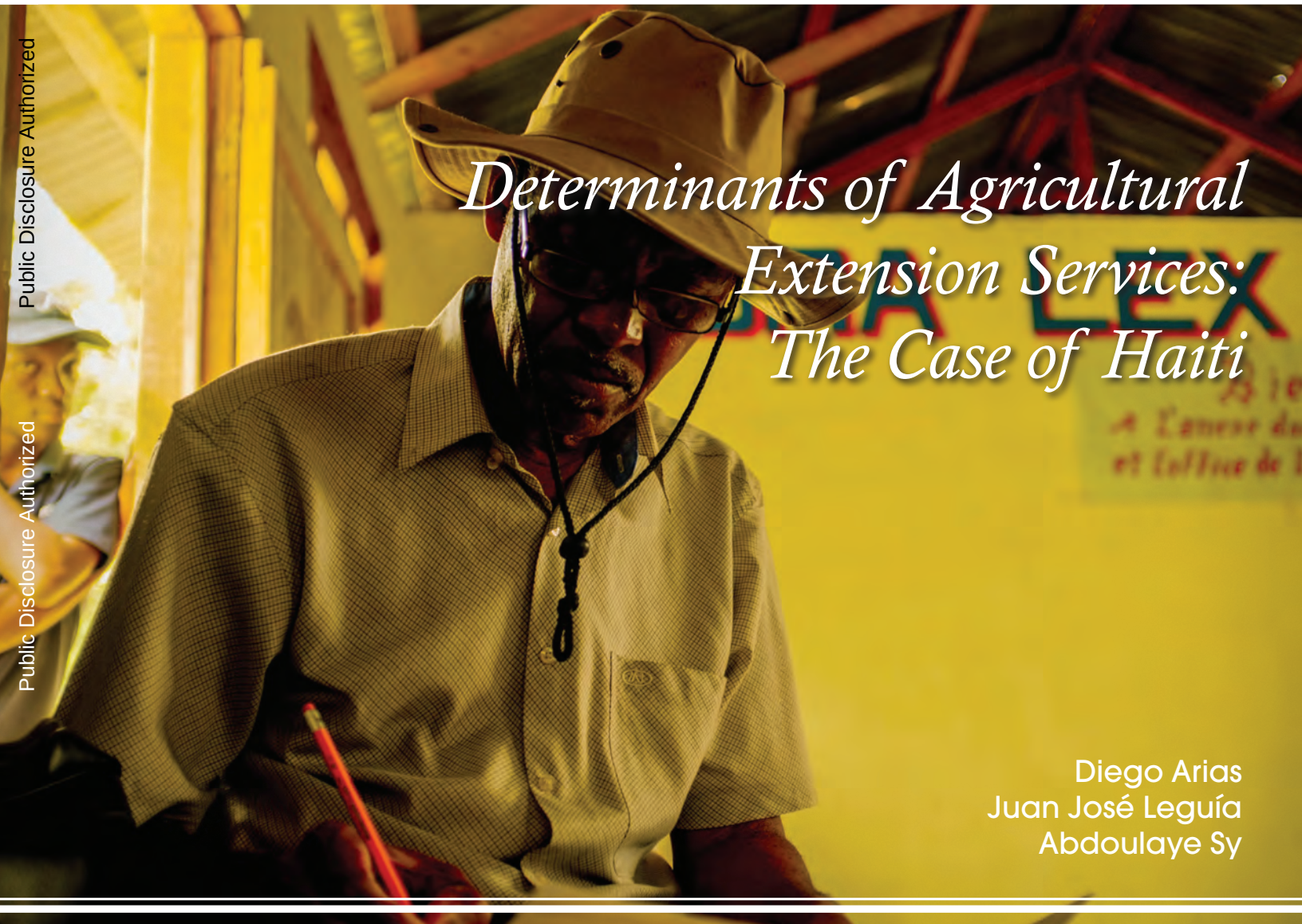
80766

World Bank LAC
opportunities for all

Latin America and the Caribbean Region

LCSSD Occasional Paper Series on Food Prices



Determinants of Agricultural Extension Services: The Case of Haiti

Diego Arias
Juan José Leguía
Abdoulaye Sy

May 24, 2013

Cover photos courtesy of Mrs Barbara Coello.
The work has been partly financed by the Trust Fund for Environmentally and Socially Sustainable Development (TFESSD)

LATIN AMERICA AND THE CARIBBEAN REGION

LCSSD FOOD PAPERS SERIES

DETERMINANTS *of* AGRICULTURAL EXTENSION SERVICES: THE CASE *of* HAITI

DIEGO ARIAS

JUAN JOSÉ LEGUÍA

ABDOULAYE SY

WORLD BANK, LCSAR

MAY 24, 2013

EXECUTIVE SUMMARY

This paper extracts relevant lessons from historical data on factors influencing the receipt of extension services in Haiti, taking stock of the use of agricultural extension services prior to the 2010 earthquake. The goal is to influence future policies and development projects involving the provision of extension services as well as the type of extension services offered.

This paper uses data from the 2010 Agricultural Census and examines the characteristics of farmers in Haiti receiving extension services by gender, education, agricultural training, farm size, and type of crop. Through in-depth study of each variable and a review of trends in the receipt of agricultural extension services, the study analyzes the equilibrium between the demand for and supply of extension services to particular farmer groups.

Using a fixed effects probit model to isolate the marginal effect of each characteristic on the likelihood of receiving extension services, and controlling for various factors, the study draws the following nine key conclusions:

1. *The proportion of households receiving agricultural extension services in Haiti is non-negligible.*

2. *Location is an important determinant of the recipients of agricultural extension services.*

3. *There are no statistical differences between men and women in terms of receipt of extension services; however, the impact of agricultural training and farm size change when the head of household is a woman.*

4. *Education level has a positive, yet small, effect on receiving extension services.*

5. *Prior agricultural training is a major determinant of the recipients of extension services.*

6. *Rehabilitation of the Ecoles Moyennes Agricoles (EMAs) for vocational and farmer field education on a nationwide scale would increase the demand for extension services, especially among small farmers.*

7. *Farmers with larger farms receive more agricultural extension services.*

8. *Coffee producers make more use of extension services than other farmers.*

9. *Promoting a hybrid system of extension may be more efficient than supporting only public or NGO-provided extension services.*

TABLE *of* CONTENTS

1. OVERVIEW OF AGRICULTURAL EXTENSION SERVICES IN HAITI

BACKGROUND

The Haitian population is among the poorest in the world, with over 78 percent living on less than US$2 a day and over 50 percent living on less than US$1 a day. In rural areas, 88 percent of individuals live below the poverty line and basic services are practically nonexistent. The devastating January 12, 2010 earthquake was a major setback to the economy and aggravated an already precarious social situation. Relaunching agricultural production is among the Haitian Government's top priorities of the country's reconstruction program. The transfer of knowledge, technologies, and practices through agricultural extension services is a critical building block to raising agricultural productivity and production in an environment dominated by very small farmers. This paper takes stock of the different uses of extension services in Haiti during the 2008–2010 period and aims to provide some historical lessons as a tool for investing most effectively in agricultural extension services in a post-earthquake era.

The concept of extension services has changed over time. While technological transfer is still important, more emphasis is being placed on expanding the skills and knowledge of farmers (i.e., human capital development), enhancing rural livelihoods, achieving food security, and creating more efficient farmer-based organizations (Swanson, 2008). Christoplos et al. (2010) defines extension 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." It also includes, for instance, "facilitation, brokering and coaching of different actors to improve market access." According to Christoplos et al. (2012), agricultural extension services can be classified primarily into three areas:

- Technology and information sharing
- Advice related to farm, organizational, and business management
- Facilitation and brokerage in rural development value chains.

The most recent Agricultural Census in Haiti, conducted by the Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR) during the 2008–2010 period, classified extension services in the following 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. Using the aforementioned classification, categories (i) to (viii) transferred information and knowledge to farmers and provided them with guidance on farm management skills, while category (ix) may have given farmers business management skills and facilitated their linkage to value chains and markets.

INSTITUTIONAL STRUCTURE OF AGRICULTURAL EXTENSION SERVICES

The MARNDR is responsible for the provision of extension services (through the organic law of September 30, 1987), and is divided into several decentralized structures: 10 Departmental Agriculture Directorates

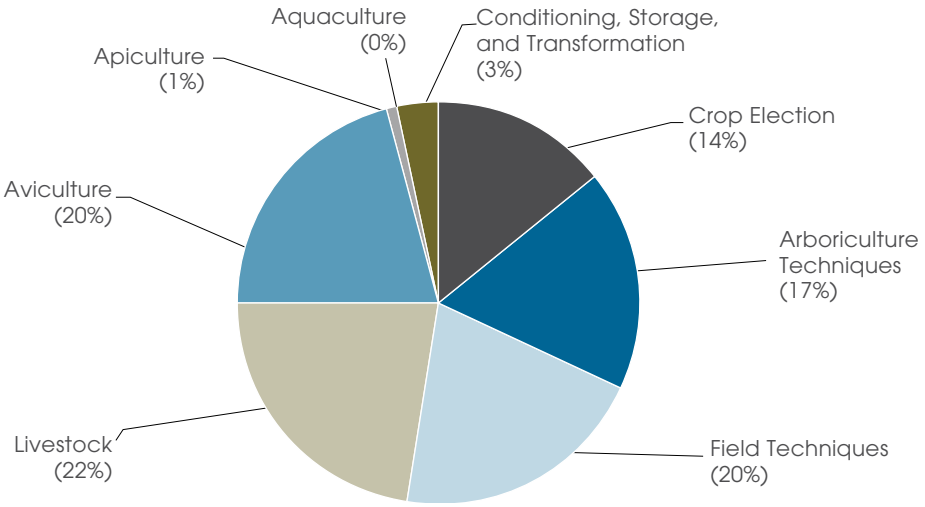
(*Direction Départementale d'Agriculture, DDA*), four sub-Departmental Directorates, and several Agriculture Bureaus (*Bureaux Agricoles*) located in 30 municipalities (among 135 in the country). In addition, about 15 research and training centers are located throughout the country and are directly linked to central services (mainly R&D) in the MARNDR. These institutions contribute to the provision of various services for plant production, animal husbandry, and natural resource management. While the MARNDR and its sub-branches fund the provision of various services for plant production, animal husbandry, and natural resource management and steer and control the regulation of the agricultural sector, the provision of services and the implementation of investments are generally handled by NGOs, producer organizations, or private entities.

II. DATA AND SUMMARY STATISTICS

Extension service coverage in Latin America and the Caribbean varies widely across countries. The OECD (2011) points out that in Mexico, 3 percent to 10 percent of agricultural units are provided with technical assistance, whereas in Chile, the Institute of Agricultural Development delivered technical assistance and credit programs to 42 percent of small farmers in 2006. In Nicaragua, a country with poverty levels comparable to those of Haiti, the Nicaraguan Institute of Agricultural Technology (INTA) serves about 20 percent of all farm families, according to the 2001 Agricultural Census.

Owing to the limited availability of data, this study considers three out of 10 departments in Haiti: South East, Center, and South. In these departments, 13.9 percent of household heads reported having received at least one of the nine aforementioned extension services. Graph 1 shows the relative importance of each type of extension service out of the total delivered in Haiti. The services most frequently delivered are those related to the first stages of the value chain (production), namely choice of seeds and varieties and agricultural techniques and practices, which account for over 50 percent of all services delivered. Extension services for livestock (cattle and poultry) account for another 42 percent of services received while post-harvest services (storage, processing, and marketing) account for only 6 percent of services delivered.

GRAPH 1: TYPE AND COMPOSITION OF EXTENSION SERVICES RECEIVED BY FARMERS



Source: Agricultural Census 2008–2010. Authors' calculations.

Tables 2.1 and 2.2 display information on both the number of households that received extension services and the number of households that reported that they needed extension services in the South East and Center departments. For instance, in the South East department, 13.51 percent of heads of household received extension services, while only 11.54 percent reported they needed them. In the Center department, 14.16 percent of households received extension services, while 11.13 percent reported they needed extension. It appears that in these departments, demand for extension services is fully met.

Therefore, this analysis addresses both how the determinants of the receipt of extension services proposed in this paper interact not only with the supply (i.e., why these farmers have less or more access to extension services), but also with the demand (i.e., why these farmers think they do not need extension services). In fact, everyone who needs extension services in these departments seems to have access to them. Furthermore, reporting that the services are needed does not ensure a marginal private benefit of extension (i.e., the demand) since there are transaction costs involved in requesting and participating in the service. Hence, the demand for extension services may be even lower than that reflected in the census.

By contrast, data collected from the South department and displayed in Table 2.3 tell a different story. In that department, 98.79 percent of household heads reported that they needed extension services, while only 13.79 percent received at least one service. While many explanations can be entertained, a mechanical explanation should not be discarded. The census in Haiti was carried

TABLE 2.1: DEMAND FOR EXTENSION SERVICES – SOUTH EAST

	Need		Not Need		Total	
	N	%	N	%	N	%
Received	9,969	11.54	1,705	1.97	11,674	13.51
Not received	0	0.00	74,735	86.49	74,735	86.49
Total	9,969	11.54	76,440	88.46	86,409	100.00

Source: Agricultural Census 2008–2010. Authors' calculations.

TABLE 2.2: DEMAND FOR EXTENSION SERVICES – CENTER

	Need		Not Need		Total	
	N	%	N	%	N	%
Received	13,764	11.06	3,859	3.10	17,623	14.16
Not received	91	0.07	106,757	85.77	106,848	85.84
Total	13,855	11.13	110,616	88.87	124,471	100.00

Source: Agricultural Census 2008–2010. Authors' calculations.

TABLE 2.3: DEMAND FOR EXTENSION SERVICES – SOUTH

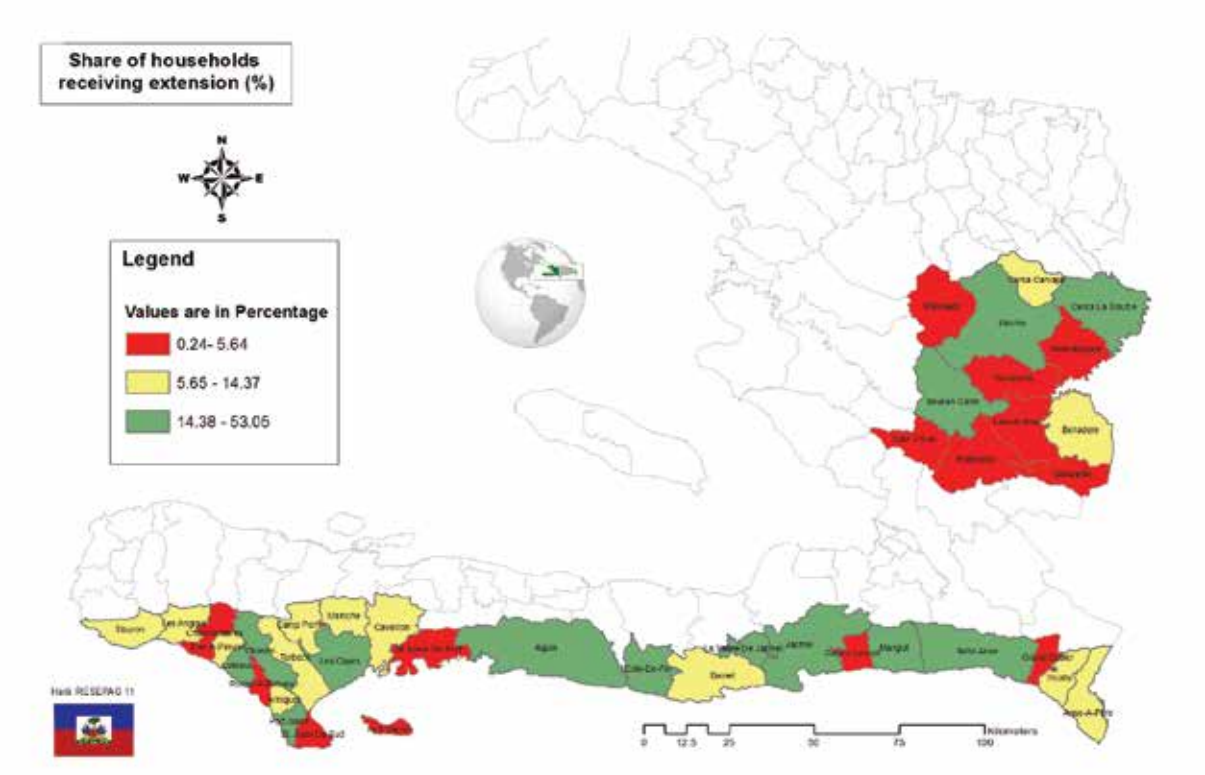
	Need		Not Need		Total	
	N	%	N	%	N	%
Received	12,490	13.71	73	0.08	12,563	13.79
Not received	77,528	85.08	1,031	1.13	78,559	86.21
Total	90,018	98.79	1,104	1.21	91,122	100.00

Source: Agricultural Census 2008–2010. Authors' calculations.

out over a period of three years (2008–2010), which means that some households were surveyed after the earthquake of 2010. If some places were systematically surveyed after the earthquake (for example, the South department), the tremendous shock caused by the disaster could explain these differences. However, this unexplained difference in demand for extension services in the South does not alter the econometric results of this paper as our dependent variable is receipt of and not demand for extension services.

Map 1 shows the percentage of household heads by commune that have received some extension services. Communes are classified into three distinct groups according to the terciles of the distribution in which they fall—less than 5.64 percent, between 5.65 percent and 14.37 percent, and 14.38 percent and over. In Map 1 we observe that there are pockets of low and high receipt of extension services. These pockets could be influenced by factors such as irrigation, geography, past interventions, political configurations, or distance to the closest DDA.

MAP 1: AGRICULTURAL EXTENSION SERVICES AT THE COMMUNE LEVEL



Source: Agricultural Census 2008–2010. Authors' preparation.

III. ANALYSIS OF POTENTIAL DETERMINANTS OF AGRICULTURAL EXTENSION

The previous section highlighted overall trends in agricultural extension services in Haiti, concluding that there are vast differences across communes. However, there might also be differences within communes. Indeed, by exploiting the variations within them, we are able to study the relationship between farmer-level characteristics and the likelihood of receiving extension services. We are specifically interested in assessing the correlation between extension services and the following farmer-specific variables: gender of head of household, education level, agricultural training, farm size, and type of crop produced. To better isolate the importance of each of these variables in predicting which farmers are more likely to receive extension services, we take into account the effect of all unobserved commune-specific variables that may be affecting both the variables under study and the receipt of extension services, particularly the distance to the nearest DDA, geography, irrigation, and political structures. In order to do this, we introduce "Commune Fixed Effects" into our probit model. The purpose of this exercise is not to find the causal effects, but the conditional correlations between the variables under examination and the likelihood of receiving extension services. We define the following econometric specification:

$$\Pr(Y_{ij} = 1) = G(\beta' X_{ij} + \delta_j + \varepsilon_{ij})$$

The equation above describes a fixed effects probit model, where $Y_{ij} = 1$ if the household head receives at least one type of extension service and is 0 otherwise; G is the normal cumulative density function; β is a row vector with all the coefficients of the variables under study; X_{ij} is a column vector with all the farmer characteristics under analysis such as gender, education (a dummy variable for each level), agricultural training (a dummy variable for each level), farm size (a dummy variable for each size range), crop type (a dummy variable for each type of crop considered), and interactions of each of these variables with gender. The reason we include gender interactions is to assess the effect of each of these variables conditioned on the gender of the household head. Finally, δ_j is the commune-specific fixed effect term, and ε_{ij} is the idiosyncratic error term. We run the regression using data pooled from all the departments under study and also for each department separately (South East, Center, and South). We used clustered standard errors at the district level (*section communale*).

Table 3.1 shows the results of the regression. The coefficients for the commune dummies are not presented in the tables; however in all cases, they are jointly significant at the 0.05 level. Therefore, as discussed previously, location is quite important in determining the level of extension services, and it is necessary to further investigate commune-specific variables causing these pockets of low reception of extension services. For instance, as already mentioned, it may be that the distribution of DDAs is unequal across communes. Even if the majority of extension services are provided by NGOs or private entities, distance to the nearest DDA may still have an effect if NGOs and development projects are located near DDAs or *Bureaux Agricoles Communales* (BACs). This may be the case for two reasons: (i) When targeting beneficiaries, NGOs may follow the advice of DDAs, which may tend to favor people located nearby, and (ii) DDAs may implement development projects or co-manage projects with NGOs.

TABLE 3.1: REGRESSION RESULTS

Determinants of usage of agricultural extension services				
Dependent variable: use of extension services = 1 if use at least one extension service, 0 otherwise				
Regressor	**All**	**South East**	**Center**	**South**
Female	0.0135	–0.08	0.123	0.0008
	(0.0439)	(0.0495)	(0.0803)	(0.0498)
Education				
None	omitted	omitted	omitted	omitted
	—	—	—	—
Literate	0.1927***	0.0639	0.1433	0.369***
	(0.0738)	(0.0627)	(0.1242)	(0.1235)
Elementary	0.0183	–0.0992	–0.022	0.1526
	(0.0787)	(0.1413)	(0.1603)	(0.1164)
High School	0.0752	0.0245	0.0661	0.1525
	(0.0624)	(0.0972)	(0.1381)	(0.1024)
Professional	0.1115	0.0173	–0.5746***	0.4518***
	(0.1236)	(0.2078)	(0.1037)	(0.1143)
University	0.1231*	0.2117*	–0.0106	0.2026**
	(0.0672)	(0.1272)	(0.2003)	(0.0895)
Agricultural Training				
Empirical	omitted	omitted	omitted	omitted
	—	—	—	—
Occasional	0.9046***	0.6633***	0.9499***	1.0046***
	(0.1032)	(0.1804)	(0.0921)	(0.1673)
Technical	0.9257***	1.3219***	0.5434***	0.881***
	(0.1599)	(0.3451)	(0.0709)	(0.1784)
University	0.0113	0.2258	0.0863	–0.1214
	(0.1275)	(0.2245)	(0.1532)	(0.18)
Farm Size (hectares)				
Less than 0.15	omitted	omitted	omitted	omitted
	—	—	—	—
From 0.15 to 0.3	0.1187	0.0012	0.1019	0.2254***
	(0.0758)	(0.1057)	(0.2272)	(0.0769)
From 0.3 to 0.6	0.2525***	0.1416	0.4005	0.3354***
	(0.0844)	(0.1134)	(0.2504)	(0.1006)
From 0.6 to 1.2	0.2359**	0.0372	0.5151	0.3005***
	(0.1012)	(0.1501)	(0.2777)	(0.1018)
From 1.2 to 2.4	0.1519	0.0166	0.3559	0.2694***
	(0.1149)	(0.1699)	(0.3343)	(0.0986)
More than 2.4	0.1372	–0.0823	0.3664	0.2688*
	(0.1284)	(0.1715)	(0.3075)	(0.1561)
Crops				
Maize	0.1653	–0.0075	–0.1178*	0.2729
	(0.1085)	(0.1415)	(0.0656)	(0.1829)

(*continued on next page*)

TABLE 3.1: REGRESSION RESULTS (*continued*)

Determinants of usage of agricultural extension services				
Dependent variable: use of extension services = 1 if use at least one extension service, 0 otherwise				
Regressor	**All**	**South East**	**Center**	**South**
Beans	–0.0573	0.0282	–0.1616	0.025
	(0.1108)	(0.117)	(0.2752)	(0.1774)
Bananas	0.02	–0.0453	0.2337*	–0.2122**
	(0.0814)	(0.1373)	(0.1223)	(0.084)
Coffee	0.2728**	0.445***	0.0166	–0.0379
	(0.1204)	(0.1633)	(0.118)	(0.1404)
Mangoes	–0.0285	–0.184	0.0719	0.0802
	(0.0797)	(0.1198)	(0.1411)	(0.1283)
Intercept	–1.6973***	–1.7464***	–2.3228***	–1.9243***
	(0.3777)	(0.2301)	(0.4424)	(0.4018)
Observations	300100	85763	123814	90523
Pseudo R2	0.1817	0.0757	0.2997	0.1527

Source: Authors.
* p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01.

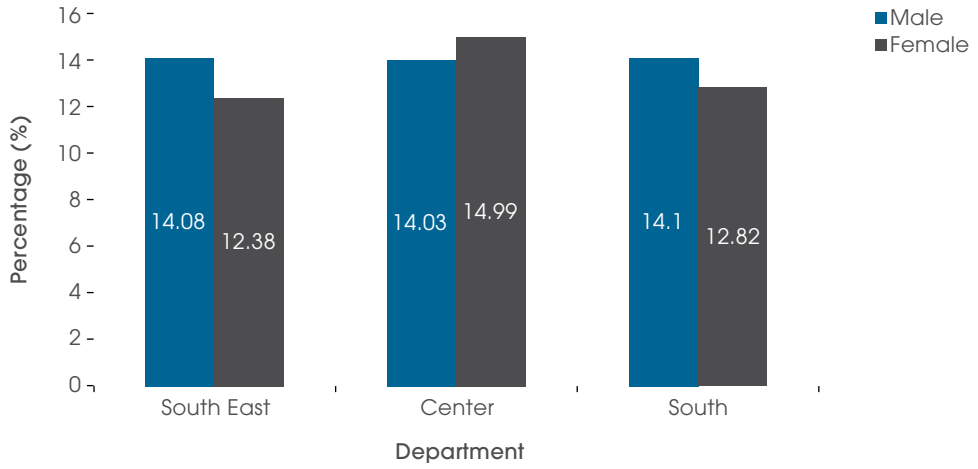
GENDER

Women play an important role in Haitian agriculture. One fourth of heads of household are women in the South and Center departments, and in the South East department, the proportion is even larger (34 percent). Moreover, a recent survey conducted by the *Conseil National de Sécurité Alimentaire* (2011) indicates that the proportion of female-headed households (pooling data from the South East, Center, and South) is 45 percent. According to Lastarria-Cornhiel (2006), the proportion of rural female-headed households for the late 1990s across 13 countries in Latin America reached nearly 23 percent (Lastarria-Cornhiel, 2006). Hence, it can be argued that the proportion of female-headed households in Haiti is higher than the regional average. This is in accordance with Saito and Spurling's (1992) argument that it is increasingly common for women to manage or operate farms on a daily basis in all parts of the world, as men leave farms in search of paid employment. It is important, therefore, to examine if there are any systematic differences between men and women in terms of their receipt of extension services.

As illustrated by Graph 2, there is no systematic trend regarding the degree to which male- or female-headed households receive extension services. Moreover, in the Center department, a larger proportion of female-headed households received extension services compared to male-headed households. Nevertheless, these results may be hiding other variables correlated to both the gender of the head of household and the likelihood of receiving extension services, introducing a bias in the interpretation of the unconditional relationship between gender and receipt of extension services. For instance, being a female-headed household can be correlated with farm size. If female-headed households had larger farms on average, and larger farms tended to receive more extension services, they would likely receive equal or more extension services than men, not because of their gender, but because of the size of their farms.

Nevertheless, on average, female-headed households have smaller farms than men. Table 3.2 tells us that for the three departments analyzed in the data, female-headed farms are much smaller than male-headed ones. For instance, in the Center department, which seems to be the area where farmers have the biggest farms, the size of male-headed farms is, on average, 1.33 hectares, while the size of female-headed farms is 1.12 hectares. The differences are fairly similar in the South East and the South departments and even larger in the Center department when we look at the median values of farm size. In Tables A.1, A.2, and A.3, we examine the proportion

GRAPH 2: HOUSEHOLDS RECEIVING EXTENSION SERVICES BY GENDER OF HOUSEHOLD HEAD



Source: Agricultural Census 2008–2010. Authors' calculations.

TABLE 3.2: AVERAGE (MEDIAN) FARM SIZE IN HECTARES BY GENDER OF HOUSEHOLD HEAD

Gender	South East	Center	South
Male	0.91 (0.65)	1.33 (0.97)	0.94 (0.65)
Female	0.68 (0.48)	1.12 (0.81)	0.68 (0.48)
Percentage Difference	34% (35%)	12% (20%)	38% (35%)

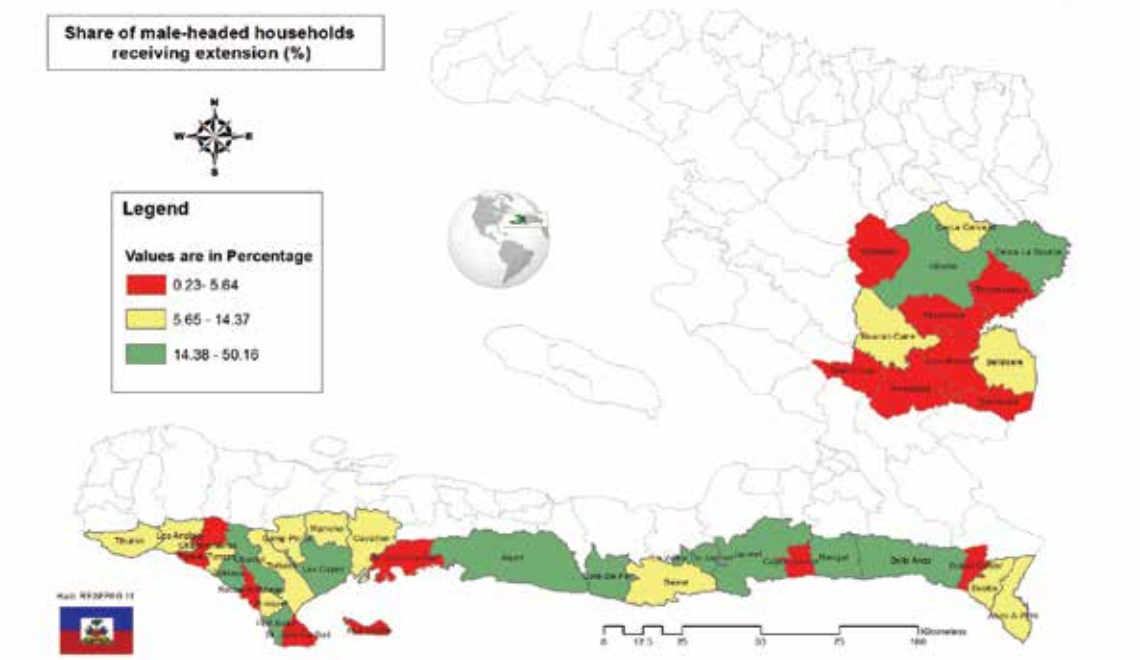
Source: Agricultural Census 2008–2010. Authors' calculations.
Farm size is calculated at the household level (where each can have more than one plot), whereas Tables A1, A2, and A3 are calculated at the plot level.

of female-headed and male-headed households by department for each bracket of plot size (not farm size). We observe clearly that as plot size increases, the proportion of female-headed households decreases, except for the last bracket size in the Center and South, where the proportion of female-headed households slightly increases in comparison to the previous bracket.

We further examine if the underlying features present in each commune that are affecting receipt of extension services interact differently with male-headed and female-headed households. Maps 2 and 3 demonstrate the level of extension services reception across communes for each type of household according to the gender of its head. The maps are fairly similar, yet there are important differences in relation to Map 1. In almost every commune, the proportion of households who received extension services is lower than the commune average if the head of household is female. Interestingly though, when the average rate of extension reception is high, female-headed households receive more extension services than male-headed households. For instance, in the Cerca La Source commune in the Center department, the average rate of extension reception is 53 percent, yet for female-headed households it is 64 percent. It seems that when the supply of extension services is scarce, men are favored over women; when supply is fairly high, the supply of extension services may be the same for both male-headed and female-headed households, thus the quantity of services allocated is solely demand-driven.

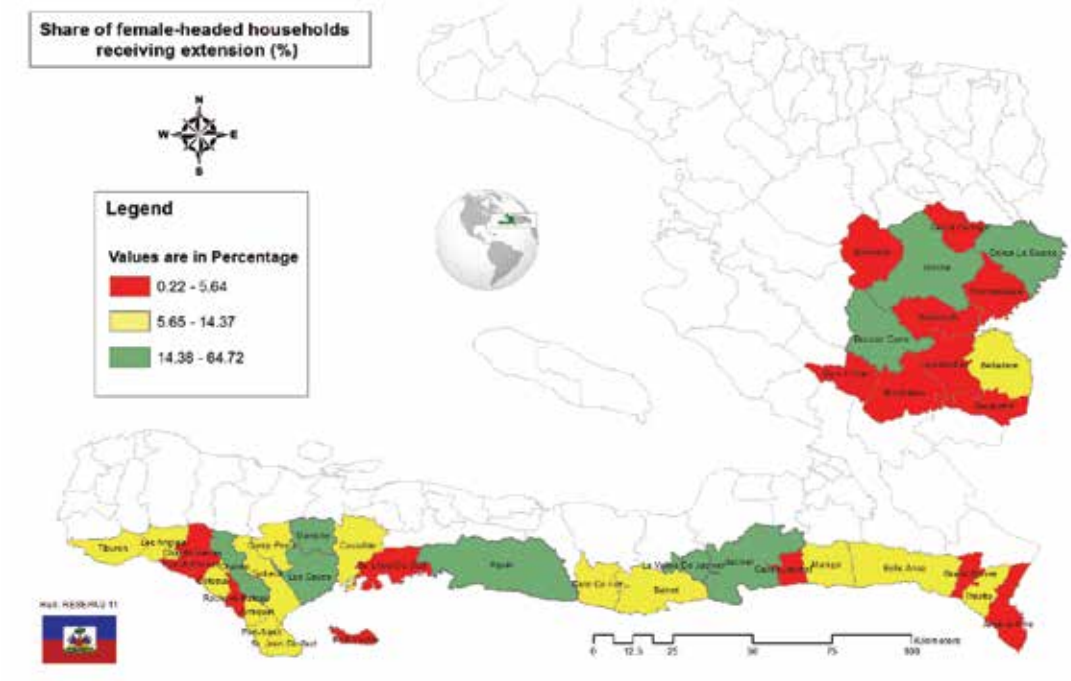
In other words, when extension is widely available, receipt of extension services may depend primarily on the demand for extension services in both female-headed and male-headed households, which appears to be higher for female-headed households. This observation has important implications for the interpretation of equilibrium between the supply of and demand for extension services—the rather small differences between men and women in terms of their receipt of extension services may be explained by a higher demand for extension services by female-headed households, and perhaps less access. Hence, the equilibrium would misleadingly appear to be the same for male-headed and female-headed households.

MAP 2: AGRICULTURAL EXTENSION SERVICES AT THE COMMUNE LEVEL – MALE-HEADED HOUSEHOLDS



Source: Authors.

MAP 3: AGRICULTURAL EXTENSION SERVICES AT THE COMMUNE LEVEL – FEMALE-HEADED HOUSEHOLDS



Source: Authors.

According to our econometric model, gender itself is not important in explaining supply and demand equilibrium levels of extension services. The fact that gender is not significant when controlling for these covariates and location means that the initial rather small differences in extension reception observed in Graph 2 were not the result of underlying differences in education, agricultural training, farm size, type of crop produced, and location between male-headed and female-headed households. We also ran two separate regressions (results not shown): one only for farmers located at Cerca La Source (a location with a high level of extension) in the Center department and the other for those farmers located at St. Louis Du Sud (a location with a low level of extension) in the South department. In the case of Cerca La Source, the coefficient on the female dummy is positive and significant at the 0.1 level. In that commune, a female-headed household has an 11.48 percent greater chance of receiving extension services than a male-headed household controlling for education, agricultural training, farm size, and type of crop. In St. Louis Du Sud, the coefficient on the female dummy is not significant. Therefore, the relationship between the gender of the head of household and the receipt of extension services, if any, may favor women. In those places with a high overall availability of extension services, women receive systematically more extension services than men. In those places with an overall low availability of extension services, there are no significant differences between men and women after controlling for other covariates in the model.

Recall that we are observing the equilibrium of demand for and supply of extension services, which means that even when female-headed and male-headed households receive the same level of extension services (provided they have the same education level, agricultural training, farm size, and produce the same type of crop), the interaction between supply and demand by which they receive the same services can be different. For instance, extension services in a particular commune may be provided primarily to male-headed households, yet the demand from female-headed households could be significantly higher than that from male-headed ones, resulting in the receipt of the same number of extension services. Sometimes, in this context, a female-headed household may receive a lower amount, as we previously observed in Maps 2 and 3, in locations where overall access is low. If we assume that the aforementioned households were being offered the same amount of extension services, we may conclude that no further interventions are necessary to correct the tendency to favor men, when in reality, discrimination may be latent—factors such as the time of the day services are offered, night travel, and long distances, among others, have been documented in Haiti as issues that prevent women from accessing services.

EDUCATION

Haiti faces challenges of both supply and demand in the education marketplace. These challenges are compounded in rural areas by high poverty and difficult access. On the supply side, there are simply not enough spaces for children to enroll in school. It is estimated that 400,000 to 500,000 children aged 6 to12, the majority of whom live in rural areas, are not attending school. On the demand side, the average cost of US$70 tuition per child per year is prohibitive for poor families, especially for those living in rural areas characterized by poverty rates of 82 percent (77 percent living in extreme poverty).[1] Even when schools are accessible, the quality of the education offered is uneven, and often very low. This is demonstrated by the findings of the recent Early Grade Reading Assessment (EGRA), carried out in 2008 and 2009 in Haiti. On average, children in Grade 3 are able to read fewer than 23 words per minute.[2] For those students studying in Creole, 29 percent were unable to read a single word by Grade 3. Reading comprehension is even weaker, with children able to answer less than 10 percent and 17 percent of reading comprehension questions correctly, in French and Creole respectively.[3]

Opportunities to improve small farmers' competitiveness are reduced as extremely poor levels of education hamper the implementation of new productivity-enhancing agricultural technologies. According to the Agricultural Census (see Table 3.3), 57.09 percent of heads of household are illiterate. If we further discriminate by gender, the

[1] The World Bank. Education for All Project – Phase II (APL). October, 2011.
[2] Sixty words per minute is standard for early primary reading fluency.
[3] Research Triangle Institute. Haiti Early Grade Reading Assessment (EGRA): Rapport pour le MENFP et la Banque Mondiale. Avril 2010.

TABLE 3.3: EDUCATION BY GENDER OF HEAD OF HOUSEHOLD

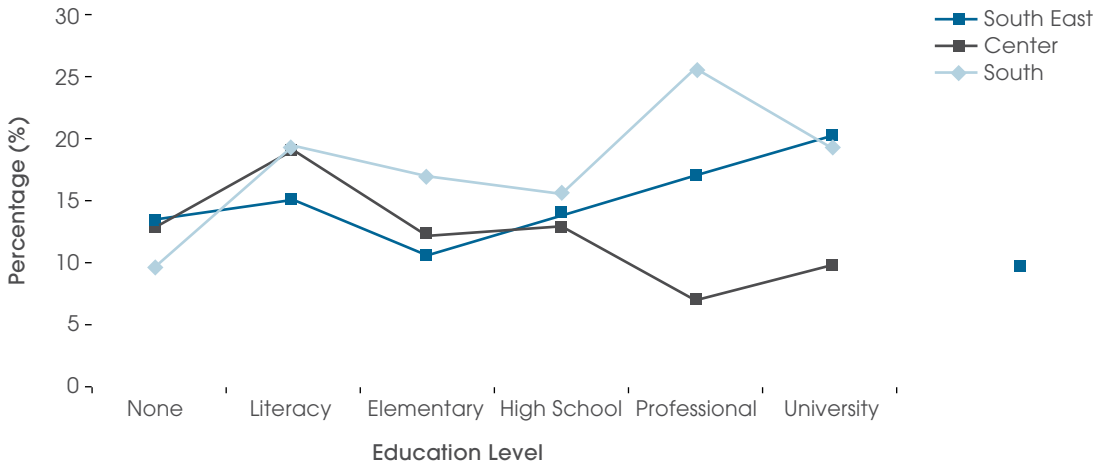
							Male-Female Ratios	
	Total		Male		Female		Male	Female
Education	N	%	N	%	N	%	%	%
None	172,011	57.09	118,758	53.86	53,253	65.88	69.04	30.96
Literate	60,865	20.20	47,137	21.38	13,728	16.98	77.45	22.55
Elementary	46,386	15.39	36,490	16.55	9,896	12.24	78.67	21.33
High School	18,866	6.26	15,366	6.97	3,500	4.33	81.45	18.55
Professional	2,305	0.76	1,960	0.89	345	0.43	85.03	14.97
University	875	0.29	765	0.35	110	0.14	87.43	12.57
Total	301,308	100.00	220,476	100.00	80,832	100.00	73.17	26.83

Source: Agricultural Census 2008–2010. Authors' calculations.

level of illiteracy in female heads of household reaches 65.88 percent. In Table 3.3, we clearly observe how the proportion of male-headed households increases as the level of education increases, indicating that women are less favored than men in terms of education. For example, the proportion of female-headed households in the three departments analyzed is 26.83 percent; however, among those heads of households with university-level education, the proportion of female-headed households is only 12.57 percent.

Graph 3 provides useful insights that may clarify the mechanisms through which receipt of extension services is influenced by education. Moving from being an illiterate to a literate farmer seems to have a positive effect on receiving extension services for all departments, presumably, as a result of required reading material. However, even if the ability to read is not necessary to receive extension services, literate people are more likely not only to be aware of the benefits of receiving agricultural extension services, but also to understand the procedures for receiving extension services and how to implement what they learn or what they receive as inputs for their farms. Berger et al. (1984) points out that "education enhances the ability of farmers to acquire accurate information, evaluate new production processes, and use new agricultural inputs and practices efficiently. Better educated farmers are twice as likely to be in contact with

GRAPH 3: HOUSEHOLDS RECEIVING EXTENSION SERVICES BY EDUCATION LEVEL



Source: Agricultural Census 2008–2010. Authors' calculations.

agricultural extension agents, indicating that farmers with higher levels of education benefit most from extension services." In addition, "educated farmers may push the extension system to deliver what they need and make sure the knowledge is appropriate to their resources."

Nevertheless, elementary schooling appears to have a negative effect on extension reception relative to mere literacy. It is important to note that as people become more educated, they acquire skills that can be better rewarded in non-farm activities. Hence, the more educated a person is beyond literacy, the lower their demand for agricultural extension services may be. However, if wage jobs are scarce, or the opportunity costs related to leaving their farms are fairly high, then we would presumably see an increasing relationship between education and the receipt of extension services, as seems to be the case in the South East department.

When controlling for other factors, the positive effect of being literate is smaller than that observed in Graph 3. In particular, literacy increases the likelihood of receiving extension services by only 3.44 percent. This trend is mainly driven by the South department, where literacy increases this likelihood by 7.43 percent. In the other departments, the effect is not even statistically significant. Moreover, in the Center department, having professional education decreases the likelihood of receiving extension services, whereas, in the South, it increases the likelihood by 10.23 percent, and university-level education increases the likelihood of receiving extension services by 2.21 percent.

On the supply side, there is the possibility that for low levels of education, access to extension services is still extremely low as extension agents may prefer to provide extension services to more educated farmers where the possibility of implementing newly acquired knowledge is higher. At the same time, on the demand side, farmers with more education are less prone to demand extension services as they are able to learn and apply new technologies or knowledge by themselves, what we could call the "knowledge effect." Furthermore, the possibility of looking for non-farm jobs is higher for those with better education. Therefore, on the one hand, there may be three education-based forces affecting the demand for extension: the "awareness effect," the possibility of finding a non-farm wage job that is economically more convenient than the farmer's agriculture-related activity, and the "knowledge effect." On the other hand, there is one clear education-based force affecting the supply of extension: the eagerness of extension agents to provide services to more educated farmers. The dynamics of these forces may explain the different levels of extension services received depending on a farmer's level of education. For instance, at first glance, it might seem strange that the positive effect of education fades beyond mere literacy and then returns after university-level education. However, if we assume both that extension agents tend to favor educated farmers and that demand for extension services is lower for higher levels of education, this result can be reasonable. It can also be argued that the demand for extension services can even increase at high levels of education as farm owners might hire farm workers that receive extension services.

These forces can also explain the apparent heterogeneity that we observe across departments. For example, in the South department, education has a more consistently positive effect overall on receipt of extension services compared to in other departments. Presumably, in the South department, the opportunity costs of leaving agriculture as a main activity are higher than in other departments. Furthermore, as we observe in Table A.4 (see Annexes), the South department has more farmers reporting livestock and fisheries as their main economic activities. These activities may be more difficult to leave behind, which means that they may be more profitable than agriculture.

AGRICULTURAL TRAINING

As demonstrated by Graph 4, there seems to be an inverted u-shaped relationship between agricultural training and the receipt of extension services. Even after controlling for other covariates, the results confirm the concavity and show that having "occasional agricultural training" (OAT) increases the likelihood of receiving extension services by 23.98 percent compared to having just empirical training. Furthermore, having technical agricultural training increases the likelihood by 25.12 percent, which means that the positive effect of agricultural training is decreasing. Apart from the "awareness effect" and the "knowledge effect," which were also discussed in the case of education (and which may be even more pronounced in this case), receiving OAT from specialized agencies, such as a DDA or NGOs, may create an enabling environment for farmers, putting forward adequate channel factors for both farmers

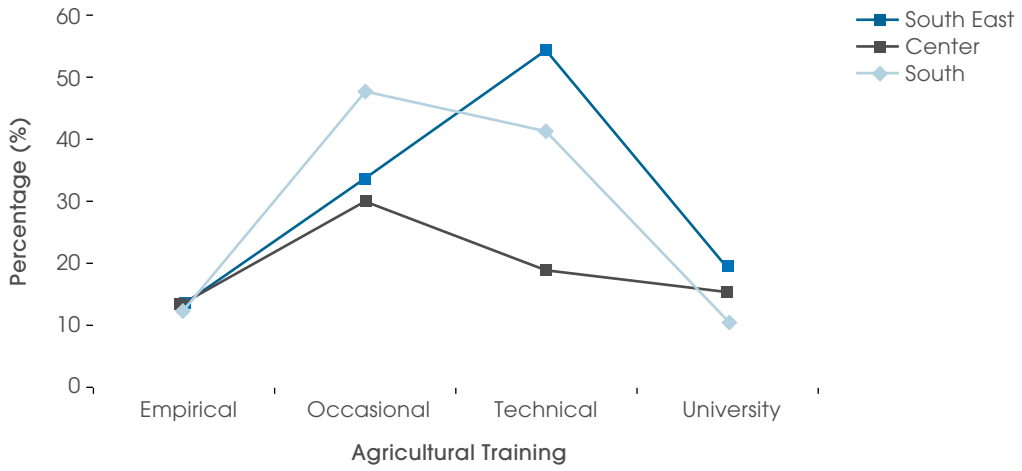
demanding extension services and extension providers supplying the services. Furthermore, extension agents may naturally target farmers with high agricultural training since adoption of new technologies and knowledge received is more likely and thus their work can be properly measured and rewarded. It is also important to note that the positive effect of having OAT in terms of the receipt of extension services diminishes significantly when the head of household is a woman (see Table A.6 in Annexes) since women may benefit less from the opportunities brought about by the channel factors mentioned above. Other possible explanations are that the "knowledge effect" may be more pronounced in the case of female-headed households, or the supply of extension services to female-headed households may be low even when they have high-level agricultural training.

The positive impact of agricultural training on the uptake of extension services starts to sink in at the technical level. It is possible that within agricultural training, the "knowledge effect" discussed previously is dominating the dynamics of receiving extension services. In other words, people with technical agricultural training might perceive the benefits of receiving extension services as minimal, or even non-existent. For example, the FAO found that 40 percent of extension personnel used in developing countries had only secondary school education (Feder et al., 1999). Hence, not surprisingly, uptake of extension services is significantly diminished as people get more informed and knowledgeable about agricultural topics—and may even be more knowledgeable than extension facilitators themselves.

One public sector supply of OAT is the *Ecoles Moyennes Agricoles* (EMAs) for Vocational and Farmer Field Education on a nationwide scale. Having the proper channels through which extension services are delivered not only increases the supply of extension, but also stimulates the demand for these services. The EMAs are well-known agricultural training institutions supported by the World Bank, Canada, USAID/USDA, and other development organizations working in Haiti. The MARNDR is seeking to leverage and strengthen the EMAs as part of the national strategic plan (PDVA) to expand extension services in Haiti.

Some might reasonably argue that occasional agricultural training is so statistically significant in explaining agricultural extension services because OAT and extension services are being perceived by the farmers interviewed as being the same thing. However, if this is true, then the correlation between receiving extension services and having occasional training should be nearly one. In order to assess the possibility that OAT and extension services might be perceived as being the same, we present Table 3.4, which shows the relationship between OAT and receipt of extension services, based on data pooled from the three departments.

GRAPH 4: PROPORTION OF HOUSEHOLDS RECEIVING EXTENSION SERVICES BY AGRICULTURAL TRAINING



Source: Agricultural Census 2008–2010. Authors' calculations.

TABLE 3.4: OCCASIONAL AGRICULTURAL TRAINING (OAT) AND EXTENSION SERVICES

	Extension					
	Received		Not Received		Total	
OAT	N	%	N	%	N	%
Received	2,819	0.93	4,562	1.51	7,381	2.44
Not received	39,160	12.97	255,461	84.59	294,621	97.56
Total	41,979	13.9	260,023	86.1	302,002	100

Source: Authors.

According to Table 3.4, among those who did not received OAT, the ratio between those who received extension services and those who did not is 0.15 (=12.97/84.59), yet within those who did receive OAT, the ratio is 0.62. Therefore, there is a positive correlation between OAT and extension services, however the correlation is rather low (0.11). Moreover, there is a significant proportion of the population who did not receive OAT and who did receive extension services. Hence, we cannot conclude that OAT and extension services are exactly overlapping events.

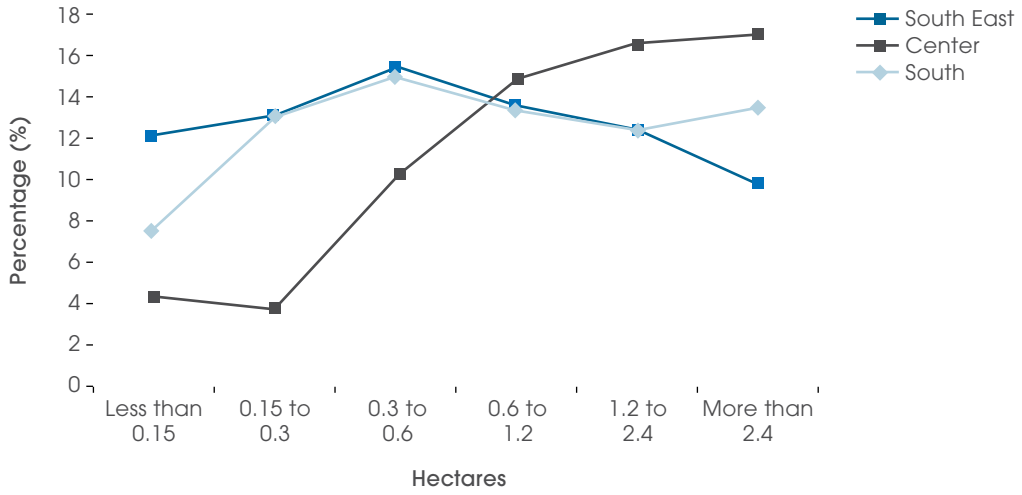
FARM SIZE

Graph 5 plots the relationship between receiving extension services and farm size. Both empirical and theoretical studies suggest that farmers with larger farms adopt extension services more quickly (Fischer, 1985); thus we would expect a greater use of extension services in larger farms. As we can see in Graph 5, the relationship between farm size and receipt of extension services is indeed positive, yet the relationship is concave, meaning that the rate of receipt of extension services decreases as farm size increases. Moreover, for the South and South East departments, these curves correlate very well with those of the previous graph. It seems that the marginal benefits of implementing extension services might be constantly reducing as farm size increases, ultimately affecting the demand for extension services. Feder (1999) shows that the effectiveness of extension investment is highly contingent on relaxing wider barriers to the successful development of the agricultural sector as a whole, including such potentially limiting factors as credit, technology stock, input supplies, price incentives, institutions, and human resource constraints. Therefore, it may be reasonable to argue that extension services in Haiti are not highly effective, and so the demand for these services is rather low for farmers with access to other alternatives for acquiring knowledge (such as fee-based extension).

However, again, we are observing the equilibrium between the supply of and demand for extension services. These preliminary results may be explained not only by issues of the marginal benefit of implementing extension advice, but also by issues related to the marginal propensity to offer extension advice. In other words, it is possible that the supply of extension services is more targeted to smaller farms. Nevertheless, the literature suggests that the opposite is true. Feder et al. (1999) stresses that there is a tendency of extension agents to favor more responsive clients, who are typically better endowed and more capable of undertaking risks. Consequently, this reinforces the possibility that the concavity of the relationship between farm size and receiving extension services is better explained by a low demand for extension services from farmers with larger farms.

The concave relationship described above between receiving extension services and farm size is somewhat supported by the results of the regression; yet if we discriminate by department, we observe that only in the South is the relationship significant. Having a farm of between 0.3 and 0.6 hectares increases the likelihood of receiving extension services by 4.57 percent compared to having a farm of less than 0.15 hectares; however, having a farm of between 0.6 and 1.2 hectares decreases the probability of receiving extension services by 0.44 percent in relation to the previous size bracket. In the South, the concavity is even more pronounced. Therefore, larger farms either received proportionally (to size) fewer extension services or received fewer extension services in absolute terms. Taking into account the tendency of extension agents to favor more responsive clients, who are typically better endowed and more capable of undertaking risks

GRAPH 5: HOUSEHOLDS RECEIVING EXTENSION SERVICES BY FARM SIZE



Source: Agricultural Census 2008–2010. Authors' calculations.

(Feder et al., 1999), this result may be driven by low demand rather than by a lack of adequate supply.

In summary, up to a certain farm size, the receipt of extension services increases as farm size increases, possibly because of a greater supply for larger farmers, but also because of economies of scale, making the implementation of new technologies more feasible, which in turn increases the demand for extension services. However, beyond that point, it is likely that demand for extension services decreases as farmers with larger farms have more leverage to acquire new knowledge from more efficient sources (such as fee-based extension).

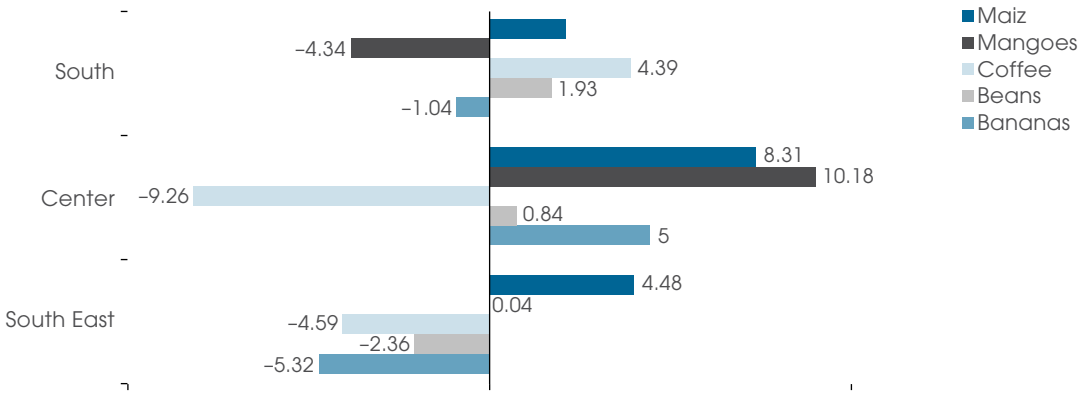
It is also important to note that for large farms, the effect on the likelihood of receiving extension services is not significant; however, for female-headed households it is significant and positive. Assuming that the supply of extension services is not higher for female-headed households, a feasible explanation for this result may be that women are generally more risk averse (see for example Eckel and Grossman (2008)) and prefer not to invest in more expensive—though more efficient—services, and so rely on free extension services although they may have the resources to acquire fee-based extension.

TYPE OF CROP

Finally, we also assess if receipt of extension services is influenced by the type of crop grown. Commodity-specific extension has been practiced across the public, parastatal, private, and social sectors, including agroprocessing and marketing firms and farmers' associations. The focus is often on one commercial or export crop (i.e., cash crops) linked to established marketing or processing outlets (Feder et al., 1999). However, according to Graph 6, a larger proportion of maize producers seem to receive extension services compared to other producers, which contradicts the aforementioned notion of the preference for cash crop farmers. For instance, in Graph 6, the number 4.48 in the horizontal bar with upward diagonals in the South East department indicates that the proportion of maize producers receiving agricultural extension services is larger than that of all non-maize producers by 4.48 percentage points. In the Center department, the advantage for maize producers is even larger.

However, after controlling for the covariates described in the model (which includes other crops), being a maize farmer is not statistically significant. On the contrary, in the Center department, being a maize farmer decreases the likelihood of receiving extension services by 1.73 percent. These results suggest that being a maize farmer is correlated with at least one of the covariates in the econometric specification. In the model, being a maize farmer does not mean that the farmer does not grow any other crops, but indicates that the farmer grows maize regardless of any other crops that he or she may work with. In other words, we acknowledge the practice of multi-cropping by considering a dummy for each crop. Naturally, the fact

GRAPH 6: HOUSEHOLDS RECEIVING EXTENSION SERVICES BY TYPE OF CROP



Source: Agricultural Census 2008–2010. Authors' calculations.
Numbers can be negative as they reflect the difference between the proportion of households growing that crop and those not growing it.

that the farmer is growing other crops (e.g., coffee) can affect both being a maize farmer and the likelihood of receiving extension services. However, we are reducing this bias, when controlling for other crops, such as bananas, beans, coffee, and mangoes, which are the most popular crops in terms of the number of farmers growing them.

In addition, contrary to our observations in Graph 6, being a coffee producer increases the likelihood of receiving extension services by 5.15 percent. This trend is mainly driven by the high numbers of coffee producers in the South East department receiving extension services, where the likelihood of receiving extension services increases by 9.33 percent for coffee producers. These results make much more sense when placed in context by the relevant literature review, which demonstrates that cash crops are favored in terms of the amount of extension services received. Coffee has been a leading cash crop in Haiti for many years, accounting for a sizeable proportion of crop exports for the country.

For future research, it will be important to investigate both whether (i) coffee producers are better organized (at least in the South East department) than other crop farmers, such as banana farmers, who apparently systematically received fewer extension services; and (ii) whether there are explicit commodity-specific extension services being provided for coffee producers. Additionally, it is important to take into account that farmers with certain types of crops may demand more extension services than others as their pre-harvest and/or post-harvest processes are more complex and require more expertise.

V. CONCLUSIONS AND RECOMMENDATIONS

The coefficients obtained from the regression results are not causal as there may be other unobserved farmer-specific variables affecting both the likelihood of receiving extension services and one or more of the covariates analyzed in the model, thereby causing omitted variable bias. Instead, the results of the fixed effects probit model allow us to establish conditional correlations between the likelihood of receiving agricultural extension services and each of the covariates. These correlations are only valid in the case of farmers located in the South East, Center, and South departments. Based on this model, we can predict the likelihood of receiving extension services conditioned on arbitrarily chosen values of the covariates under analysis. In other words, we can calculate the likelihood of receiving extension services for a household with a specific profile based on location, gender, education, and agricultural training of the head of household, farm size, and type of crop being produced. Furthermore, based on a set of profiles (those who received fewer extension services), a development project can use the results of this paper to better target a specific group of marginalized farmers so that the effects of the project will be maximized. This in turn has the potential to increase the power of statistical tests performed to evaluate the project's impact, making impact evaluation feasible or even reducing the costs of evaluation because of a reduced sample size.

In this study we only observe extension allocation resulting from the market equilibrium between the demand for and supply of extension services. In future studies, it would be useful to assess the demand for and supply of extension services separately to more clearly understand whether the variation in the receipt of extension services is caused mainly by either changes in the demand or in the supply. It would also allow for a refined understanding of the suggested mechanisms through which gender, education, agricultural training, farm size, and type of crop affect the demand for and supply of extension.

SOME KEY CONCLUSIONS AND RECOMMENDATIONS THAT ARISE FROM THIS ANALYSIS INCLUDE THE FOLLOWING:

1. The proportion of households receiving agricultural extension services in Haiti is non-negligible. Indeed, there are places in Haiti where, by regional standards, a large proportion of households receive agricultural extension services. Although public sector extension services have virtually disappeared in recent decades, the relatively widespread availability of extension services shows that donor funded projects, the private sector, and NGOs are providing a significant level of agricultural services. This highlights the importance of mainstreaming and integrating current agricultural extension services into the national level agriculture system led by the MARNDR, facilitating coordination and funding, to avoid duplication and allowing for clear priorities and comprehensive engagement.

2. Location is an important determinant of the recipients of agricultural extension services. There are pockets of both low and high receipt of extension services at the commune level. However, the differences in extension reception at the commune level may be reflecting

other variables not addressed by the Agricultural Census, such as distance to the nearest DDA, irrigation, geography (topography and communications), and political configurations, among others. In particular, the decentralization process in Haiti remains a major challenge, although the MARNDR is the Ministry with the strongest presence in rural areas. As already discussed, the current centralized scheme may favor those communes located near the capital or those that are easily reached by a DDA/BAC. This calls for particular attention to be paid by DDAs and BACs in the provision of extension services in order to provide and coordinate extension support (public and private) that not only reaches all farmers, but that is also adapted to local conditions and demands.

3. There are no statistical differences between men and women in terms of receipt of extension services; however, the impact of agricultural training and farm size change when the head of household is a woman. Specifically, being a female-headed household diminishes the positive effect of having occasional agricultural training (OAT) and amplifies the positive effect of having larger farms on the likelihood of receiving agricultural extension services. In addition, women seem to receive more extension services than men where the overall supply of extension services is high. This indicates that given the opportunity to have access to agricultural extension services, women avail themselves of these services more than men do, which suggests that the apparent equivalence between men and women may be better interpreted as men having either equal or less demand for extension services than women rather than equal access. Therefore, agricultural extension services need to ensure that women are not excluded, as it has been proven that if given the opportunity, women will make use of such services. The time of the day, the need for night travel, long distances, and other factors have been documented in Haiti as issues that can prevent women from accessing services. Therefore, details on when, how, and where extension services are provided are key to including (or excluding) women, and thus need to be carefully thought out in order to offer women a fair opportunity to participate.

4. Education level has a positive yet small effect on receiving extension services. Being literate increases the likelihood of receiving extension services; however, this positive effect fades at higher education levels and then returns with university-level education. On the one hand, extension agents have incentives that favor educated farmers, as the positive effects of extension would be more pronounced on more educated subjects. On the other hand, we identify three forces influencing demand: the "awareness effect," the "knowledge effect," and the possibility of getting a non-farm wage job. The influence of these three factors and the supply of extension services will ultimately determine the allocation of extension services according to a specific education level. Communication campaigns could exploit the "awareness effect" to provide information about the benefits of extension services to farmers with lower levels of education, which would also allow for an increase in demand (and thus supply). Indeed, demand-driven agricultural extension services can be an effective way of allocating such services if farmers are aware of the benefits beforehand.

5. Prior agricultural training is a major determinant of the recipients of extension services. From the perspective of demand, apart from the fact that the "awareness effect" and "knowledge effect" are even more pronounced than for the case of education, receiving training in agriculture may create an enabling environment for farmers who need extension services. For instance, on some occasions, receipt of extension services may be just a matter of knowing the person responsible for providing the services or being familiar with the administrative processes for receiving extension services. In other words, having agricultural training increases awareness not only of the benefits of extension, but also of the people, procedures, and mechanisms through which extension services are provided, which in turn increases the demand for these services as farmers have a clearer picture of how to acquire them. From the supply side, extension agents may be inclined to favor those whom they know and are more likely to effectively implement the knowledge provided.

6. Rehabilitation of the *Ecoles Moyennes Agricoles* (EMAs) for vocational and farmer field education on a nationwide scale would increase the demand for extension services, especially among small farmers. Our results indicate that OAT significantly increases the likelihood of receiving agricultural extension services as it opens channel factors through which farmers can develop a better understanding of the basic steps toward

receiving extension services and make contact with key players (e.g., extension agents). In other words, having the proper channels through which extension services are delivered not only increases the supply of extension services, but also stimulates the demand for these services. EMAs are well-known agricultural training institutions supported by the World Bank, Canada, USAID/USDA, and other development organizations working in Haiti. The MARNDR is seeking to leverage and strengthen the EMAs as part of the national strategic plan (PDVA) to expand extension services in Haiti.

7. Farmers with larger farms receive more agricultural extension services. The relationship between farm size and access to extension is positive and concave, meaning that farmers with larger farms receive more extension, yet the rate of extension reception diminishes as farm size increases. The supply of extension services may be greater for larger farms, since both economies of scale (more with less) and the likely reduction of transaction costs motivate extension agents to favor large-scale farmers. However, the demand for extension services may be reduced as farm size increases, given that wealthy farmers can afford both more expensive and more efficient alternatives to learning innovative and productive technologies to be applied on their farms (e.g., fee-based extension), provided the marginal benefits of the currently free extension services are low.

This conclusion is key for future agricultural extension programs in that there should be no discrimination based on farm size, in particular against the smallest plots. Although over 90 percent of farms in Haiti are under 5 hectares, agricultural extension should adapt to the demand from different segments, tailoring support to different farm sizes, types of services required, and other logistical and demographic considerations.

8. Coffee producers make more use of extension services than other farmers. Being a coffee producer increases the likelihood of receiving extension services by 5.15 percent. However, this effect is largely driven by the South East department, where coffee producers are 9.33 percent more likely to receive extension services. It appears that a commodity-specific type of extension mechanism is operating in that region, favoring crops that are mainly oriented toward export (i.e., cash crops). Nevertheless, production of other cash crops, such as bananas, has a negative impact on the likelihood of receiving extension, which suggests that the criteria for favoring one crop over another goes beyond its categorization as a cash crop. Presumably, the level of coordination among producers, the presence of cooperatives, managerial sophistication, and/or the complexity of relevant processes may play a key role in determining both the demand and supply of extension services for different crop producers.

9. Promoting a hybrid system of extension may be more efficient than supporting only public or NGO-provided extension services. In recent years, the improvement of agricultural extension services has been the focus of attention of recent agriculture policies and programs in Haiti, and the World Bank, IADB, and USAID have been increasing investments in this area. However, as we observed, the demand for extension services decreases beyond certain thresholds of farm size and agricultural training. The mechanisms by which this may occur point to the fact that some farmers (those with larger farms and greater knowledge of agricultural techniques) may have a latent demand for fee-based extension services. Therefore, a more efficient alternative may be to offer targeted public and NGO-provided extension services only to those farmers who cannot access fee-based extension services (e.g., small farmers), taking into account the specific services different farmers require.

In addition, instead of using fiscal resources to provide extension services to farmers who may not even need them, the government could channel these resources toward creating an environment in which private investment for extension services is feasible, fostering the development of a parallel fee-based extension market. Yet another alternative would be to subsidize private extension services, crowding-in private companies to the extension market until the demand is substantial enough to fully privatize extension. A combination of these measures would serve to promote the demand, equity, and effectiveness of agricultural extension services, yielding greater benefits in terms of increased demand for extension services as well as increased and more equitable farmer participation—particularly female—regardless of location, crop type, or farm size.

REFERENCES

Alex, G. et al. 2000. Decentralizing Agricultural Extension: Lessons and Good Practice. The World Bank, Washington, DC.

Berger, M. et al. 1984. Bridging the Gender Gap in Agricultural Extension. International Center for Research on Women. Washington, DC.

Christoplos, I. 2010. Mobilizing the potential of rural and agricultural extension. Food and Agriculture Organization of the United Nations. Rome, Italy.

Christoplos, I. et al. 2012. Guide to Evaluating Rural Extension. Global Forum for Rural Advisory Services (GFRAS). Switzerland.

Feder, G. et al. 1999. Agricultural Extension: Generic Challenges and Some Ingredients for Solutions. The World Bank. Washington, DC.

Fischer, A. 1985. On the Provision of Extension Services in Third World Agriculture. The World Bank. Washington, DC.

Lastarria-Cornhiel, S. 2006. Feminization of Agriculture: Trends and Driving Forces. Background paper for the WRD 2008. The World Bank. Washington, DC.

McMahon, M., and Valdés, A. 2011. Análisis del Extensionismo Agrícola en México. OECD. Paris, Francia.

Rivera, W. and Alex, G. 2004. Volume 3. Demand-Driven Approaches to Agriculture Extension: Case Studies of International Initiatives. The World Bank. Washington, DC.

Rivera, W. and Alex, G. 2004. Volume 5. National Strategy and Reform Process: Case Studies of International Initiatives. The World Bank. Washington, DC.

Saito, K. and Spurling, D. 1992. Developing Agricultural Extension for Women Farmers. The World Bank. Washington, DC.

Swanson, B. 2008. Global Review of Good Agricultural Extension and Advisory Service Practices. Food and Agriculture Organization of the United Nations. Rome, Italy.

Swanson, B. and Rajalahti, R. 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems. The World Bank. Washington, DC.

Umali, D. and Schwartz, L. 1994. Public and Private Agricultural Extension: Beyond Traditional Frontiers. The World Bank. Washington, DC.

ANNEXES

TABLE A.1: FARM SIZE BY GENDER OF HOUSEHOLD HEAD – SOUTH EAST

	Total		Male Male		Female Female		Male-Female Ratios	
Hectares	N	%	N	%	N	%	%	%
Less than 0.15	46,323	25.73	29,937	24.09	16,386	29.38	64.63	35.37
0.15 to 0.3	43,874	24.37	30,026	24.16	13,848	24.83	68.44	31.56
0.3 to 0.6	51,052	28.36	35,721	28.74	15,331	27.49	69.97	30.03
0.6 to 1.2	28,490	15.82	20,652	16.62	7,838	14.05	72.49	27.51
1.2 to 2.4	8,222	4.57	6,287	5.06	1,935	3.47	76.47	23.53
More than 2.4	2,082	1.16	1,651	1.33	431	0.77	79.30	20.70
Total	180,043	100	124,274	100	55,769	100	69.02	30.98

Source: Authors.

TABLE A.2: FARM SIZE BY GENDER OF HOUSEHOLD HEAD – CENTER

	Total		Male Male		Female Female		Male-Female Ratios	
Hectares	N	%	N	%	N	%	%	%
Less than 0.15	3,878	2.30	2,769	2.10	1109	2.98	71.40	28.60
0.15 to 0.3	10,139	6.00	7,457	5.66	2,682	7.21	73.55	26.45
0.3 to 0.6	39,438	23.35	29,878	22.68	9,560	25.70	75.76	24.24
0.6 to 1.2	60,395	35.75	47,822	36.30	12,573	33.80	79.18	20.82
1.2 to 2.4	41,991	24.86	33,696	25.58	8,295	22.30	80.25	19.75
More than 2.4	13,084	7.75	10,104	7.67	2,980	8.01	77.22	22.78
Total	168,925	100	131,726	100	37,199	100	77.98	22.02

Source: Authors.

TABLE A.3: FARM SIZE BY GENDER OF HOUSEHOLD HEAD – SOUTH

	Total		Male Male		Female Female		Male-Female Ratios	
Hectares	N	%	N	%	N	%	%	%
Less than 0.15	20,017	12.54	15,050	12.04	4,967	14.37	75.19	24.81
0.15 to 0.3	34,252	21.46	26,396	21.11	7,856	22.73	77.06	22.94
0.3 to 0.6	53,961	33.81	41,735	33.38	12,226	35.37	77.34	22.66
0.6 to 1.2	36,214	22.69	29,484	23.58	6,730	19.47	81.42	18.58
1.2 to 2.4	11,235	7.04	9,484	7.58	1,751	5.07	84.41	15.59
More than 2.4	3,925	2.46	2,891	2.31	1,034	2.99	73.66	26.34
Total	159,604	100	125,040	100	34,564	100	78.34	21.66

Source: Authors.

TABLE A.4: PRINCIPAL PRODUCTION ACTIVITIES BY GENDER OF HOUSEHOLD HEAD

Activity	South East		Center		South	
	N	%	N	%	N	%
Agriculture						
Male	49,252	86.33	90,641	95.06	56,408	82.60
Female	22,737	77.62	25,415	87.80	14,348	63.21
Total	72,021	83.35	116,218	93.37	70,840	77.74
Fisheries						
Male	1,135	1.99	410	0.43	1,983	2.90
Female	204	0.70	118	0.41	186	0.82
Total	1,340	1.55	529	0.42	2,173	2.38
Livestock						
Male	823	1.44	1,158	1.21	2,590	3.79
Female	242	0.70	587	2.03	1,017	4.48
Total	1,073	1.24	1,747	1.40	3,610	3.96
Buildings and public works						
Male	489	0.86	443	0.46	1,117	1.64
Female	39	0.13	22	0.08	55	0.24
Total	528	0.61	465	0.37	1,174	1.29
Administration						
Male	360	0.63	354	0.37	762	1.12
Female	46	0.16	69	0.24	190	0.84
Total	411	0.48	423	0.34	971	1.07
Mines and quarries						
Male	35	0.06	155	0.16	303	0.44
Female	2	0.01	3	0.01	121	0.53
Total	37	0.04	158	0.13	426	0.47
Transformation						
Male	82	0.14	34	0.04	83	0.12
Female	38	0.13	7	0.02	83	0.37
Total	122	0.14	41	0.03	166	0.18
Commerce						
Male	2,096	3.67	1,406	1.47	2,180	3.19
Female	4,891	16.70	2,612	9.02	5,782	25.47
Total	6,991	8.09	4,024	3.23	7,971	8.75
Services						
Male	2,019	3.54	624	0.65	2,474	3.62
Female	529	1.81	90	0.31	770	3.39
Total	2,564	2.97	715	0.57	3,251	3.57
Handicraft						
Male	758	1.33	129	0.14	259	0.38
Female	563	1.92	22	0.08	120	0.53
Total	1,322	1.53	151	0.12	379	0.42

Source: Authors.

TABLE A.5: AREA USED FOR PRINCIPAL CROPS BY GENDER OF HOUSEHOLD HEAD

	Total			Male			Female		
Major crop	Ha	HHs	Avg. Size	Ha	HHs	Avg. Size	Ha	HHs	Avg. Size
Maize	124,051.6	201,814	0.61	96,888.52	147,989	0.65	27,163.06	53,601	0.51
Beans	58,644.76	102,095	0.57	44,489.71	72,652	0.61	14,155.06	29,333	0.48
Bananas	23,331.87	72,307	0.32	17,792.01	52,750	0.34	5,539.86	19,467	0.28
Mangoes	304.13	3,161	0.10	262.53	2,309	0.11	41.6	849	0.05
Coconuts	311.16	3,785	0.08	246.02	2,681	0.09	65.13	1,102	0.06
Coffee	7,883.74	23,909	0.33	5,777.54	16,715	0.35	2,106.19	7,181	0.29

Source: Authors.

TABLE A.6: REGRESSION RESULTS – WITH INTERACTIONS

Determinants of usage of agricultural extension services				
Dependent variable: use of extension services = 1 if use at least one extension service, 0 otherwise				
Regressor	All	South East	Center	South
Female	–0.081	–0.2249*	0.2635*	–0.0205
	(0.0704)	(0.1269)	(0.1385)	(0.0705)
Education				
None	omitted	omitted	omitted	omitted
	—	—	—	—
Literate	0.204***	0.0582	0.1764	0.3684***
	(0.075)	(0.0539)	(0.1308)	(0.1178)
Elementary	0.0119	–0.1046	–0.0084	0.1322
	(0.0796)	0.1437	(0.1654)	(0.1204)
High School	0.0755	0.0303	0.084	0.1357
	(0.063)	(0.1049)	(0.1261)	(0.1101)
Professional	0.1221	0.0153	–0.5215***	0.4422***
	(0.1183)	(0.2311)	(–0.1401)	(0.116)
University	0.1282*	0.2228*	–0.0332	0.2007**
	(0.0706)	(0.1326)	(0.2707)	(0.089)
Agricultural Training				
Empirical	omitted	omitted	omitted	omitted
	—	—	—	—
Occasional	0.9234***	0.662***	0.9713***	1.0301***
	(0.1091)	(0.1882)	(0.0957)	(0.1785)
Technical	0.9276***	1.2237***	0.5524***	0.9493***
	(0.1445)	(0.3013)	(0.0813)	(0.1988)
University	0.1003	0.4331*	0.0719	–0.016
	(0.1565)	(0.2598)	(0.2146)	(0.181)
Farm size (hectares)				
Less than 0.15	omitted	omitted	omitted	omitted
	—	—	—	—

(*continued on next page*)

TABLE A.6: REGRESSION RESULTS – WITH INTERACTIONS *(continued)*

Determinants of usage of agricultural extension services				
Dependent variable: use of extension services = 1 if use at least one extension service, 0 otherwise				
Regressor	**All**	**South East**	**Center**	**South**
From 0.15 to 0.3	0.1022	–0.0293	0.185	0.2012***
	(0.0839)	(0.1244)	(0.1751)	(0.0716)
From 0.3 to 0.6	0.224***	0.0877	0.5032**	0.3151***
	(0.0872)	(0.1138)	(0.2294)	(0.0996)
From 0.6 to 1.2	0.2105**	–0.0168	0.6133**	0.2906***
	(0.1053)	(0.1456)	(0.2755)	(0.1036)
From 1.2 to 2.4	0.1066	–0.0364	0.4209	0.251**
	(0.1208)	(0.1741)	(0.3441)	(0.0996)
More than 2.4	0.0643	–0.1091	0.3741	0.2903*
	(0.1185)	(0.185)	(0.3196)	(0.1654)
Crops				
Maize	0.162	–0.0135	–0.1175	0.2711
	(0.1156)	(0.1436)	(0.0788)	(0.19)
Beans	–0.042	0.0521	–0.1801	0.056
	(0.0796)	(0.1148)	(0.2977)	(0.1702)
Bananas	0.0178	–0.0608	0.2198*	–0.2016**
	(0.0796)	(0.1377)	(0.1197)	(0.0804)
Coffee	0.2652**	0.4298***	0.056	–0.0409
	(0.1145)	(0.1614)	(0.1161)	(0.1294)
Mangoes	–0.0435	–0.1938*	0.0488	0.0677
	(0.0793)	(0.1169)	(0.1545)	(0.1314)
Interactions				
Female with Education				
Female*None	omitted	omitted	omitted	omitted
		.	.	.
Female*Literate	–0.0471	0.0197	–0.1455**	0.0009
	(0.0459)	(0.0998)	(0.0573)	(0.0613)
Female*Elementary	0.0327	0.0219	–0.031	0.0853*
	(0.0403)	(0.0837)	(0.054)	(0.0504)
Female*High_school	–0.0016	–0.0304	–0.0674	0.0847
	(0.0585)	(0.0868)	(0.1222)	(0.0844)
Female*Professional	–0.0811	0.0483	–0.287	0.0162
	(0.1287)	(0.2884)	(0.3616)	(0.1111)
Female*University	–0.0728	–0.4293	0.3177	–0.0541
	(0.2147)	(0.306)	(0.5322)	(0.2964)
Female with Agricultural training				
Female*Empirical	omitted	omitted	omitted	omitted
	—	—	—	—
Female*Occasional	–0.1052*	0.008	–0.1502*	–0.133

(continued on next page)

TABLE A.6: REGRESSION RESULTS – WITH INTERACTIONS *(continued)*

Determinants of usage of agricultural extension services				
Dependent variable: use of extension services = 1 if use at least one extension service, 0 otherwise				
Regressor	**All**	**South East**	**Center**	**South**
	(0.0564)	(0.1032)	(0.0815)	(0.1002)
Female*Technical	0.0034	0.5042	–0.0793	–0.4944***
	(0.2827)	(0.319)	(0.1605)	(0.1243)
Female*University	–0.5944**	omitted*	0.0365	–0.6876***
	(0.302)	.	(0.5143)	(0.2532)
Female with Farm size				
Female*Less_than_0.15	omitted	omitted	omitted	omitted
	—	—	—	—
Female*From_0.15_ to_0.3	0.0272	0.0655	–0.2219	0.0618
	(0.0463)	(0.0629)	(0.1686)	(0.0492)
Female*From_0.3_ to_0.6	0.0551	0.1265***	–0.3***	0.0583
	(0.0479)	(0.0493)	(0.1109)	(0.0507)
Female*From_0.6_ to_1.2	0.0386	0.1323*	–0.312**	0.0216
	(0.0522)	(0.0785)	(0.1543)	(0.053)
Female*From_1.2_ to_2.4	0.1315*	0.1365**	–0.1661	0.0588
	(0.071)	(0.0623)	(0.1761)	(0.0665)
Female*More_than_2.4	0.271**	0.014	0.0962	–0.2324*
	(0.1313)	(0.0937)	(0.1316)	(0.124)
Female with Crops				
Female*Maize	0.0161	0.0317	–0.0276	0.0121
	(0.0486)	(0.0679)	(0.1069)	(0.0517)
Female*Beans	–0.06	–0.0735	0.0764	–0.1378*
	(0.0694)	(0.0494)	(0.1407)	(0.0777)
Female*Bananas	0.0134	0.0476	0.0661*	–0.0438
	(0.0331)	(0.0556)	(0.0378)	(0.0467)
Female*Coffee	0.0251	0.0445	–0.1548**	0.0131
	(0.0527)	(0.0582)	(0.0738)	(0.1021)
Female*Mangoes	0.0555	0.0296	0.0936	0.0415
	(0.0388)	(0.0523)	(0.094)	(0.058)
Intercept	–1.6591***	–1.6922***	–2.3708***	–1.9122***
	(0.3768)	(0.237)	(0.4546)	(0.4046)
Observations	300100	85743	123814	90523
Pseudo R2	0.1823	0.0763	0.3016	0.1536

Source: Authors.
* p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01, omitted* = predicts perfect failure.

World Bank LAC

opportunities for all

About the series:

The LCSSD Occasional Paper Series is a publication of the Sustainable Development Department (LCSSD) in the World Bank's Latin America and the Caribbean Region. The papers in this series are the result of economic and technical research conducted by members of the LCSSD community. The series addresses issues that are relevant to the region's environmental and social sustainability; water, urban, energy and transport sector development; agriculture, forestry and rural development; as well as cross-cutting topics related to sustainable development such as climate change; logistics; crime and violence; and spatial economics.

While all papers in this series are peer reviewed and cleared by the LCSSD Economics Unit on behalf of the Director of LCSSD, the findings, interpretations, and conclusions expressed in this paper, as in all publications of the LCSSD Occasional Paper Series, are entirely those of the authors and should not be attributed in any manner to the World Bank, to its affiliated organizations or to members of its Board of Executive Directors or the countries they represent. The World Bank does not garantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use.

For environmental sustainability reasons as well as ease of distribution, the primary vehicle for the dissemination of this series is electronic, with papers available on the following website: www.worldbank.org/lcssdpapersseries