings in table 3 suggest that factors significantly associated with OD practice among agricultural households in Haiti were: location, education, access to the media, plot number, livestock, level of agricultural income and participation in local organisations.

In comparison to the Grand'Anse region, agricultural households in Artibonite, Nord-Est and South were less likely to practice OD. Households whose members had a minimum education at secondary school are 0.689 time less likely to defecate in the open (AOR 0.689; 95% CI 0.500 to 0.650). The results indicated that households with 2.3 to 6 TLUs were >1.4 times likely (AOR 1.484; 95% CI 1.025 to 2.150) than those with less livestock to defecate in the open. They also revealed that households cultivating less fragmented farm (less than three plots)

**Table 2** Prevalence of open defecation practice by socio-economic characteristics of households

Sociodemographic characteristics	Open defecation		P value*
	Yes n (%)	No n (%)	
Region			
Nord	88 (38.8)	134 (61.2)	***
Nord-Est	14 (8.0)	162 (92.0)	
Artibonite	92 (21.5)	335 (78.5)	
Sud	17 (5.4)	296 (94.6)	
Grand'Anse (ref)	47 (35.1)	87 (64.9)	
Gender of household head			
Male (ref)	216 (20.3)	847 (79.7)	ns
Female	39 (18.9)	167 (81.1)	
Age of household head (years)			
<45	81 (20.4)	316 (79.6)	ns
45–55	64 (18.1)	290 (81.9)	
55 (ref)	110 (21.2)	408 (78.8)	
Education level in the household			
No one with minimum secondary (ref)	143 (26.2)	403 (73.8)	***
At least one member with more than secondary	112 (15.5)	611 (84.5)	
Household size			
<5	96 (21.1)	358 (78.9)	ns
5 and more (ref)	159 (19.5)	656 (80.5)	
Access to the media			
Yes	114 (15.8)	608 (84.2)	***
No (ref)	141 (25.8)	406 (74.2)	
Distance to plot in average (min)			
<30	84 (15.9)	444 (84.1)	ns
>30 (ref)	86 (20.6)	331 (79.4)	
Farm size (ha)			
Up to 1.5 (ref)	145 (19.2)	611 (80.8)	ns
>1.5	110 (21.4)	403 (78.6)	
Livestock (UBT)			
<2.3 (ref)	97 (19.1)	410 (80.9)	*
2.3–3.6	85 (22.6)	291 (77.4)	
>3.6	73 (18.9)	313 (81.1)	
Plot number			
Low (<3)	79 (16.2)	409 (83.8)	***
Medium (=3)	57 (20.2)	225 (79.8)	
High (>3) (ref)	119 (23.8)	380 (76.2)	
Agricultural specialisation			
Specialised in the farm (ref)	92 (30.5)	210 (69.5)	***
Both in and out of the farm	75 (20.5)	291 (79.5)	
Specialised out of the farm	88 (14.6)	513 (85.4)	
Participation level in associations			

Continued

Table 2 Continued

Sociodemographic characteristics	Open defecation		P value*
	Yes n (%)	No n (%)	
Low participation (ref)	196 (23.2)	649 (76.8)	
Average and high participation	59 (13.9)	365 (86.1)	***
Agricultural income (HTG)			
Negative or low (<10 000 000) (ref)	98 (24.8)	297 (75.2)	
Average (10–50 000 000)	107 (17.4)	509 (82.6)	
High (>50 000 000)	50 (19.4)	208 (80.6)	***
Off farm income (HTG)			
Low (<100 000) (ref)	123 (22.7)	419 (77.3)	
Average (100 000–200 000)	56 (18.9)	240 (81.1)	
High (>200 000)	76 (17.6)	355 (82.4)	ns
Remittances			
Yes	168 (21.6)	609 (78.4)	
No (ref)	87 (17.7)	405 (82.3)	*

\*P<0.05; \*\*p<0.01; \*\*\*p<0.001.

ns, not significant; ref, reference; UBT, Unité Bovins Tropicaux.

were 0.6 time less likely to practice OD (AOR0.665; 95% CI 0.460 to 0.960) compared with those with more fragmented farms. Households whose members were involved in local associations (AOR0.581; 95% CI 0.410 to 0.822) or specialised in and out (AOR0.596; 95% CI 0.402 to 0.881) or mostly out of the farm (AOR0.558; 95% CI 0.386 to 0.806), were less likely to defecate in the open.

## DISCUSSION

The results of the study are very inspiring for public policy and intervention. Because OD is mostly known as a rural phenomenon worldwide, in Haiti as in many low-income and middle-income countries, many local non-for-profit organisations supported by UNICEF are trying to raise awareness against this unsustainable sanitation behaviour. Despite continuous efforts, our results showed that actors like farmers and their households continue to largely practising this phenomenon that represents a high risk of contaminating foods that they produce and sell, particularly fruits and vegetables.

From this cross-sectional field survey conducted in Haiti in 2020–2021, we found that the overall proportion of farming households practising OD in Haiti was estimated at 20.1%. This rate appears to be lower than the rural rate measured by Paul *et al.*<sup>25</sup> One possible explanation is that not all rural households are engaged in agricultural activities. In our survey, not all agricultural households were living in rural areas. In fact, the results indicate the more they are specialised out of the agriculture (agriculture as occasional occupation), the less they practice OD.

This result clarifies what Osumanu *et al.*<sup>23</sup> pointed out for Ghana about OD among farmers.

Understanding factors related to the OD behaviour among agricultural households is important to reduce the practice and fight its health consequences and food quality. Most of the time, in Haiti, fruits and vegetables harvested by farmers have contact with the soil. If they practice OD, these foods can be contaminated. Similarly, OD practice can have contamination effect downstream a watershed. In addition, agricultural households' members who defecate in the open, in a context of under-investment in the water, sanitation and hygiene sector in Haiti, are also threatening their own health. They also contribute to amplify a community threat because people greet each other by shaking hands, sharing faecal germs in a context of poor health services.

Many studies on OD using Demographic Health Survey data have found that poor households are more likely to practice OD.<sup>23 27 29 31 41 42</sup> In our case, we use income instead of the wealth index often used in absence of income information. Our bivariate results show that agricultural income is significantly associated with OD. On the contrary, off farm incomes and remittances are not found to be significantly associated with OD practices probability. One of the reasons is that OD practices among agricultural households may have more cultural rather than economic determinants. In addition, agricultural households in Haiti receive much less remittances than urban households. This also means that remittance inflows are not funding OD reduction for the more vulnerable population. Agricultural activity itself cannot help reduce OD practices among farming households since those poor people do not necessarily allocate agricultural income in buying toilets. In fact, the education level is very low among agricultural households in Haiti, and the ability to earn important off farm income is highly volatile within the sample data. But the main explanation is that in rural areas, households who have toilets either received it as gifts from charitable organisations or built it themselves with local materials with no significant monetary costs. For agricultural households, having a toilet is more about good sanitation awareness than having some penny.

According to our results, households with higher educated members were associated with a lower likelihood to defecate in the open than those with no educated members. The existing literature often tests the 'level of the education of the household head'. At the same time, it is said that the number of children and the presence of elderly in the households are predicting factors for OD.<sup>25 44</sup> This suggests that although the investment in toilet building might be the head of household's decision, it also depends on other household members' views. Their education may be an important ingredient in influencing the whole household's decision about OD. This result is not in contradiction with past studies on head of household education.<sup>23 29 43 45</sup> Education creates awareness about sustainable sanitation practices, responsible

**Table 3** Logistic regression estimates for open defecation practice by background characteristics among agricultural households in Haiti

Sociodemographic characteristics	P value	Adjusted OR	95% CI
Region			
Nord	ns	1.097	0.673 to 1.789
Nord-Est	<0.01	0.152***	0.076 to 0.307
Artibonite	<0.01	0.248***	0.138 to 0.450
Sud	<0.01	0.106***	0.056 to 0.200
Grand'Anse (ref)			
Education level in the household			
No one with minimum secondary (ref)			
At least one member with more than secondary	<0.05	0.689**	0.500 to 0.850
Access to the media			
Yes	<0.01	0.640***	0.467 to 0.875
No (ref)			
Livestock (UBT)			
<2.3 (ref)			
2.3–3.6	<0.05	1.484**	1.025 to 2.150
>3.6	ns	1.308	0.886 to 1.931
Plot number			
Low (<3)	<0.05	0.665**	0.460 to 0.960
Medium (=3)	ns	0.738	0.499 to 1.092
High (>3) (ref)			
Agricultural specialisation			
Specialised in the farm (ref)			
Both in and out of the farm	<0.05	0.596**	0.402 to 0.881
Specialised out of the farm	<0.01	0.558***	0.386 to 0.806
Participation in local associations			
Low participation (ref)			
Average and high participation	<0.01	0.581***	0.410 to 0.822
Agricultural income (HTG)			
Negative or low (<10 000 000) (ref)			
Average (10–50 000 000)	<0.01	0.458***	0.276 to 0.758
High (>50 000 000)	<0.01	0.458***	0.256 to 0.820
Remittances			
Yes	ns	1.280	0.929 to 1.962
No (ref)			

\*P<0.05; \*\*p<0.01; \*\*\*p<0.001.  
ns, not significant; ref, reference; UBT, Unité Bovins Tropicaux.

health behaviours and owning a toilet.<sup>23</sup> Previous study demonstrated that education level can affect household income necessary to buy a toilet.<sup>43</sup> More largely than the existing literature which only focuses on household head's education, our test of all the household members' education gives broader understanding. The reason is that awareness about OD's negative impacts, and motivation for good sanitation behaviours can come from any household member, not only the household head.

According to our results, households with access to mass media had a lower risk of defecating in the open than those with no access to the media. This result is consistent with previous research on OD prediction in Haiti<sup>25</sup> and several other studies where it is argued that mass media can help raise awareness, increase level of understanding, and influence household behaviours and attitudes.<sup>46 47</sup> Agricultural households with access to mass media can be informed about the unsustainable effects

of OD and the benefits of using a toilet.<sup>43</sup> It has been discussed that lower exposition to the media implies less access to information that can influence OD practice as well as local non-sanitary beliefs and behaviours.<sup>22 25</sup> This result based on media including the internet brings a little more understanding of the phenomenon. A recent Internet Society report that 90% of Haitian had access to the internet, as of 2021. This media access is mainly through smartphones which also represent an appropriate means of communication (telephone penetration rate averaged 64% as of 2020) that can be used to raise awareness against OD practice.

Social inclusion, for instance, participation in local associations (farmer organisations or other community-based organisations including religious associations) is significantly and negatively associated with the agricultural households' probability to defecate in the open. This result is consistent with previous studies that analysed the link between OD and social inclusion.<sup>25 43</sup> Actually, non-for-profit organisations are mobilising social pressure as a form of institutional capital (as defined by Paul<sup>48</sup>) to bring households reducing OD practices. Their principle is as follows: if in a given neighbourhood of a 100 households 1 is practising OD, the 99 others who use the toilet are exposed equally to the environmental and health risks. Mean test conducted with average annual households' healthcare expenses supports this idea. We found no significant difference ( $F=0.969$  with  $p=0.325$ ) between households who defecate in the open (mean: 15404 Haitian gourdes which represented in 2021 about US\$150) and those who use toilet (17984 Haitian gourdes which represented in 2021 about US\$170).

Location is an influencing factor of OD probability. This is consistent with other studies.<sup>23 26 43</sup> Location reflects other socio-economic factors. Departments like Artibonite, Northeast, which are dominated by rural areas, concentrate households primarily engage in agriculture.<sup>48</sup> The engagement in agriculture is particularly explained by time spent working in the agricultural fields, far from the house. Paul *et al*<sup>25</sup> showed that rural Haitian regions are also the poorer and with higher OD prevalence. Although the South is not a rural dominant region, it was severely struck and impoverished by hurricane Matthew in 2016.<sup>49–51</sup> Households in rural areas, as shown by Paul *et al*,<sup>25</sup> were less exposed to mass media than their urban counterparts,<sup>52</sup> and therefore more likely to be engaged in OD practices.

In addition, our data reveal two new factors that have not been tested or discussed in previous studies. These new factors associated with OD are: farm fragmentation and livestock. Our results revealed that farm fragmentation (into more or less plots) and livestock are two new influencing factors to OD practices. Plot number and livestock are two characteristics of a farm that can make farmers or other agricultural households' members spend much more time out of the house. In such cases, they can judge it is less important to have a toilet which will be not used. On one hand, the more fragmented a

farm is, the more the farmer is supposed to spend time managing it. On the other hand, in Haiti, livestock is mostly kept on a rope and moved plot to plot for feeding. This farming method is time-consuming and increases the time spent outdoors. In such conditions, investing in toilets can be perceived as useless and therefore OD can tend to be more practised. We also found that the level of specialisation in agriculture were significantly associated with OD practice among households. Although, average distance to plots and farm size were not significantly associated with OD. In addition, it has been a common practice in rural farming for agricultural households that raise pigs to defecate directly in front of these animals that use to eat faeces.

In opposition to the literature,<sup>26 27 29</sup> OD practice was neither significantly influenced by gender nor the age of agricultural households head. These results can be explained by the fact that only 16.2% of the households were headed by women; and among agricultural households there was very little age dispersion, most of them were aged >35 years. In the Haitian context of declining agriculture,<sup>53</sup> there were few young household heads among farmers.

In contrast to previous researches, household size was not significantly associated with OD among farmers. For the whole Haitian population, Paul *et al*<sup>25</sup> found that households with fewer than three members had greater odds to practice OD than households with three or more members. In table 2, statistics show no significant difference of OD prevalence across the three size groups of households. This result can be explained by the relatively high household size (average=6) in rural areas where farmers live.

### Strengths and limitations

One of the strengths of this study is the focus on agricultural households. This is, to our best knowledge, the first study on OD based specifically on agricultural households. Agricultural activities represent the second largest economic occupation of all Haitians, after informal economy.<sup>52</sup> Rural areas are where the largest population practising OD is living and farmers are more likely to practice OD because of low income and day-to-day occupation out of the house. This study focused on them provides valuable information for interventions. It adds to the literature by identifying new factors associated with OD practice among this under-documented part of the population, such as plot fragmentation and livestock, specialisation level in the agriculture, the overall level of education in the households, social inclusion in community-based organisations. Most studies about OD focus in Asian and sub-Saharan countries, although they do not focus on Haiti which is in the same category of highest rate of OD practice<sup>26</sup> and the country with the worst situation in LAC.

This study suffers limitations of its outreach and sample size, focused only on 5 out of 10 geographic departments, although these are representative of the rest of the



country, they do not allow generalisation. The respondents were not selected with systematic random sampling but through rational and area stratified sampling. In addition, it may be embarrassing for respondents to declare OD practice resulting in under-reporting which could lead to an underestimation of the phenomenon in Haiti. The research focused on agricultural households but not in farmers' individual behaviours when they are spending individual time on the farm.

## CONCLUSION

As for several of the SDGs, Haiti is far from the achievement of the objective to eliminate OD by 2030, and therefore to achieve sustainable OD-free status the government of Haiti was engaged to meet. With an important part of the population living in poverty particularly in rural areas where they engage in agriculture, our study revealed that OD practices is prevalent among 20.1% of the agricultural households.

The results show that geographic localisation, level of education in the household, access to the media, social inclusion in local organisations, livestock, farm fragmentation (plots number), level of specialisation in agricultural activities and agricultural incomes are factors associated with OD practice among agricultural households in Haiti.

These characteristics are to be taken into special consideration in order to reduce OD. Actually, the governmental conviction to not subsidise toilet acquisition for poor households appears to be inappropriate with the SDG engagement and public health efforts. Our results suggest that awareness campaigns, particularly through local organisations (including agricultural associations) are needed to bring better hygiene and good sanitation practices to agricultural communities and households. As more and more Haitians have access to mobile phones, mass media communication can use these devices to sensitize use of toilets. Farmers who spent a lot of time in the field must be encouraged to dig holes for faeces disposal. Social inclusion which can enforce norms and institutions, namely institutional capital<sup>48</sup> towards sustainable sanitation behaviours.

Of course, faecal waste could have been used as fertilisers for agricultural production. But, reducing OD is still an emergency, and such waste management innovations are still limited or at experimental stage.<sup>54</sup> It is also recommended to sensitise farmers to manage faeces securely, even in the field, and help them buy toilets or built latrines for their households.

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