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Differences in income, farm size and nutritional status between female and male farmers in a region of Haiti

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Introduction: Haiti is the poorest country in the Americas and has the highest levels of gender inequality. It has high burdens of malnutrition and food insecurity. Our aim in this study was to investigate differences between female and male heads of farms in their farm's size and income and in their nutritional status.

Methods: We conducted a mixed-method study with a quantitative survey with 28 female and 80 male farmers and qualitative semi-structured interviews with seven women and 11 men, in nine rural communities, Plateau de Rochelois, Nippes, Haiti.

Results: We found that significant inequalities existed between female and male heads of farms in this region of Haiti. Farm income was associated with farm size, with female farmers having on average smaller farms, and markedly lower farm incomes compared to male farmers, even after adjusting for the fact that their farms were smaller. Male farmers also had more access to seeds, financing and transportation to market. In addition, female farmers had markedly higher levels of overweight and obesity. In both male and female heads of farms around 1 in 20 were underweight.

Discussion: These findings complement those from other settings, showing that female farmers in low- and middle- income countries typically face severe challenges in accessing resources such as land, credit, and inputs, which can limit their productivity and income-generating potential. Gender sensitive interventions to promote farmer health, well-being and productivity are required.

KEYWORDS

small holder farmers, gender, inequalities, nutrition, body mass index, income, Haiti, Caribbean

1 Introduction

Haiti, home to ~11.5 million people in 2022, is the lowest income country in the Caribbean and Latin American region. It has had persistently high levels of food insecurity, with only 57% of its population having access to sufficient food ([The World Bank, 2023](#)). The country also faces high burdens of malnutrition, including childhood stunting (22% prevalence), anemia in women of reproductive age (48%), and overweight and diabetes in adults (>50 and 9%, respectively; [Country Nutrition Profiles, 2022](#)).

There are more than one million small family farmers, who cultivate on average <1.5 ha of land. Agriculture constitutes the main source of income for about 60% of rural Haitians,

accounts for ~20% of the gross domestic product and employs more than 50% of the active labor force (World Economic Forum, 2011; Bargout and Raizada, 2013; The World Bank, 2023; World Food Programme, 2023). Agriculture has historically played a crucial role in the country's economy and has shaped the landscape through the sector's activities. Haiti covers an area of 27,500 km², roughly 60% of which is mountainous terrain. Around 40% of the landmass is used for agriculture (Montgomery, 2007; Bargout and Raizada, 2013). Centuries of colonial exploitation and deforestation, coupled with unsustainable farming practices, have significantly reduced suitable agricultural land available to smallholder farmers today (Smucker et al., 2005; Montgomery, 2007). The resultant deterioration of soil quality impedes crop production and contributes to poverty and malnutrition in Haiti. Many farmers have felt channeled to engage in unsustainable cultivation techniques due to poverty and insufficient resources (Bargout and Raizada, 2013).

The importance of addressing the environmental sustainability and economic viability of food production by small holder farmers for population food security and nutrition in Haiti was given new emphasis in 2018 with the National Policy and Strategy for Food Sovereignty, Security and Nutrition. The policy recognizes the central role of women within the food system, including as farmers, food traders, and guardians of children's diets (Steckley et al., 2023). Globally, it is well-known that there are substantial gender inequalities across food systems, from agricultural production through to retail and consumption, particularly in low and middle income countries (Njuki et al., 2023). Women tend to be disadvantaged in accessing a range of resources, including: knowledge and information, tools and technology, credit, land, time and access to markets (Njuki et al., 2023). Time poverty, related to other roles, such as managing households, childcare and food preparation is another constraint than women face (Arora, 2015; Pathak, 2022). In addition, female small-holder farmers in low and middle income countries tend to be more vulnerable to food insecurity and poor health outcomes compared to their male counterparts (Agarwal, 2012; Botreau and Cohen, 2020).

Gender inequality in Haiti, as assessed by the gender inequality index (United Nations, 2024), is the highest in the Americas and one of the highest in the world. In the work reported here, we use data from a mixed method study of farmers in the Nippes Region of Haiti to investigate differences by gender. We aim to answer the question, are there differences in farm size, produce diversity, income and nutritional status between female and male heads of farms? Through answering this question, we aim to inform further work designed to address gender inequalities amongst small holder farmers in Haiti.

2 Methods

This study was undertaken as part of an international collaborative project (UKRI, BB/T008857/1) between the Universities of the West Indies, South Pacific, Exeter (UK), McGill (Canada), Cambridge (UK) and the State University of Haiti (UEH). The overarching aim of this study was to explore and pilot test approaches to improving local food production and nutrition in Small Island Developing States (SIDS) in the Caribbean and Pacific. In Haiti the project was led from the Faculty of Agriculture

and Veterinary Medicine at UEH by PD and RPT. The project area in Haiti was the Plateau de Rochelois, in the Department of Nippes (one of Haiti's 10 administrative Departments).

2.1 Population and sample

Three communes within the Plateau de Rochelois were chosen: Paillant, Anse-à-Veau and Petite-Rivière de Nippes. Sampling and recruitment were purposefully conducted in order to capture the diversity of agricultural activities in these communes. Three communities were randomly selected from each commune, and for the quantitative survey, from each community 12 farmers were identified and recruited, giving 108 in total. Of these, 28 (25.9%) were women and 80 (74.1%) men. These proportions of female and male headed farms are similar to what is found nationally, with it being reported in 2017 that 22% of farms are managed by women (Plantin, 2021).

A sub-set of the quantitative sample was asked for a semi-structured qualitative interview and 18 heads of farms agreed. For the qualitative study and its purposive sample, seven female and 11 male heads of farms agreed to be interviewed.

2.2 Data collection

A quantitative questionnaire was developed and administered to the study participants (i.e., to the head of each farm) to gather comprehensive information about them and their farms. The questionnaire covered a range of socio-demographic characteristics, including age, gender, number of persons per household, and farm revenue. Farm characteristics were also assessed, including farm size, ownership of tools (machete, hoe, pruning knife, and ax), number of different types of crops grown, and number of animals raised. The height and weight of each farmer were measured. Respondents were asked whether they were under treatment for diabetes and raised blood pressure. Income data was collected in local Haitian gourdes (HTG) currency and then converted to US dollars using the exchange rate of 1 USD = 150 HTG.

In the qualitative one-on-one interviews, interviewees were asked about their positive and negative experiences as food producers, the barriers they faced and how these could be overcome, and the relationships between their own food production and nutrition within their households. Both quantitative questionnaire and qualitative topic guide were developed with careful consideration of cultural, linguistic, and literacy factors to ensure that it was clear and comprehensible to all participants. Data collection was conducted by five agriculture Masters students at UEH under the supervision of two lead investigators (PD, RPT).

2.3 Ethical approval

Prior to data collection, ethical approval was obtained from the National Bioethics Committee (CNB) of Haiti, and from the

Research Ethics Committee of the University of Exeter (as the lead institution for the overall project).

2.4 Data analysis

The quantitative data was entered into an Excel spreadsheet and imported into Stata version 17, for cleaning and analysis. Three age groups were created for analysis: 20–39, 40–59, and 60 years and above. Body mass index (kg/m^2) was calculated from height and weight, and three categories created (according to World Health Organization classification criteria): underweight ($\text{BMI} < 18.5$), overweight ($\text{BMI} \geq 25$ to < 30) and obese ($\text{BMI} \geq 30$). For the purpose of examining farm income by farm size in bivariate analyses, three categories of farm size were created: small ($0.16 \text{ ha} \leq \text{FS} < 1.13 \text{ ha}$), medium ($1.13 \text{ ha} \leq \text{FS} < 2.42 \text{ ha}$), and large ($2.42 \text{ ha} \leq \text{FS} \leq 12.09 \text{ ha}$). Two categories of tool ownership were created, those owning all four types of tools (hoe, machete, pruning knife, and ax) and those owning < 4 .

As appropriate to the type and distribution of the data, data is summarized as mean (standard deviation) or median (interquartile range) or proportion (as a percentage). Differences between male vs. female heads of farms are presented with 95% confidence intervals and p -values, with confidence intervals that do not contain 0, and a p -value of < 0.05 being considered as “statistically significant.” Multiple linear regression was used to explore the extent to which male to female differences in farm income were related to other differences in farm characteristics, including farm size (entered as a continuous variable), number of persons on the farm, ownership of tools, number of varieties of crops grown and number of animals.

All qualitative interviews were audio-recorded, transcribed verbatim and translated from Haitian Creole to English. A “follow a thread” mixed-method analysis approach (Dupin and Borglin, 2020) was used, in which findings from one dataset are used to guide analysis in the other. Here, the quantitative analysis, which was carried out first, particularly focused on gender differences for the reasons given in the introduction. Although gender was not explicitly part of the qualitative interview questions, the qualitative analysis of transcripts subsequently focused on different experiences between farmers of different farm size and potential difference between male and female heads of farms. The qualitative analysis was supported by the software Dedoose version 7.0.23 (www.dedoose.com).

3 Results

Quantitative survey data was collected from 108 heads of farms, 28 of which were women and 80 men. Roughly half the men and women were aged between 40 and 59 years. The median farm size was significantly smaller in female (1.1 ha) than in male (1.94 ha) headed farms (Table 1).

Male farmers were older on average than female farmers, they headed households with more members and owned more tools (Table 2). Male farmers also reported growing a greater variety of crops and owning more animals per farm than female farmers (Table 2). The farm income for male headed farms was almost

2½ times greater than for female headed farms (Table 2). The total annual revenue reported by male farmers (i.e., including any additional income from outside farming activities) was almost twice as large as for female farmers (Table 2).

Qualitative interviews were conducted with 18 participants, the characteristics of which are summarized in Table 3.

The qualitative data provide contextual information to these differential experiences, and gave a greater understanding as to how access to land might relate to crop diversity, livelihoods, food security and health. All heads of farms emphasized that their crops at least partly provided main staples for their household—yams, cassava, sweet potatoes, taro, leeks, carrots, bananas, beans etc., and generally crops rather than livestock (such as chickens, cows, pigs, or goats) are for household consumption. What type of crop could be cultivated, however, was discussed by heads of small farms as being limited by land availability.

Farmer (3; female, 40+ years old, small farm): I raise cows, goats. Now, it's not raining, it's carrots, yams, beans. I do not plant cabbage.

Interviewer: Why are you doing this?

Farmer: I do it because it's the easiest thing for me to do. We don't plant the cabbage because we don't have land for it. We cannot grow cabbage in the land we have.

Other facilitators that interviewees mentioned for the types and varieties of crop that could be grown included access to training, availability of seeds of specific crops that were considered favorable, and availability of financial assistance such as “micro-credit.” These were mainly discussed by the male farmers. All farmers, including from small sized farms, explained in their interviews that they sold livestock and surplus crops at market, although this was heavily dependent on access to transportation needed to get produce to market. It was clear that male farmers had greater access to transportation options and could therefore more easily sell at market and reap the benefits of additional income for household expenses such as for children's education and healthcare. Additionally, while over half the men spoke about sources of income from other jobs and activities, only one woman described additional income beyond selling at market.

Farmer (8; male, under 40, small farm): I grow cabbage, carrots, yams, sweet potatoes. I raise cows. After I'm also a builder and a taxi driver too.

The relationships between farm income, gender and farm size were further explored in the quantitative survey data. Firstly, an analysis stratified by three levels of farm size was conducted (Table 4). At each level income is significantly higher in men compared to women.

Secondly, multiple linear regression was undertaken, with farm income as the dependent variable. The following independent variables were examined: gender, farm size (as the continuous variable, not the three categories in Table 4), age, number of persons per household, owning at least four types of tools (as a dichotomous, yes/no, variable), number of types of crops and number of animals. Those variables that were statistically significantly related to farm income in unadjusted analyses were

TABLE 1 Number of participants by age, gender and farm size, and showing the difference in farm size between men and women.

Age Grp	Men		Women		M minus W diff in farm size	
	<i>n</i>	Farm size (Ha) ^a	<i>n</i>	Farm size (Ha)	Ha (95% CI)	<i>p</i> -value
20–39	23	1.61 (0.89, 2.56)	12	1.21 (0.84, 1.87)	0.4 (–0.81, 1.46)	0.56
40–59	41	2.04 (1.45, 3.23)	15	0.97 (0.67, 1.29)	1.07 (0.19, 1.94)	0.018
60+	16	1.93 (1.61, 3.02)	1	0.89 (-)	1.04 (–5.32, 7.41)	0.73
All	80	1.94 (1.45, 3.06)	28	1.10 (0.73, 1.64)	0.84 (0.21, 1.40)	0.009

Figures are median (interquartile range) unless otherwise stated.

^aHectares.

TABLE 2 Comparison of selected characteristics by gender of the head of the farm.

	Men	Women	M minus W	
			Diff (95% CI)	<i>p</i> -value
Age (years)	47.7 (11.7)	41.4 (10.6)	6.3 (1.3, 11.3)	0.0137
Persons per household	6.4 (1.9)	5 (1.2)	1.4 (0.7, 2.2)	0.0002
No. types of crops grown	10.6 (1.1)	9 (1.3)	1.6 (1.1, 2.1)	<0.0001
Animals per farm	16.5 (11.5, 24)	10 (6, 16)	6.5 (1.5, 12.5)	0.012
At least four types of tools (%)	53.8	0	53.8 (42.8, 64.7)	<0.0001
Annual farm revenue (USD)	2,945 (2,340, 3,795)	1,198 (1,092, 1,712)	1,747 (1,291, 2,208)	<0.0001
Annual total revenue (USD)	3,540 (2,795, 4,342)	1,930 (1,343, 2,687)	1,610 (1,006, 2,205)	<0.0001

Figures are mean (SD) or median (interquartile range) unless otherwise stated.

entered together into the final regression model (Table 5). After adjusting for other farm characteristics, the average annual farm revenue for male headed farms was almost 750 USD more than for female headed farms. The results in Table 5 also show that farm size is an independent predictor of farm income: on average an additional hectare of farm size is associated with around 228 USD more in annual income.

With one exception, all of the other male to female differences shown in Table 2, also persisted after controlling for differences in farm size. After adjusting for farm size, male headed farms had 1.1 (95% CI 0.4–1.9, *p* < 0.001) more persons per household and grew 1.4 (0.9–1.9, *p* = 0.004) more types of crops than female headed farms. Among men, farm size was associated with tool ownership, with 21% of men heading small farms owning at least four types of tools compared to 87.5% of men heading large farms (*p* < 0.001). However, irrespective of farm size, all female farmers owned <4 types of tools. The exception was the number of animals. Male to female differences in the number of animals owned became non-significant when controlling for farm size (*p* = 0.169).

The qualitative interviews provided insights on difficulties experienced by the respondents. Most heads of farm regardless of gender—and most of them having grown up in farming families—pointed to increasing challenges to their livelihoods.

Farmer (1; male, under 40, small farm): For a long time, it was more for own consumption we used to produce. For example, sweet potato has become so expensive that we have to sell it to the schools that buy them from us [rather than eat ourselves]. And the climatic season has become a problem: as

now there is no rain, all fields fall to waste. Since the garden is wasted, the misery will increase. So we have become unable to produce either for yourself or for sale.

Such environmental change with increased flooding and droughts, degradation of soil, rising costs of fertilizer (and concerns about health impacts of fertilizer and pesticide use) were seen as important challenges to the resilience of their livelihoods and food security. In addition, rising costs of produce at market but also rising costs of transport to get produce to market, were seen as threats.

Anthropometric characteristics are compared in Table 6. Over two thirds of the women were overweight or obese, compared to around a quarter of the men. Roughly 1 in 20 of the men and women were underweight, with a BMI of <18.5. No woman reported a diagnosis of diabetes, whereas 6 (7.5%) men did (Table 7). A diagnosis of hypertension was reported by just under 1 in 5 men and by 1 in 10 women.

The qualitative interview data found that despite their own food production, imported and processed foods were a significant portion of farmers’ diets. All farmers bought additional staples from market, mainly carbohydrates such as rice, flour, corn and spaghetti. Most farmers would have food prepared from what they produced for morning meals, while they would use foods from the market in the evening, to allow for a variety of types of meals, while acknowledging that when income was scarce, they would have to depend more on what they grew to

TABLE 3 Characteristics of the participants in the qualitative study.

Gender	Age (year)	Large farm size ^a	Medium farm size ^a	Small farm size ^a	Total
Men	40 or more	2	3	1	6
Men	<40	0	1	4	5
Women	40 or more	1	2	2	5
Women	<40	0	2	0	2
Total		3	8	7	18

^aSee text in Methods section for definitions.

TABLE 4 Comparison median farm income by farms headed by men and women, stratified by farm size.

Farm size ^a		Men	Women	M minus W	
				Diff (95% CI)	p-value
Small	n	19	16		
	Income (USD)	2,195 (1,758, 2,536)	1,156 (1,014, 1,353)	1,039 (598, 1,475)	<0.0001
Medium	n	37	8		
	Income (USD)	2,748 (2,104, 3,209)	1,619 (1,400, 2,002)	1,129 (512, 1,730)	0.001
Large	n	24	4		
	Income (USD)	4,362 (3,563, 4,830)	1,585 (1,126, 2,323)	2,777 (604, 3,999)	0.01

Figures are median (interquartile range) unless otherwise stated.

^aSee text in Methods section for definitions.

feed themselves and their households (10; female, <40, medium size farm):

In the morning we can eat foodstuffs like the yam [from farm]. In the afternoon we cook rice or corn. It's like that all week... In this way we also don't have money to make food, it's the foodstuff, we eat in the morning and in the afternoon... So it is the food in the garden that I eat the most, and the food in the garden is always better.

When asked about the relationship between their own food production and health, what was said mainly related to food security, "because it sustains our life" (3; female, over 40, small farm), but it was also opined that what they grew had more nutritional value than what they could buy (14; male, over 40, large farm):

I must give more value to my product because I know how to make it, I rely more on it than what they can give me. There are some types of products they [market] can give me that will not be good for my health.

"It is natural, but it will bring health benefits. Because we get a vitamin in it, it has no chemicals" (6; female, over 40, medium farm).

Farmers brought up the use of pesticides and chemical fertilizers and their relationship to the nutritional value of their produce. Some noted that these were necessary to grow their own produce, which is healthier than processed foods. However, others were more ambivalent, noting that pesticides and chemical fertilizers could negatively affect health.

It's a bit difficult because of the fertilizers we use because it is a chemical product. But economically it is good even if it is not too good for our health...

But we have to put it on to grow enough (5; male, over 50, medium size farm).

4 Discussion

Gender inequality in Haiti, as assessed by the gender inequality index (United Nations, 2024), is one of the highest in the world. Recent national policy recognizes the central role that women play in the food system, and the need to promote greater gender equality (Steckley et al., 2023). Within this context, we use data from our mixed-method study in the Nippe Region of Haiti, to investigate whether there are differences in farm size, produce diversity, income and nutritional status between female and male heads of farms. We find that on average female heads of farms have smaller farms, grow a lower diversity of crops, have fewer livestock and a lower number of farm tools. Female heads of farms had markedly lower income, even after adjusting for differences in farm size. Our assessment of nutritional status, based on body mass index (BMI), indicated that roughly one in 20 women and men were underweight. However, overweight and obesity was experienced by two out of three women compared to one in four men.

4.1 Revenue and productivity in female and male farmers

Our findings of gender disparities in farm size, revenue, and resources are consistent with those from studies in other low

TABLE 5 Predictors from multiple linear regression of annual farm income (in USD).

Variable	B (95% CI) unadjusted	p-value	B (95% CI) adjusted ^a	p-value
Gender (m vs. f)	1,614.4 (1,069.4, 2,159.2)	<0.0001	749.1 (137.2, 1,361.0)	0.017
Farm size (Ha)	436.5 (311.7, 561.3)	<0.0001	228.4 (86.0, 370.8)	0.002
Age (years)	13.6 (-9.9, 37.0)	0.253	-	-
Persons per household	228.1 (82.2, 374.0)	0.002	-19.3 (-147.8, 109.1)	0.766
At least four types tools	1,422.2 (931.9, 1,912.5)	<0.0001	540.4 (14.9, 1,066.0)	0.044
No. types of crops	419.4 (232.8, 606.0)	<0.0001	125.6 (-66.7, 317.8)	0.198
No. animals	43.4 (23.2, 63.6)	<0.0001	21.8 (4.1, 39.6)	0.017

Figures are beta regression coefficients (95% confidence intervals) unless otherwise stated.

^aAll variables entered together into the adjusted model. Age not included in the adjusted model as not associated with income in the unadjusted analysis. Farm size entered as a continuous variable.

TABLE 6 Anthropometric characteristics of male and female heads of farms.

	Men	Women	M minus W	
			Diff (95% CIs)	p-value
Height (m)	1.67 (0.06)	1.61 (0.07)	6.3 (0.04, 0.09)	<0.0001
Weight (Kg)	64.6 (7.7)	66.7 (12.7)	-2.2 (-6.2, 1.8)	0.288
BMI (Kg/m ²)	23.1 (2.5)	25.7 (4.3)	-2.6 (-3.9, -1.3)	0.0002
Underwt (BMI < 18.5)	5%	7.1%	-2.1 (-12.8, 8.5)	0.67
Overwt (BMI ≥ 25- < 30)	23.8%	57.1%	-33.4 (-54, -12.8)	0.0012
Obese (BMI ≥ 30)	1.3%	10.7%	-9.5 (-21.1, 2.2)	0.0225

Figures are mean (SD) unless otherwise stated.

TABLE 7 Percentage (95% confidence intervals) of men and women reporting a diagnosis of diabetes and hypertension.

	Men	Women
Diabetes	7.5% (3.4, 15.8)	0
Hypertension	18.8% (11.6, 28.9)	10.7% (3.5, 28.7)

and middle income countries, as described in a recent systematic scoping review (Njuki et al., 2023), and with findings from a recent gender analysis conducted in Haiti and focussed on agricultural development (Kellum et al., 2022).

Across a broad range of settings, consistent difficulties are faced by female compared to male farmers (Njuki et al., 2023). These include, but are not limited to: social norms and roles restricting freedom of movement and access to transport; greater barriers in accessing finance and credit; institutional barriers to accessing information and agricultural technologies; and less access to land. The recent gender analysis from Haiti (Kellum et al., 2022) finds disadvantages for women compared to men that include: worse access to credit, due to gender discrimination by lending institutions; worse access to technical assistance and training; and much less involvement in cattle value chains related to less mobility due to other roles and responsibilities.

Although we do not have data from our study on factors such as differential access to finance, knowledge and technology, it is reasonable to hypothesize that these factors contributed to the gender disparities found. Data from the qualitative part

of our study do suggest that male, compared to female, heads of farms have greater access to transport and thus greater opportunity to sell produce at market. The qualitative data also suggest that male farmers were more likely to have additional sources of income from other types of work. Female heads of farms in Haiti, as in other settings (Njuki et al., 2023), typically have additional responsibilities, including childcare and food preparation, responsibilities that are not remunerated and limit opportunities for other employment.

There is evidence from other low and middle income country settings that women farmers on average have lower crop yields than men, significantly affecting their income and economic opportunities. For example, in a study in Ethiopia, the gender yield gap for Maize ranges from 10 to 30%, meaning that women farmers typically produce 10–30% less Maize per hectare than their male counterparts (Gebre et al., 2021). The United Nations Food and Agriculture Organization estimates that on average women-run farms produce 20–30% less than farms run by men (Food and Agriculture Organization of the United Nations, 2011). These gaps in productivity can be attributed to various factors, including limited access to inputs and resources, lower levels of education and training, and social norms prioritizing men’s agricultural activities over women’s. Our findings are broadly consistent with this picture of lower productivity. We found that female farmers on average had smaller farms, grew fewer types of crops and owned a smaller number of animals. Even when controlling for differences in farm size between female and male farmers, and differences in other factors related to income, such as number of animals and

tools owned, female farmers earned significantly less than their male counterparts.

4.2 Nutritional status in female and male farmers

Our study's results indicate significant gender disparities in the nutritional status of farmers in this region of Haiti, particularly women who had a notably higher mean BMI than men, and associated levels of overweight and obesity. Our findings are consistent with the observed differences by gender in BMI, overweight and obesity in the Caribbean as a whole (Guariguata et al., 2018), where women typically have higher BMI, overweight and obesity than men. Compared to recent national estimates for Haiti, our study sample had slightly lower prevalence of obesity and slightly higher prevalence of underweight (Country Nutrition Profiles, 2022). In other parts of the Caribbean, women on average have lower levels of physical activity than men which may contribute to higher levels of overweight and obesity (Guariguata et al., 2018). We did not collect data on physical activity in this study, and so are unable to comment if this is the case here. Data from the qualitative part of the study suggest that processed foods make up a significant proportion of the diet, however, we did not collect dietary data to enable us to quantify this contribution. Whether there are differences in diet between women and men that contribute to the differences in obesity requires further investigation.

From our study, we can only report self-reported diagnosed diabetes and hypertension. These were higher in men than women. In studies where blood glucose and blood pressure are measured, diabetes (the predominant form of which is type 2) in the Caribbean tends to be higher in women (Guariguata et al., 2018) and hypertension similar or higher in men (Howitt et al., 2015; Country Nutrition Profiles, 2022). Recent estimates for the whole of the Caribbean, for example, give a prevalence of hypertension of 22.9% in men and 19.1% in women (Country Nutrition Profiles, 2022). We are unable to say whether the findings in our study represent differences in access to health care, with men being more likely to be diagnosed than women. Further investigation would be required to objectively (e.g., through the measurement of blood glucose and blood pressure) determine the prevalence of diabetes and hypertension in female and male farmers in our study.

4.3 Strengths and limitations

The main strength of this study is that it contributes to the literature describing inequalities between female and male farmers in low and middle income country settings, and does so with data from a country and region with relatively little published evidence on such differences (Njuki et al., 2023). The approach to sampling aimed to achieve a representative sample of farms within the Plateau of Rochelois in Haiti. Although we do not have access to underlying data from that area to compare our sample to, it is reassuring that the proportion of female headed farms in our study (26%) is not dissimilar to that described for Haiti as a whole (22%) (Plantin, 2021). In addition, although the study sample size

is relatively small, the differences found between female and male headed farms are statistically robust.

The major limitation of our study is that we have limited data to explore potential determinants of the gender inequalities that we describe. In addition, it is important to acknowledge that the gender differences described here are between female and male heads of farms, and not between all women and men working on farms. We must also acknowledge that our study was based in one area (Plateau of Rochelois) of one region (Nippes) of Haiti, and it is theoretically possible that the type and size of gender inequalities between farmers may be different in other parts of Haiti. Finally, we note that the data collected in this study are as reported to the interviewers by the respondents. It is conceivable, although unlikely in our view, that there are systematic differences in the way the female and male farmers answered the questions posed. Whether or not this is the case would require further investigation.

4.4 Implications for future work

Our findings emphasize the importance of considering and addressing gender inequalities in measures designed to improve the situation of farmers, food security and food sovereignty in Haiti. In order to do this further work is required to better understand the underlying causes of the inequalities we describe. A recent gender analysis from Haiti identified the impacts of potentially differential access by gender to finance, technical assistance, and livestock value chains (Kellum et al., 2022). Further work examining the barriers female farmers face is needed to help inform gender sensitive interventions. Involving female farmers in the design of interventions to improve food production and sustainability is crucial, but remains an under researched area globally (Njuki et al., 2023). Finally, addressing the gender differences in overweight and obesity requires initially a better understanding of what underlies them, from potential differences in diet and physical activity, through to their social and economic determinants.

5 Conclusion

In this paper we demonstrate marked differences across several parameters, including farm size, income and crop diversity between female and male farmers in one region of Haiti. Our findings add to an international body of literature on gender inequalities in access to agricultural resources and incomes. Low female participation in agriculture has been described across the Caribbean (Landportal, 2019). Further work is needed on how to design and implement interventions to successfully overcome barriers female farmers face in Haiti and other parts of the Caribbean. Such work should benefit not only female farmers, but also their dependents and the food security and sovereignty of the wider population.

Data availability statement

The raw quantitative data supporting the conclusions of this article can be made available by the authors on reasonable request. The qualitative data has been collected in a small setting and is

therefore not fully anonymous. The corresponding author can be contacted to discuss limited access to the transcripts.

Ethics statement

The studies involving humans were approved by the Comité National de Bioéthique (Haiti) and the University of Exeter Medical School Research Ethics Committee (United Kingdom). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

PD: Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing—original draft, Writing—review & editing. RT: Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Writing—original draft, Writing—review & editing. CHa: Writing—original draft, Writing—review & editing. MMM: Conceptualization, Methodology, Formal analysis, Writing—original draft, Writing—review & editing. CG: Conceptualization, Funding acquisition, Methodology, Formal analysis, Writing—review & editing. CHO: Formal analysis, Methodology, Writing—review & editing. EA: Formal analysis, Writing—review & editing. EH: Conceptualization, Funding acquisition, Methodology, Writing—review & editing. NU: Conceptualization, Formal analysis, Funding acquisition, Writing—original draft, Writing—review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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